

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

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Abstract

The construction industry plays a crucial role in driving economic growth and infrastructure development in Nigeria. However, the sector has long grappled with quality issues, including structural defects, substandard materials, and poor workmanship, leading to building failures, safety hazards, and economic losses. Addressing these challenges requires a robust quality assurance (QA) framework that encompasses the entire construction lifecycle. This article conducts 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, such as the Standard Organisation 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. The article also explores various quality assurance models, including 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, encompassing 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 critical to any nation's development. Physical infrastructure development, including buildings, roads, and bridges, often gauges a nation's economic growth pace (Olatunde et al., 2017; Amiril et al., 2014). Construction project development involves numerous parties, various processes, different phases and stages of work, and a tremendous deal of input from both the public and private sectors, with the major aim being to bring the project to a successful conclusion (Rahman et al., 2019). The level of success in carrying out construction project development activities will depend heavily on the quality of the managerial, financial, technical, and organisational performance of the respective parties, while taking into consideration the associated risk management, the business environment, and economic and political stability (Zheng et al., 2016; Hwang et al., 2015). As construction becomes more complex, a more sophisticated approach is necessary to deal with initiating, planning, financing, designing, approving, implementing, and completing a project (Smith & Bohn, 2021; Forcada et al., 2017). According to Alias et al. (2014), Larsen et al. (2016), and Suprpto et al. (2015), the common assessment of the success of construction projects is their timely delivery, adherence to budget, compliance with technical specifications, and client satisfaction.

Quality issues, ranging from structural defects to substandard materials and workmanship, have long plagued the construction industry in Nigeria (Oyedeke, 2013). These problems not only pose severe risks to public safety and property but also undermine the reputation and economic viability of the industry (Abdellatif et al., 2006). The prevalence of substandard construction practices has led to a culture of mediocrity, where contractors prioritise profits over quality and clients often prioritise short-term gains over long-term sustainability (Oyedeke & Bokor, 2015). The consequences of poor construction quality are far-reaching and devastating. Structural defects can lead to building collapses, resulting in loss of life and property (National Building Code, 2006). Substandard materials and workmanship can lead to costly repairs, legal liabilities, and even loss of life (Burati et al., 1992). Furthermore, poor construction quality can lead to environmental hazards, such as water pollution and soil contamination, due to the use of substandard materials and inadequate waste management practices (Ede et al., 2017). Addressing these quality concerns has become a pressing priority. The Nigerian government has implemented various measures, including the establishment of 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). Additionally, industry stakeholders are promoting sustainable construction practices, such as the use of 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 play a crucial role in mitigating these risks and ensuring that construction projects meet the required standards and specifications (Rumane, 2011). QA encompasses a comprehensive set of planned and systematic activities aimed at providing confidence that the constructed facility will fulfil the intended quality requirements (Arditi & Gunaydin, 1997). By implementing robust QA practices, construction firms can identify and rectify potential defects at various stages of the project, thereby minimising the likelihood of costly rework and delays (Love & Li, 2000). Construction practitioners' lack of strict compliance with quality assurance principles has resulted in poor-quality finished building projects. People in Nigeria have blamed this for the persistent structural failures they report. The purpose of this article is to conduct a comprehensive analysis of the current state of quality assurance practices in the Nigerian building sector. It aims to identify the key

challenges and shortcomings in the existing QA framework and propose strategies for improvement. The scope of the article encompasses 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 Practices in the Nigerian Building Sector

Quality assurance is a more modern approach to achieving production quality. By directing organizational efforts towards planning and preventing problems at their source, quality assurance achieves a lasting and continuous improvement in quality, marking a shift from the old inspection and quality control systems. It represents a shift from detection to prevention of nonconformance. As a result, quality assurance (QA) seeks to eliminate errors and mistakes that lead to waste and defects. Quality assurance (QA) is broadly defined as the prevention of quality problems through planned and systematic activities. These include the creation of sound quality management systems, the assessment of their adequacy, the audit of the system's operation, and the review of the system itself (Harris & McCaffer, 2002). The PMI (1996) describes QA as all the planned and systematic activities implemented within a quality system to provide confidence that projects will satisfy relevant quality standards. QA focuses on production or construction management methods and procedural approaches to integrate quality into the production system.

