



Enhancing Occupational Safety in the Nigerian Construction Industry: The Role of Lean Construction and Health and Safety Training

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DOI: 10.31080/ASMS.2024.08.1897

Received: June 12, 2024

Published: July 24, 2024

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Abstract

The construction industry is vital to economic growth in Nigeria, yet it faces significant occupational safety challenges. This study investigates the effectiveness of health and safety training practices within construction firms in Nigeria's South-South region, emphasizing lean construction principles for enhancing safety performance. Employing a mixed-methods approach, the research integrates quantitative surveys and qualitative interviews to comprehensively assess the factors contributing to construction site accidents. Key findings reveal significant variations in the Rate of Occupational Incidents (ROI) across states, with Rivers and Cross River showing lower incident rates compared to higher rates in Akwa Ibom and Bayelsa. The study highlights the effectiveness of training programs, with 95% of workers finding the content relevant and 85% rating its clarity highly. Practical methods, such as hands-on demonstrations, were particularly effective. Post-training assessments showed a 30% reduction in workplace incidents, improved safety culture, and compliance with regulations. Organizational benefits included cost reductions and enhanced employee morale. The results underscore the need for tailored, state-specific safety training strategies to address unique local challenges. Continuous improvement and customization of training programs are essential for achieving sustainable safety performance and improving the overall health and safety outcomes in Nigeria's construction industry.

Keywords: Occupational Safety; Lean Construction; Health and Safety Training; Construction Industry and Nigeria

Introduction

The construction industry is a vital sector globally, contributing significantly to economic growth and development [1]. In Nigeria, as in many other countries, the construction sector plays a crucial role in infrastructure development and employment generation [2,3]. However, this industry is also fraught with various occupational hazards and safety challenges [2]. Occupational accidents and injuries remain a pressing issue in the Nigerian construction industry, posing risks to the health and well-being of workers and hindering project progress [2]. Despite efforts to improve safety measures, the occurrence of accidents persists, necessitating a deeper understanding of the root causes and effective strategies for prevention [4,5].

Studies have identified several factors contributing to accidents in construction, including poor safety culture [6,7], inadequate training [8], lack of effective safety management systems [9,10], and non-compliance with safety regulations [11]. Additionally, the complexity of construction projects, coupled with tight deadlines and budget constraints, often leads to increased risks [12]. Addressing these challenges requires a multifaceted approach that integrates lean construction principles with robust safety management practices [12].

Lean construction, characterized by its emphasis on waste reduction and continuous improvement, offers promising avenues for enhancing safety performance in the industry [13,14]. By pro-

moting collaboration, standardization, and transparency, lean methodologies enable construction firms to identify and mitigate safety risks more effectively [15]. Furthermore, the adoption of lean principles fosters a culture of proactive hazard identification and employee engagement, thereby fostering a safer work environment [16,17]. Integrating lean practices with traditional safety management approaches can yield synergistic benefits, driving improvements in both productivity and safety outcomes [18].

In this context, it becomes imperative to explore the enablers and barriers to implementing lean construction practices in the Nigerian construction industry [19]. While studies have highlighted the potential of lean construction in improving safety performance [20], there is a need for empirical research to assess its effectiveness within the Nigerian context. By examining the experiences of construction firms and stakeholders, valuable insights can be gained into the challenges and opportunities associated with lean implementation [21]. Such insights can inform the development of tailored strategies to promote the integration of lean principles and safety management practices, ultimately contributing to a safer and more sustainable construction industry in Nigeria [22].

In this study, we aimed to address this gap by investigating the applicability of lean construction principles in enhancing safety performance in the Nigerian construction industry. Drawing on a combination of quantitative and qualitative research methods, we sought to identify the key factors influencing the adoption and implementation of lean practices, assess their impact on safety outcomes, and provide recommendations for industry stakeholders. By advancing our understanding of the intersection between lean construction and safety management, this research seeks to contribute to the development of evidence-based strategies for improving occupational safety and health in Nigeria's construction sector [23].

Methods

Research design

This study utilized the mixed-methods approach that integrates both qualitative and quantitative methods to thoroughly examine the causes of accidents on construction sites. This design allows for a comprehensive understanding of the diverse factors contributing to accidents, offering both numerical data and qualitative insights.

Data collection methods

Quantitative data

Surveys and questionnaires were distributed to construction workers and professionals within the Nigerian construction indus-

try to gather quantitative data on the frequency and types of accidents, as well as the perceived contributing factors. This approach facilitates the collection of numerical data, which can be statistically analyzed to identify patterns and correlations.

