

Challenges Against Implementation of Quality Control Practices in SUBEB Construction Projects in Bauchi State, Nigeria

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Abstract

This study investigates the challenges militating against the implementation of quality control practices by the State Universal Basic Education Board (SUBEB) in construction projects in Bauchi State, Nigeria. The study also assessed the effects of quality control practices and associated challenges on the overall effectiveness of quality control processes in SUBEB construction projects within the study area. Utilizing a quantitative research design, structured questionnaires based on 5-point Likert Scale were employed for data gathering from professionals involved in SUBEB projects, including architects, engineers, quantity surveyors, and builders. The data collection instrument consisted of both closed-ended questions. A total sampling frame of 27 professionals was purposively selected based on their involvement as staff of the Works Department in SUBEB, Bauchi State. Reliability analysis yielded Cronbach's Alpha values exceeding the acceptable threshold of 0.70, indicating high internal consistency. The study employed descriptive statistics and multiple regression analysis to assess the identified challenges and their effects on the effectiveness of quality control practices. Findings revealed that the most significant challenges to effective implementation included incomplete drawings and designs, client interference, and inadequate consultant experience. The regression analysis indicated a positive correlation between the types of quality control practices and their effectiveness ($R^2 = 0.251$, $p < 0.001$), while challenges presented a statistically insignificant impact on effectiveness ($p = 0.741$). In conclusion, the study underscores the necessity of enhancing quality control practices to promote better construction outcomes in SUBEB projects. Recommendations for improvement include fostering strong managerial commitment, providing professional development opportunities for consultants, and establishing a more robust supervisory structure. These measures are critical to ensuring that educational facilities in Bauchi State meet quality standards conducive to optimal learning environments.

Keywords: Quality Control Practices, SUBEB, Construction Projects, Bauchi State, Nigeria.

Introduction

According to Lindström, Larsson, Jonsson, and Lejon (2017) quality control is a universal managerial process for conducting operations to provide stability to prevent adverse change and to maintain the status quo. He stated that in order to maintain stability, the quality control process evaluates actual performance, compares performance to goal, and takes action on the difference. Quality control takes place by using a feedback loop (Albers,

Gladysz, Pinner, Butenko & Stürmlinger, 2016). Montgomery (2020) asserts that the feedback loop is ubiquitous and essential to all quality control issues. It is applicable to all kinds of operations, whether they are in product or service. The quality control procedure is explained by the feedback loop. By ensuring that control measures are rigorously followed throughout the production process, quality control in the building production process deals with the full application of quality policies.

Steiss (2019) defines quality control as meeting requirements, which must be specified in quantifiable and understandable language. One of the aims and objectives that organizations aim to accomplish is the quality control practice. Any company's place in the market is determined by its quality control procedures for its goods and services. Customers want the most value for their money, which is why they do this. The client is the only one who can define a product or service's quality control. This implies that a company needs satisfied clients in order to be satisfied with the quality of its products or services. In management theories, quality is a complicated idea that has grown to be one of the most alluring. This is to say that every business today wants to produce quality products or services that are acceptable to consumers, which are also affordable. The quality control practice is a functional management discipline, which is responsible for defining quality purposes. The prerequisites for effective quality control are freedom from deficiency and minimization or reduction of the following costs; waste, re-work replacement and inspection costs (Khan, Homri, Dantan & Siadat, 2021). All these are manufacturing problems that should not only be detected and corrected at the earliest time but prevented if possible (Shingo & Dillon, 2019). The quality control practice can therefore be achieved by establishing a standard for effective supervision and delivery. The quality of educational facilities is crucial for creating conducive learning environments, particularly in Nigeria, where educational infrastructure plays a vital role in the achievement of educational goals. The construction of these facilities under the auspices of the State Universal Basic Education Board (SUBEB) in Bauchi State has faced persistent challenges in the effective implementation of quality control practices (Garba, 2020).

Despite various efforts and recommendations made by previous researchers and stakeholders, issues such as inadequate adherence to quality control guidelines, lack of training for personnel, insufficient funding, and poor project management have continued to undermine the integrity of educational infrastructure in projects carried out by SUBEB in most States in Nigeria (Udoaka & Udo, 2023). These challenges not only lead to the construction of substandard educational facilities but also adversely affect the overall learning experience for students. Poorly constructed buildings may result in safety hazards, inadequate learning spaces, and a negative impact on student performance and retention rates (Abdulazeez, 2021). The persistent failures in quality assurance mechanisms and oversight result in a cycle of rework, additional costs, and ultimately, a compromised educational experience for learners in Bauchi State. Prior studies have consistently highlighted these challenges and formulated various recommendations aimed at

strengthening quality control measures (Iroha, Watanabe & Satoshi, 2024). For instance, studies conducted by Imeh (2019) demonstrated that extensive training and capacity building for SUBEB staff could be fundamental in enhancing the quality control processes. Similarly, Arong and Ogbadu (2010) suggested a systematic approach to project management and oversight that could mitigate the prevalent quality issues. However, the implementation of these recommendations has been sporadic and insufficient, leading to a gap in the practical application of the suggested improvements. The failure of past research to translate theoretical recommendations into practical solutions exposes a crucial gap in addressing the root causes of quality control challenges in SUBEB projects.

Consequently, the current study is aimed at bridging this gap by systematically evaluating these ongoing challenges and their effects on the effectiveness of quality control practices in SUBEB construction. This study seeks to evaluate the challenges militating against the effective implementation of quality control practices by SUBEB in Bauchi State and to assess the effects of quality control practices and associated challenges on the overall effectiveness of quality control processes in SUBEB construction projects within Bauchi State. By doing so, it will provide actionable insights for policymakers and stakeholders regarding the enhancement of quality assurance processes, thereby promoting the construction of educational facilities that meet established standards and ultimately foster an optimal learning environment for students in Bauchi State, Nigeria.