Johnson (2003) posits that quality assurance and quality control are crucial aspects of building projects. Kado (2010) asserted that, although there are such laws and regulatory organisations and their manuals, shortcomings still persist in the construction industry. Additionally, Bamisile (2004) noted that in some cases, unqualified individuals who prepare architectural and engineering designs and/or working drawings do so in a poor manner. In some cases, they even fail to include a drawing number, the designer's name, or a completed drawing by column, not to mention the name of the person who reviewed the drawings before they were issued. Moreover, the design team often neglects to use specifications, leaving the task of writing them to quantity surveyors. These practices negate the essence of quality assurance requirements and can lead to failure.

The American Society for Quality Control defines quality as the aggregate components and attributes of an item or administration made or performed to meet clients' needs (Talha, 2004). It is the extent to which a product may match specified standards and constraints. Cornick (1988) defines quality as conformance to requirements, achieved through management for improvement by all project participants, leading to assurance through demonstration (p. 211). Quality assurance (QA) is, therefore, any systematic process of determining whether a product or service meets specified requirements. QA establishes and maintains standards for developing or manufacturing reliable products. A quality assurance system aims to boost customer confidence and a company's credibility, enhance work processes and efficiency, and boost competitiveness. The International Organisation for Standardisation (ISO) is a driving force behind QA practices and mapping the processes used to implement QA. The concept of QA as a formalised practice started in the manufacturing industry, and it has since spread to most industries, including software development.

The building construction sector defines quality as ensuring client satisfaction and meeting their needs within a specified budget. Quality control, on the other hand, is the process of inspecting the completed facilities to ensure that they satisfy the contract's specifications. The client assumes responsibility for quality control, as they set the project's standards and outcomes. Quality control is an aspect of quality management that assures that products and

services fulfil requirements. Quality assurance encompasses a wide range of activities such as planning, design, and development. The expected outcomes of implementing these quality assurance programmes in the construction industry remain unclear, as some companies have successfully implemented these strategies, while others may have failed to do so. The implementation of quality assurance, particularly ISO 9000, has yielded varying outcomes. Due to this variability, different companies have created assumptions to explain why the implementation of these quality assurances does not yield positive outcomes. We've arrived at the assumption that different companies implement these quality assurance strategies using different methodologies, resulting in one company achieving the desired outcome while another employs its own methods, leading to implementation failure.

Quality Management Systems in Construction

Quality management systems have therefore become focal points in businesses within the construction industry (Smallwood & Rossouw, 2008). A quality management system, according to ISO 8402 (1994), refers to all management functions that determine quality policy, objectives, and responsibilities and implement them by means such as quality planning, quality control, quality assurance, and quality implementation within any quality system. The quality management system creates a framework of reference points to guarantee the consistent use and application of the same information, methods, skills, and controls during every process (Dale, 2003). Essentially, a quality management system standardises organisations' processes, helps to minimise waste and rework, and increases organisations' profit margins (Wilkinson & Scofield, 2010). This management discipline is concerned with preventing problems from occurring by creating the attitudes and controls that could make prevention possible. According to Nicholas and Steyn (2008), a successful quality management system is crucial in ensuring compliance with the quality criteria of projects. To put it another way, the quality management system serves as the benchmark for measuring an organization's quality performance, leading to the development of quality management standards. Many in the construction industry now use it to guarantee correct execution on the first attempt. Abdulrahman (1996) suggests that minimising 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.



Figure 1: Total Quality Management in Construction Process

Source: Arditi & Gunaydin (1997)

To this end, a series of international quality management standards have gained wide acceptance in the construction industry. For instance, over the last two decades, the International Organisation for Standardisation (ISO) has emerged as a system applicable to various types of organisations, aiming to enhance quality procedures and products. Due to their generic nature, the ISO has progressively developed its initial sets of standards to be relevant to the construction industry (Chini and Valdex 2003). The ISO establishes an assurance regime that provides confidence that an organization has a quality process installed and that the organisation provides consistent products that will meet its customers' needs and other regulatory requirements. According to Love and Li (2000), this implementation results in third-party certification, confirming that a product or service meets the required standards and demonstrating the attainment of an optimal level of quality. Quality is about meeting standards and end-user requirements. ISO, a quality management standard, has a customer focus in all of its requirements (Rotimi, 2013). The probability of meeting customers' needs is higher when such a standard guides quality management performance. ISO 9000 sets the minimum standard for quality management systems.

