

CONSTRUCTION QUALITY IMPROVEMENT: A COMPREHENSIVE ANALYSIS OF QUALITY ASSURANCE PRACTICES IN THE NIGERIAN BUILDING SECTOR

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ABSTRACT

The construction industry is pivotal for driving economic growth and infrastructure development in Nigeria. However, the sector has long struggled with quality issues such as structural defects, substandard materials, and poor workmanship, which lead to building failures, safety hazards, and economic losses. To address these challenges, a robust quality assurance (QA) framework encompassing the entire construction lifecycle is essential. This article provides a comprehensive analysis of the current state of QA practices in the Nigerian building sector, identifying key challenges and proposing strategies for improvement. It examines the roles of regulatory bodies, including the Standard Organization of Nigeria (SON), the Council for the Regulation of Engineering in Nigeria (COREN), and the Nigerian Building and Road Research Institute (NBRRI), in establishing standards, enforcing compliance, and promoting best practices. Additionally, the article explores various quality assurance models, such as ISO 9001, Six Sigma, Lean Construction, and Total Quality Management (TQM), evaluating their suitability for the Nigerian context. Furthermore, it outlines a framework for implementing an effective QA system that includes policy and regulation, institutional capacity building, construction approval processes, post-construction maintenance, and stakeholder participation. By addressing the shortcomings in the existing QA framework and adopting a collaborative approach involving all stakeholders, the Nigerian construction industry can enhance quality, ensure public safety, and bolster its economic competitiveness.

INTRODUCTION

The construction industry is essential for the development of any nation, often reflecting economic growth through the development of infrastructure such as buildings, roads, and bridges (Olatunde et al., 2017; Amiril et al., 2014). Construction project development involves many parties, processes, phases, and stages of work, requiring substantial input from both public and private sectors to achieve successful project completion (Rahman et al., 2019). The success of these projects heavily depends on the quality of managerial, financial, technical, and organizational performance, while considering risk management, business environment, and economic and political stability (Zheng et al., 2016; Hwang et al., 2015). As construction projects become more complex, sophisticated approaches are needed for initiating, planning, financing, designing, approving, implementing, and completing projects (Smith & Bohn, 2021; Forcada et al., 2017). Successful construction projects are typically assessed based on timely delivery, staying within budget, meeting technical specifications, and achieving client satisfaction (Alias et al., 2014; Larsen et al., 2016; Suprpto et al., 2015).

In Nigeria, the construction industry has long faced quality issues, including structural defects and substandard materials and workmanship (Oyedele, 2013). These problems pose significant risks to public safety and property, undermining the industry's reputation and economic viability (Abdellatif et al, 2006). A culture of mediocrity has developed, where contractors prioritize profits over quality, and clients seek short-term gains over long-term sustainability (Oyedele & Bokor, 2015). The consequences of poor construction quality are severe, leading to building collapses that result in loss of life and property (National Building Code, 2006). Substandard materials and workmanship can cause costly repairs, legal liabilities, and environmental hazards such as water pollution and soil contamination due to inadequate waste management practices (Ede et al, 2017).

Addressing these quality concerns is a priority. The Nigerian government has implemented measures such as establishing the Council for the Regulation of Engineering in Nigeria (COREN) and the Nigerian Building and Road Research Institute (NBRRI) to regulate and enforce quality standards in the construction industry (COREN, 2020; NBRRI, 2020). Industry stakeholders are also promoting sustainable construction practices, including using locally sourced materials and energy-efficient designs, to improve the quality and environmental sustainability of construction projects (Adebisi et al, 2020)

Quality assurance (QA) practices are crucial for mitigating risks and ensuring that construction projects meet required standards and specifications (Rumane, 2011). QA involves planned and systematic activities to ensure the constructed facility meets quality requirements (Arditi & Gunaydin, 1997). Implementing robust QA practices allows construction firms to identify and rectify potential defects at various project stages, minimizing costly rework and delays (Love & Li, 2000). The lack of strict adherence to QA principles by construction practitioners has been linked to poor-quality finished building projects and frequent structural failures in Nigeria.