Qualitative data

Semi-structured interviews and focus group discussions are conducted with key stakeholders, including construction workers, site managers, safety officers, and regulatory authorities. These qualitative methods allow for an in-depth exploration of the underlying reasons and contextual factors related to construction site accidents.

Participants

The study involves participants from various roles within the Nigerian construction industry, including construction workers, site managers, safety officers, regulatory authorities, and industry experts. By incorporating diverse perspectives, the study aims to capture a comprehensive understanding of the factors influencing construction site safety.

Data analysis techniques

Quantitative analysis

Statistical analysis techniques, such as descriptive statistics, regression analysis, and factor analysis, are applied to the quantitative data obtained from surveys and questionnaires. These analyses help identify significant variables and relationships associated with construction site accidents.

Qualitative analysis

Thematic analysis is used to examine the qualitative data collected from interviews and focus group discussions. This approach involves systematically identifying, organizing, and interpreting patterns or themes within the qualitative data, allowing for an exploration of the underlying factors contributing to accidents.

Ethical considerations

Throughout the data collection process, ethical guidelines, such as informed consent and confidentiality, are strictly followed to protect the rights and privacy of participants. Additionally, ethical approval may be sought from relevant institutional review boards or ethics committees. By employing a mixed-methods approach and adhering to ethical guidelines, this study aims to provide a comprehensive understanding of the causes of accidents in the Nigerian construction industry. The insights gained will contribute to improving safety management practices and reducing the occurrence of accidents on construction sites.

Results

To assess the effectiveness of health and safety training practices within construction firms in the captured area, a suitable analytical measure of choice was the Rate of Occupational Incidents

(ROI), which is calculated as the number of occupational incidents (injuries, illnesses, near misses, etc.) per 100,000 hours worked. This measure allowed for the comparison of safety performance across different construction firms and over time.

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

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

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.

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

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.

Table 2: Evaluation of the Effects of Health and Safety Training Practices of Construction Firms Concerning the Acquisition of Safety Knowledge by Workers during Training.

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

Below is a tabulated result for the evaluation of health and safety training practices within construction firms on key organizational objectives.

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.

The table presents a comparative analysis of the outcomes of health and safety training practices among construction firms in

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.

Table 3: Health and Safety Training Practices within Construction Firms on Key Organizational Objectives.

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

Table 4: Comparative Examination of the outcomes of health and safety training practices within between south-south states construction firms on the key organizational objectives of safety training.

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.

The evaluation results of 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.

Discussion

The analysis of health and safety training practices within construction firms in the South-South region of Nigeria highlights crit-

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.

Table 5: Evaluation of the Effects of Health and Safety Training Practices of Construction Firms Concerning the Acquisition of Safety Knowledge by Workers during Training.

ical insights into occupational safety performance and the impact of training programs on workers and organizational outcomes. This discussion synthesizes findings from various evaluations, providing a comprehensive view of the current state of safety practices and their effectiveness.

A key measure in assessing the effectiveness of health and safety practices is the Rate of Occupational Incidents (ROI), which is calculated as the number of occupational incidents per 100,000 hours worked. This metric allows for a standardized comparison across different firms and over time. The data reveals significant variations in ROI across construction firms in different South-South states. Rivers and Cross River exhibit the lowest incident rates, suggesting that the health and safety training programs in these states might be more effective compared to others. Conversely, Akwa Ibom and Bayelsa show the highest incident rates, indicating potential areas where safety procedures and training need significant improvement. Edo and Delta fall in the middle range, reflecting relatively better but still improvable safety practices. These variations underscore the importance of tailored health and safety training that addresses the specific challenges and needs of each state. By identifying areas with higher incident rates, construction firms can focus their efforts on improving safety measures and training programs where they are most needed.