The Roles of Regulatory and Professional Bodies in 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. Several key institutions in Nigeria oversee various aspects of quality assurance in building construction projects. By examining these bodies' mandates and activities, we can gain insight into the current quality assurance framework and identify areas for further improvement.

The Nigerian Institute of Architects (NIA): As a body charged with making our world a better place through the creation of exceptional designs while prioritising safety, the Nigerian Institute of Architects (NIA) plays an important role in quality assurance by providing a solid framework, encouraging early detection of problems, improving testability and consistency, effectively managing changes, guiding quality assurance activities, aligning with business goals, and facilitating communication. In order to construct high-quality systems that fulfil functional and non-functional needs, a well-planned architecture is necessary. The different climates, rapid urbanization, varying degrees of infrastructural development, and Nigeria's regulatory framework make quality assurance in design a unique problem.

Standard Organisation of Nigeria: The Standard Organisation of Nigeria (SON) plays a pivotal role in ensuring quality assurance in the building and construction sectors 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 a 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).

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 performs this function by registering qualified engineers, monitoring practices, and enforcing 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). When violations occur, COREN has the authority to penalize or temporarily suspend the licenses of erring engineers (Adeboye, 2022; COREN, 2022). It also collaborates with other agencies, like SON, to enforce standards for construction materials (Adeboye, 2022).

Nigerian Building and Road Research Institute (NBRRI): Decree 54 established the Nigerian Building and Road Research Institute (NBRRI) in 1973 with the 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. NBRRI has several key functions, including the development and testing of indigenous construction materials, research and training on innovative construction techniques, laboratory testing services, and the documentation and dissemination of research findings (NBRRI, 2022; Ugwu and Haupt, 2007). Over the years, it has conducted significant research, resulting in standards for laterite blocks, interlocking stabilized soil blocks, bamboo reinforcement in concrete, and so on (NBRRI, 2022). However, studies have shown that utilisation of research outputs in the Nigerian construction industry remains low due to a lack of collaboration between NBRRI and relevant stakeholders (Ugwu and Haupt, 2007).

The Phases of Implementing Quality Assurance in Architecture

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.
- The mobilization stage involves restructuring regulatory bodies and training staff. Awareness campaigns are carried out.
- **Material Testing and Certification Stage:** SON tests and certifies all construction materials at this stage before use. This ensures conformity with standards.
- **Engineering Design Stage:** Only qualified engineers registered with COREN undertake code-approved structural designs.
- **Construction Stage:** Son and Colin conduct periodic site inspections to check for deviations, workmanship quality, and the use of fake materials.

- **Completion Stage:** After confirming all QA procedures, agencies award completion certificates, allowing employment.
- **Post-Occupancy Stage:** Agencies schedule audits to ensure structural integrity is maintained after people move in.

Quality Assurance Models

In building construction, quality assurance models serve as frameworks or approaches to guarantee and enhance 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.



Fig 2: Effective ISO 9001 Quality Management System

Source: (Willar, 2012)

- **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.
- **Quality Function Deployment (QFD):** QFD is a systematic approach that translates customer requirements into specific design and construction characteristics. It helps ensure that the final product meets customer expectations and quality standards.

Quality Assurance Evaluation Methods

The quality assurance models commonly used globally present both opportunities and 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 Colin to check for compliance (Adeboye, 2022; Oladapo, 2007). While this provides oversight, there are limitations, including insufficient personnel and resources to monitor the high volume of projects (Adeboye, 2022). Frequent evasion by inspectors and a lack of follow-up on defects identified have also reduced effectiveness (Oladapo, 2007). Before participating in construction, the certification model requires all stakeholders to receive certification based on set criteria (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). Over time, maintaining accreditation standards 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 the 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.

Perspectives of Architects on Quality Assurance in Nigeria

According to Ferguson and Clayton (1998), quality assurance (QA) is a program that covers activities necessary to provide quality in the work to meet the project requirements. Quality assurance (QA) entails the establishment of project-related policies, procedures, standards, training, guidelines, and systems that are essential for producing quality work. The design professional and constructor are responsible for developing an appropriate programme for each project. Quality Assurance (QA) protects against quality issues by providing early warnings of potential problems. Such early warnings play an important role in preventing

both internal and external problems." On the other hand, quality control (QC) is the specific implementation of the QA programme and related activities. Effective QC reduces the possibility of changes, mistakes, and omissions, which in turn result in fewer conflicts and disputes.