This article aims to analyze the current state of quality assurance practices in the Nigerian building sector comprehensively. It seeks to identify key challenges and shortcomings in the existing QA framework and propose strategies for improvement. The article covers the entire construction life cycle, from design and planning to execution and post-construction maintenance, with a particular focus on the building sector.

Overview of Quality Assurance Practises in Nigerian Building Sector

Quality assurance (QA) represents a modern approach to achieving quality in production, moving away from traditional inspection and quality control systems. Instead of focusing on

detecting issues, QA emphasizes preventing problems at the source through organizational planning and proactive measures. The goal is to eliminate errors and defects that cause waste. QA involves preventing quality issues through planned and systematic activities, which include establishing robust quality management systems, assessing their adequacy, auditing system operations, and reviewing the system itself (Harris & McCaffer, 2002). According to the Project Management Institute (PMI, 1996), QA encompasses all planned and systematic activities within a quality system to ensure projects meet relevant quality standards. It focuses on production and construction management methods and procedural approaches to integrate quality into the production system.

Johnson (2003) argues that both quality assurance and quality control are critical in building projects. Despite existing laws, regulatory organizations, and their manuals, shortcomings persist in the construction industry (Kado, 2010). Bamisile (2004) observed that unqualified individuals sometimes prepare architectural and engineering designs, and working drawings are often inadequately prepared, lacking essential details such as drawing numbers, designer names, and verification columns. Additionally, drawings can be uncoordinated and inadequate for construction, and specifications are sometimes written by quantity surveyors rather than the design team. Such practices undermine quality assurance requirements and can lead to failures.

The American Society for Quality Control defines quality as the aggregate components and attributes of a product or service created to satisfy customer needs (Talha, 2004). Quality is the degree to which a product meets specified standards and constraints. Cornick (1988) describes quality as conformance to requirements, achieved through management improvement by all project participants, resulting in assurance through demonstration. QA, therefore, is a systematic process to determine whether a product or service meets specified requirements. It establishes and maintains set requirements for developing or manufacturing reliable products, increasing customer confidence, enhancing company credibility, and improving work processes and efficiency. This enables a company to compete better. The International Organization for Standardization (ISO) plays a significant role in QA practices and in defining the processes for implementing QA. QA as a formalized practice originated in the manufacturing industry and has since extended to most industries, including software development.

In the building construction sector, quality is seen as meeting client satisfaction and needs within a specified budget. Quality control, conversely, involves inspecting completed facilities to ensure they meet contract specifications. It is considered the client's responsibility to determine the project's standards and outcomes. Quality control assures that products and services meet requirements and includes various activities, from planning and design to development. The implementation outcomes of QA programs in construction vary; some companies achieve success, while others face failures, especially with ISO 9000 standards. This variability leads to assumptions about the reasons behind these mixed outcomes. One assumption is that different methodologies for implementing QA strategies lead to varying results; one company's success may be due to its approach, while another's failure may result from its different implementation methodology.

Quality management systems in construction

Quality management systems have become central to businesses within the construction industry (Smallwood & Rossouw, 2008). According to ISO 8402 (1994), a quality management system encompasses all management functions that determine quality policy, objectives, and responsibilities, implementing them through quality planning, quality control,

quality assurance, and quality improvement. This system establishes a framework ensuring that each process is performed consistently using the same information, methods, skills, and controls (Dale, 2003). Essentially, a quality management system standardizes organizational processes, minimizes waste and rework, and increases profit margins (Wilkinson & Scofield, 2010). This discipline focuses on preventing problems by creating the attitudes and controls necessary for prevention.

Nicholas and Steyn (2008) emphasize that a robust quality management system is crucial for ensuring compliance with project quality criteria. It serves as the benchmark for measuring organizational quality performance and developing quality management standards. In the construction industry, it is widely used to ensure that processes are done correctly the first time. Abdulrahman (1996) suggests that minimizing errors and mistakes during the delivery of goods and services is possible with the introduction of formal quality management systems to plan, monitor, and control production processes.