The effectiveness of health and safety training is also evaluated based on several key aspects of knowledge acquisition and practi-

cal application. An impressive 95% of surveyed workers reported that the training materials adequately covered relevant safety topics, while 85% of workers rated the clarity of training content as 'Excellent' or 'Good'. These high ratings suggest that the training programs are well-designed to address the real safety needs of the workers. Hands-on demonstrations received the highest satisfaction rating, with 90% of workers finding them effective in understanding safety procedures, indicating that practical, interactive training methods are highly valued and likely more effective than purely theoretical approaches. Engagement levels were high, with 80% of trainers observing significant participation among workers during training sessions. Post-training assessment scores improved by an average of 20%, indicating a substantial increase in knowledge retention, and during simulated emergency drills, 75% of workers correctly applied safety procedures learned during training. This practical application is crucial as it demonstrates the real-world effectiveness of the training programs. Additionally, a strong 90% of workers provided positive feedback in anonymous surveys, stating that the training significantly improved their understanding of safety practices. Following the completion of the training program, a 30% reduction in the number of workplace incidents was observed, further demonstrating the effectiveness of the training. These findings collectively demonstrate that high-quality, relevant, and clear training materials, combined with effective delivery methods, significantly enhance workers' safety knowledge and practical skills, leading to a safer work environment.

The impact of health and safety training extends beyond individual knowledge and skill acquisition to broader organizational objectives. A 30% decrease in workplace accidents and injuries was observed in the six months following the implementation of the training program, highlighting the direct impact of effective training on improving workplace safety. Additionally, 100% of workers demonstrated understanding and compliance with relevant safety regulations and industry standards, as assessed by regulatory audits. This full compliance underscores the importance of comprehensive training programs in ensuring adherence to safety standards. Surveys revealed a significant improvement in safety culture, with 90% of workers reporting increased awareness and commitment to safety in the workplace. This cultural shift is essential for sustaining long-term improvements in safety performance. Employee satisfaction surveys indicated a 20% increase in morale and engagement levels following the implementation of the training program, which can lead to higher productivity and job satisfaction, benefiting the organization as a whole. Cost analysis showed a 25% reduction in medical expenses, worker compensation claims, and downtime costs attributed to workplace accidents, providing a compelling financial incentive for investing in effective health and safety training. Stakeholder surveys indicated a notable improvement in the organization's reputation and stakeholder confidence due to its commitment to safety and employee welfare, enhancing business opportunities and stakeholder relationships. Incident reports showed a 40% decrease in the number of near misses, indicating improved risk management practices among workers, which is crucial for preventing accidents before they occur. 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, demonstrating that effective safety training also plays a role in attracting and retaining skilled workers. These outcomes collectively highlight the comprehensive benefits of effective health and safety training, not only in improving safety performance but also in enhancing overall organizational health and performance.

A comparative analysis of training outcomes among the South-South states reveals state-specific strengths and areas for improvement. Bayelsa demonstrates high compliance with regulations and standards, as well as a strong safety culture, while Edo and Delta show significant reductions in workplace accidents and cost savings. Rivers exhibits strong performance in safety culture and proactive risk management, whereas Akwa Ibom and Cross River are effective in cost reduction and proactive risk management practices. Each state, however, demonstrates unique challenges that require tailored interventions to optimize training outcomes. For

instance, Akwa Ibom and Bayelsa need to focus on reducing their high incident rates, while Rivers and Cross River might work on further enhancing their engagement levels during training sessions.

The comprehensive analysis of health and safety training practices across construction firms in the South-South region underscores their critical role in improving safety performance. High relevance and clarity of training content, coupled with effective delivery methods, significantly reduce workplace incidents and improve knowledge retention. Training positively affects accident reduction, regulatory compliance, safety culture, employee morale, cost savings, and risk management. Variations in training outcomes highlight the need for customized strategies to address distinct local challenges. These findings affirm the necessity of ongoing evaluation and refinement of health and safety training practices to ensure the optimal safety and well-being of workers in the construction industry. By continuously improving training programs and tailoring them to address specific state-level needs, construction firms can achieve significant improvements in safety performance and overall organizational health.

Conclusion

The analysis of health and safety training practices within construction firms in Nigeria's South-South region underscores their pivotal role in enhancing workplace safety and organizational performance. Variations in the Rate of Occupational Incidents (ROI) highlight the effectiveness of these programs in different states. For instance, Rivers and Cross River exhibit lower incident rates, suggesting more effective training, while Akwa Ibom and Bayelsa show higher rates, indicating areas for improvement. The evaluation reveals high worker satisfaction with training content, delivery methods, and practical applications, leading to significant reductions in workplace incidents and improved compliance with safety standards. Additionally, the training positively impacts safety culture, employee morale, cost savings, and risk management. Customized, state-specific training strategies are essential to address unique local challenges, ensuring optimal safety and well-being for construction workers. Continuous improvement and refinement of training programs are crucial for achieving sustainable safety performance and organizational health in the construction industry.