Design Quality Assurance: Creating architectural plans that take into account the wide range of weather conditions found in Nigeria, from the desert north to the rainiest south, as well as its many coastal areas. We must consider local materials, building methods, and environmental factors (Agboola, 2016). Creative design solutions can solve issues such as water shortages, inconsistent electricity, and the need for sustainable construction techniques.

Material Quality and Specification: To help the economy and ensure that the materials are appropriate for the area, encourage people to use high-quality materials that are already available (Onyegiri & Ugochukwu, 2016). To ensure consistency and longevity, however, strict QA is required (OKE, 2019). We must set up stringent quality control procedures to ensure that imported materials are up to par.

Construction Quality Assurance: Spending money on construction worker training and certification to increase their competence and compliance with quality standards is one way to deal with the inconsistent quality of workmanship (Oludare & Oluseye, 2016). Regular site inspections by trained quality assurance specialists to check for quality and conformity to specifications are essential.

Managing and documenting projects: Developing comprehensive quality assurance plans that include roles, procedures, and criteria for the whole project (Irfan, Khan, Hassan, Habib, Khan, & Khan, 2021). This includes protocols for dealing with discrepancies and guaranteeing responsibility.

Keeping detailed records of all quality assurance tasks, such as inspection notes, test findings, and conformity certifications. This paperwork is critical for the sake of transparency and future reference.

Post-Construction Quality Assurance: Making sure all building systems are properly and effectively commissioned is essential in light of Nigeria's energy problems. Conducting post-occupancy assessments to learn how occupants felt about the facility and what problems needed fixing for future projects. We prioritize the environment and ensure its long-term sustainability. To lessen the burden on traditional power grids and water supplies, advocates of green construction practices are pushing for measures like passive cooling, rainwater collection, and renewable energy use (Akadiri, Chinyio, & Olomolaiye, 2012). We are performing comprehensive EIAs to guarantee that new projects are both ecologically sound and able to accommodate the community's requirements.

Ongoing Development and Modification: Putting in place systems for receiving and processing feedback in order to gain insight from finished initiatives and apply that knowledge to ongoing endeavours. According to Yuan (2023), one way to improve design correctness, efficiency, and project management in general is to use modern technologies like Building Information Modelling (BIM) and other digital tools. Nigeria must overcome numerous obstacles to ensure high-quality architecture. Architects in Nigeria can significantly enhance the quality and sustainability of projects by prioritizing contextual design, improving construction staff training, and utilizing new technology (Moyanga, 2023).

To advance architectural quality assurance throughout the nation, there must be a focus on continuous development and adaptability to local situations.

Theoretical Framework

Resource-Based View Framework

The resource-based view framework (RBV) emphasizes the association's assets as critical determinants of competitive advantage and implementation. The Resource Based View framework (RBV) incorporates two fundamental assumptions to decipher competitive advantage (Barney, 2001). This model accepts that organizations within an industry may be heterogeneous in terms of the assets they control. Secondly, it acknowledges that asset heterogeneity could persist over time due to the immobility of the assets used to implement firms' strategies, meaning that some assets are difficult to exchange and collect. We view asset heterogeneity (or uniqueness) as a crucial condition for an asset package to enhance its competitive advantage.

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, the lack of a robust and coordinated quality framework has allowed substandard practices to persist, resulting in building failures and the 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 NBRI. 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.

Recommendations

The study recommended that:

Regulatory bodies must enhance their monitoring and enforcement mechanisms to ensure strict compliance with established quality standards. This involves conducting regular inspections, imposing penalties for non-compliance, and fostering collaboration with industry stakeholders to address systemic issues.

Embracing technological innovations such as Building Information Modeling (BIM), advanced materials testing, and digital quality management systems can significantly enhance construction quality and efficiency. Government incentives and industry-wide initiatives should be introduced to facilitate the adoption of these technologies across the sector.

Establishing platforms for collaboration among stakeholders, including government agencies, industry associations, academia, and practitioners, can facilitate the exchange of best practices, lessons learned, and innovative solutions. This collective effort can drive continuous improvement in quality assurance processes and standards.

Educating consumers and stakeholders about the importance of quality assurance in construction is essential for fostering demand for high-quality buildings and infrastructure. Public awareness campaigns can empower individuals to make informed decisions, demand accountability from industry players, and contribute to raising overall standards.

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