A series of international quality management standards have gained wide acceptance in the construction industry. The International Organization for Standardization (ISO) has emerged over the past two decades as a system applicable to various types of organizations to improve quality procedures and products. The ISO's initial standards have been progressively developed to be relevant to construction due to their generic nature (Chini and Valdex, 2003). ISO creates an assurance regime providing confidence that an organization has a quality process in place, consistently producing products that meet customer needs and regulatory requirements. Love and Li (2000) state that implementing such standards leads to third-party certification, confirming that a product or service meets requirements and demonstrating that an optimal level of quality is achieved. Quality management standards like ISO focus on meeting customer requirements. Rotimi (2013) notes that the probability of meeting customers' needs is higher when guided by such standards. ISO 9000, for instance, sets the minimum standard for quality management systems.

Roles of Regulatory/Professional Bodies in Building Quality Assurance Practices

Ensuring effective quality assurance in the construction sector requires a coordinated effort among various regulatory bodies and professional organizations. These entities play pivotal roles in establishing standards, enforcing compliance, and promoting best practices within the industry. In Nigeria, several key institutions have been tasked with overseeing different aspects of quality assurance in building construction projects. By examining the mandates and activities of these bodies, we can gain insight into the current quality assurance framework and identify areas for further improvement.

Standard Organization of Nigeria: The Standard Organization of Nigeria (SON) plays a pivotal role in ensuring quality assurance in the building and construction sector through its mandate of establishing and enforcing standards for construction materials and processes. SON develops compulsory standards and specifications for various construction materials by adopting international codes and formulating indigenous Nigerian standards (Oladapo, 2007). These cover critical components such as cement, sand, aggregates, steel reinforcement bars, roofing sheets, doors, and windows (Oladapo, 2007; SON, 2022). To promote compliance, SON undertakes mandatory conformity assessment and certification of all regulated construction materials, whether imported or locally manufactured (Oladapo, 2007). This involves inspecting production processes and testing material samples from manufacturing plants before issuing certificates (Oladapo, 2007; SON, 2022). Additionally, SON conducts periodic market surveillance to monitor the quality of materials in circulation and ensure they meet the stated requirements (Oladapo, 2007). While SON's efforts have contributed to

improving material quality in the construction sector, certain areas require further attention. One challenge has been the agency's limited resources and personnel to effectively monitor the rapidly growing volume of construction projects across the nation (Adeboye, 2022). Strengthening SON's institutional capacity through increased funding and staffing could enhance its ability to conduct more comprehensive inspections and testing. Moreover, closer collaboration between SON and other regulatory bodies, such as COREN and state-level agencies, could foster better coordination and information sharing, thereby improving overall enforcement of quality standards (Adeboye, 2022). Engaging with industry stakeholders, including professional associations and construction firms, could also facilitate the dissemination of SON's standards and promote voluntary compliance within the sector.

Council for the Regulation of Engineering in Nigeria: The Council for the Regulation of Engineering in Nigeria (COREN) regulates the practice of engineering in Nigeria, including construction engineering (Adeboye, 2022). It undertakes this function through the registration of qualified engineers, monitoring of practice, and enforcement of the COREN Act (Adeboye, 2022; COREN, 2022). To ensure quality assurance in building construction, COREN mandates that only registered engineers take up construction roles such as design, supervision and project management (Adeboye, 2022; COREN, 2022). It also conducts regular inspections of construction sites to check for compliance with regulatory standards and procedures (Adeboye, 2022). Where violations are found, COREN has powers to sanction erring engineers through penalties or temporary suspension of licenses (Adeboye, 2022; COREN, 2022). It also collaborates with other agencies like SON to enforce standards for construction materials (Adeboye, 2022).