Bibliography

1. Giang D T and Sui Pheng L. "Role of construction in economic development: Review of key concepts in the past 40 years". *Habitat International* 35.1 (2011): 118-125.

2. Idoro GI. "Health and safety management efforts as correlates of performance in the Nigerian construction industry". *Journal of Civil Engineering and Management* 14.4 (2008): 277-285.
3. Idoro GI. "Influence of quality performance on clients' patronage of indigenous and expatriate construction contractors in Nigeria". *Journal of Civil Engineering and Management* 16.1 (2020): 65-73.
4. Abdul Rahman H., et al. "Waste Processing Framework for NonValue Adding Activities Using Lean Construction". *Journal of Frontiers in Construction Engineering* 1.1 (2012): 8-13.
5. Abdullah S., et al. "Towards Producing Best Practice in the Malaysian Construction Industry: The Barriers in Implementing the Lean Construction Approach". In International Conference on Construction Industry 2 (ICCI2) (2019).
6. Agwu MO. "Total Safety Management: A Strategy for Improving Organisational Performance in Selected Construction Companies in Nigeria". *International Journal of Business and Social Science* 3.20 (2012): 210-217.
7. Agwu M O and Olele H E. "Fatalities in the Nigerian Construction Industry: A Case of Poor Safety Culture". *British Journal of Economics, Management and Trade* 4.3 (2014): 431-452.
8. Colligan M J and Cohen A. "The role of training in promoting workplace safety and health". *The Psychology of Workplace Safety* (2004): 223-248.
9. Hallowell MR. "Safety-Knowledge Management in American Construction Organizations". *Journal of Management in Engineering* 28.2 (2012): 203-211.
10. Hallowell M R and Calhoun M E. "Interrelationships among highly effective construction injury prevention strategies". *Journal of Construction Engineering and Management* 137.11 (2011): 985-993.
11. Jones DT and Womack J P. "Lean thinking: Banish waste and create wealth in your corporation". New York, NY: Simon and Schuster. Kabiesz, P., & Bartnicka, J. (2019). 5S system as a manner for improving working conditions and safety of work in a production company. *Multidisciplinary Aspects of Production Engineering* 2.1 (2019): 496-507.
12. Haslam RA., et al. "Contributing factors in construction accidents". *Applied Ergonomics* 36.4 (2005): 401-415.
13. Nahmens I and Ikuma LH. "An Empirical Examination of the Relationship between Lean Construction and Safety in the Industrialized Housing Industry". *Lean Construction Journal* (2019): 1-12.
14. Abdelhamid TS and Everett JG. "Identifying Root Causes of Construction Accidents". *Journal of Construction Engineering and Management* 126.1 (2020): 52-60.
15. Ballard G and Howell G. "What kind of production is construction?" In Proceedings of the 6th Conference of the International Group for Lean Construction, Guarujá, Brazil. Retrieved from <http://leanconstruction.org.uk/media/docs/BallardAndHowell.pdf> Ballard, G., & Howell, G. (2023). Lean project management. *Building Research and Information*, 31.2 (2018): 119-133.
16. Guo BH., et al. "Predicting safety behaviour in the construction industry: Development and test of an integrative model". *Safety Science* 84 (2016): 1-11.
17. Guo H., et al. "Visualization technology-based construction safety management: A review". *Automation in Construction* 73 (2017): 135-144.
18. Nadhim E., et al. "Falls from Height in the Construction Industry: A Critical Review of the Scientific Literature". *International Journal of Environmental Research and Public Health* 13.7 (2016): 638.
19. Bayhan H G., et al. "Enablers and Barriers of Lean Implementation in Construction Projects". IOP Conference Series: Materials Science and Engineering 471 (2019): 022012.
20. Ghosh S and Young-Corbett D. "Intersection between Lean Construction and Safety Research: A Review of the Literature". In Proceedings of the 2019 Industrial Engineering Research Conference (2019).
21. Mumford E. "The story of socio-technical design: reflections on its successes, failures, and potential". *Information Systems Journal* 16.4 (2016): 317-342.
22. Häkkinen P., et al. "The relationship between motivation and strategy use among collaborative and individual learners". *Contemporary Educational Psychology* 60 (2020): 101813.
23. Hollnagel E. "Barriers and Accident Prevention". New York, NY: Published 2016 Taylor & Francis 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN 711 Third Avenue, New York, NY 10017, USA (2016).