The Nigerian Building and Road Research Institute: The Nigerian Building and Road Research Institute (NBRRI) was established in 1973 through Decree 54 with a mandate to conduct research on building and road construction technologies suitable for Nigerian conditions (NBRRI, 2022; Ugwu and Haupt, 2007). It is an agency under the Federal Ministry of Science, Technology and Innovation located in Abuja. Some key functions of NBRRI include development and testing of indigenous construction materials; research and training on innovative construction techniques; provision of laboratory testing services; and documentation/dissemination of research findings (NBRRI, 2022; Ugwu and Haupt, 2007). Over the years, it has undertaken significant research leading to standards on laterite blocks, interlocking stabilized soil blocks, bamboo reinforcement in concrete, etc (NBRRI, 2022). However, studies have shown that utilization of research outputs in the Nigerian construction industry remains low due to lack of collaboration between NBRRI and relevant stakeholders (Ugwu and Haupt, 2007).

Phases of Quality Assurance Implementation

With adequate stakeholder participation and resources, following these key stages can help strengthen QA implementation across the Nigerian construction sector.

- **Planning Stage:** This involves developing an implementation framework through stakeholder consultations. Resources and timelines are also determined.
- **Mobilization Stage:** In this stage, regulatory bodies are restructured and staff trained. Awareness campaigns are carried out.
- **Material Testing and Certification Stage:** At this stage, all construction materials are tested and certified by SON before use. This ensures conformity to standards.
- **Engineering Design Stage:** Only qualified engineers registered with COREN undertake approved structural designs based on codes.

- Construction Stage: Periodic site inspections by SON and COREN check for deviations, workmanship quality and fake materials use.
- Completion Stage: Upon confirming all QA procedures, agencies award completion certificates allowing occupation.
- Post-Occupancy Stage: Scheduled audits by agencies ensure maintenance of structural integrity after people move in.

Quality Assurance Models in Construction Building

Quality assurance models in building construction are frameworks or approaches that are used to ensure and improve the quality of construction projects. These models provide guidelines and standards for various aspects of construction, including materials, processes, and project management. Here are some commonly used quality assurance models in building construction:

- **ISO 9001:** This is an international standard for quality management systems. It provides a systematic approach to quality assurance by setting requirements for quality control, documentation, and continuous improvement.
- **Six Sigma:** Six Sigma is a data-driven approach that aims to minimize defects and variations in construction processes. It involves using statistical analysis and quality improvement techniques to achieve high levels of quality and efficiency.
- **Lean Construction:** Lean construction focuses on eliminating waste and maximizing value in construction projects. It emphasizes collaboration, continuous improvement, and the efficient use of resources to enhance quality and productivity.
- **Total Quality Management (TQM):** TQM is a management approach that involves the participation of all stakeholders in the construction process. It aims to continuously improve quality by focusing on customer satisfaction, employee involvement, and process optimization.
- **Building Information Modeling (BIM):** BIM is a digital model-based approach that enables the integration and coordination of project information. It helps improve quality by facilitating better communication, clash detection, and visualization of construction processes.

These quality assurance models can be implemented individually or in combination, depending on the specific needs and requirements of a construction project. By adopting these models, construction companies can enhance quality, reduce errors and rework, and improve overall project performance.

Evaluation of Models

The quality assurance models commonly used globally present opportunities as well as limitations for the Nigerian building sector. A thorough evaluation of these models is necessary to identify the most suitable approach. The inspection model currently employed involves regular site visits by SON and COREN to check for compliance (Adeboye, 2022; Oladapo, 2007). While this provides oversight, limitations include insufficient personnel and resources to monitor the high volume of projects (Adeboye, 2022). Frequent evasion of inspectors and lack of follow-up on defects identified have also reduced effectiveness (Oladapo, 2007). The certification model requires all stakeholders be certified based on set criteria before participating in construction (Okeke et al., 2020). This ensures only qualified professionals are involved but poses challenges in Nigeria due to the large informal sector (Okeke et al., 2020). High certification costs may also limit widespread adoption.

The accreditation model assesses organizations through documentation reviews and audits before granting accreditation (Okeke et al., 2020). This confirms the adequacy of quality systems in place but the rigorous process may deter some local firms (Okeke et al., 2020). Maintaining accreditation standards over time also requires strong monitoring. Implementation of the integrated management system model promotes continual improvement through standards integration (Okeke et al., 2020). However, this model depends on robust documentation and data collection which local construction firms may find challenging to adopt (Okeke et al., 2020).

The total quality management model focuses on stakeholder satisfaction through employee training and use of quality metrics (Okeke et al., 2020). While effective globally, cultural barriers and the informal nature of the Nigerian industry pose difficulties in fully applying this model (Okeke et al., 2020). In summary, a hybrid approach leveraging the strengths of these models may work best for Nigeria's building sector. This involves aspects of certification, inspection and quality system implementation to establish a rigorous yet inclusive assurance framework

Framework for Implementation of Quality Assurance in Building construction

Ensuring quality assurance in the building construction sector is vital for infrastructure development, public safety and economic growth in Nigeria. However, lack of a robust and coordinated quality framework has allowed substandard practices to persist, resulting in building failures and loss of lives. To address this challenge, there is a need for stakeholders in the built environment including regulatory agencies, professionals, contractors, manufacturers and communities to come together and establish a comprehensive system for implementing quality assurance at all stages of building projects. This framework aims to outline the key elements and actors required to strengthen quality infrastructure from design to post-construction and facilitate collaborative action among relevant players. These frameworks include:

Policy and Regulation

- Strengthen SON, COREN and NBRRI mandates through updated Acts and codes
- Enforce licensing of engineers, contractors and building artisans
- Set clear standards for construction materials, processes and certification

Institutional Capacity

- Adequately fund regulatory agencies for expanded inspection/testing labs
- Train building officials, engineers and artisans on QA procedures
- Introduce mandatory continuing education for professionals

Construction Approval

- Require engineering designs and site supervision by qualified engineers
- Verify material quality and structural stability through audits
- Issue certificates of completion/occupancy only upon QA confirmation

Post-Construction

- Establish framework for periodic building inspection/maintenance
- Set up consumer complaint/dispute resolution mechanisms
- Impose penalties for non-compliance, substandard workmanship

Stakeholder Participation

- Involve professional bodies in policymaking and enforcement
- Encourage community monitoring through awareness campaigns
- Incentivize private sector investment in QA systems and certification

CONCLUSION

Ensuring quality assurance in the Nigerian building construction sector is critical for promoting public safety, economic growth, and sustainable development. Despite the efforts of regulatory bodies and the existence of quality assurance frameworks, the industry continues to struggle with persistent challenges, such as structural defects, substandard materials, and poor workmanship. Addressing these issues requires a comprehensive and coordinated approach involving all stakeholders, including regulatory agencies, professional bodies, contractors, manufacturers, and communities. To achieve effective quality assurance, a robust policy and regulatory framework must be established, supported by strengthened institutional capacity and adequate resources for regulatory bodies like SON, COREN, and NBRRI. Furthermore, the construction approval process should mandate the involvement of qualified professionals, rigorous material testing, and site inspections to verify compliance with standards. Post-construction monitoring and maintenance protocols should also be implemented to ensure the long-term structural integrity and safety of buildings.

Equally important is the promotion of stakeholder participation and collaboration. Professional bodies should be actively engaged in policymaking and enforcement, while community awareness campaigns can encourage grassroots monitoring and accountability. Incentivizing private sector investment in quality assurance systems and certification can also drive voluntary adoption of best practices. Ultimately, improving construction quality in Nigeria requires a paradigm shift – a collective commitment to prioritizing quality over short-term gains and a culture of excellence that permeates every aspect of the construction process. By implementing the proposed framework and fostering a collaborative ecosystem, the Nigerian building sector can overcome its long-standing quality challenges, enhance public safety, and position itself as a leader in sustainable and resilient infrastructure development.

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