Literature Review

The concept of quality has existed for many years, but its meaning has changed and evolved. Before the early twentieth century, quality management meant inspecting products to ensure that they met specifications. This is evident in the Egyptian wall painting circa 1450BC which showed evidence of measurement. According to Collins and Zimran (2024) around the 1940s, during World War II, quality became more statistical. Statistical sampling practices were used to evaluate quality, and quality control charts were used to monitor the production process. In the 1960s, with the help of so-called "quality gurus," the concept took on a broader meaning. Quality began to be viewed as something that encompassed the entire organization, not only the production process. All functions were responsible for product quality and shared the costs of poor quality. However, in the 1970s and 1980s, many U.S. industries had to make changes to their quality policies when they lost market share to foreign competition particularly in the auto industry. Many hired consultants and instituted quality training programs for their employees (Collins & Zimran, 2024). Ruiz, Ramón and Domingo (2020) established that many of the management practices used to support construction organizations are being challenged. The industry's clients are moving forward. Clients demand improved service quality, faster buildings and innovations in technology.

Quality Control

Pecorale, Inzerillo, and Salvadori (2024) define "quality control" as the procedure a business uses to ensure that production defects are reduced or eliminated and that product quality is maintained or improved. Furthermore, the researchers noted that quality control is the procedure utilized to ensure that instructions are regularly followed. The control technique includes watching actual demonstrations, comparing them to a few standards, and acting whenever the observed performance significantly deviates from the norm. Rumane (2023) defines quality control in construction as confirming completed or started efforts to ensure that works have been carried out or completed as specified, using established practices, references, codes, and principles to meet expected use, and materials that have been chosen or approved.

Quality Control Processes

The continuous search for ways to rectify aberrations is referred to as quality management (Parsamehr, Perera, Dodanwala, Perera & Ruparathna, 2023). By fostering the attitudes and circumstances that make avoidance feasible, this aims to prevent issues. Quality administration encompasses quality control and quality confirmation in addition to the other ideas of value strategy, quality arranging, and quality improvement. Quality management advises keeping development project quality at the required level to please customers and guarantee the company's long-term survival. Harrison-Zotsi (2021) identifies three primary ways that value is significant in the development process: managing costs, achieving deadlines, and making sure that the fundamental components of the finished assignment fit within the required boundaries. This is now known as the quality set of three, as seen in figure 1. Quality management includes confirming that the product or structure will meet the stated or suggested needs for which it was chosen.

The Standards of Quality Management

According to Beyene (2024) reports known as criteria of Quality are used to outline acceptable circumstances or practices in construction activities and to serve as a gauge to make sure that those conditions or practices meet the required criteria. Norms usually define the lowest standards; world-class quality is by definition above the average execution level. Norms may be written or unwritten, required or optional. Furthermore, gauges were described as a kind of base for viewpoints required to assess if a quality framework is enough. The quality framework must encompass all exercises that precede the final construction activity (Parsamehr, Perera, Dodanwala, Perera & Ruparathna, 2023). Contingent upon the extent of activity of the association, these exercises incorporate arranging, structure, improvement, acquiring, generation, review, stockpiling, conveyance, and after-deals.

Importance of Standards

Standards are important because they contribute to the desired quality requirements in construction projects. Jumaa and Khaleel (2022) provided the following explanations of some of these standards in their discussion of the significance of quality standards:

- a. Criteria provide guidance: They establish goals or criteria for producers and customers to follow. For the producer that wants to get into a new industry and the gullible consumer who has to buy something else, they are invaluable.
- b. Disentanglement of principles: They reduce the number of sizes, procedure assortment, stock measure, and administrative effort, which collectively account for a large portion of manufacturing and selling overhead costs.
- c. Standards moderate: By enabling large-scale production of standard plans, they promote improved tooling, more cautious design, and more precise controls, therefore reducing the production of insufficient and excess parts. Reduced expense is another way that guidelines benefit the client.
- d. Standards provide a foundation for confirmation: They serve as valuable indicators that the sponsor, who concentrates on exhibited attributes, and the buyer, who observes the registered trademark, nameplate, or mark, can utilize to their infinite advantage.

Quality Control Practices

To ensure that their processes, products, and services meet predefined standards of quality, organizations and teams employ quality control (QC) methods, which are essential procedures and activities (Westgard & Westgard, 2016). The operational foundation of quality assurance consists of these protocols, which focus on the everyday actions taken to uphold and improve quality standards. Some key components and accepted practices for quality control are listed below;

- a. Defect Prevention: Identify potential defects early in the process to prevent them from occurring.
- b. Consistency: Ensure that products and services are delivered consistently up to the defined quality standards.
- c. Customer Satisfaction: Meet or exceed customer expectations through quality assurance.
- d. Compliance: Adhere to legal, regulatory, and industry standards by implementing effective QC practices.

Common Quality Control Practices

Testing and Inspection: These two essential quality control procedures make sure that building projects adhere to established guidelines and standards. Inspections are methodical assessments of materials, procedures, and construction techniques to confirm adherence to project specifications. Testing is the process of assessing components and

materials to make sure they adhere to industry standards and applicable codes (e.g., thermal performance tests for insulation, strength testing for concrete). Objective testing in conjunction with regular, comprehensive inspections can greatly lower the probability of flaws and improve project quality (Alharthi, Washer & Connor, 2024).

Checklists and Forms

According to Kocot, Gransberg and Tapia (2024) checklists can improve accountability and ensure consistency across inspections and quality checks. Forms can also be used to document inspections, report deficiencies, and monitor compliance throughout the construction phases. This documentation aids in communication among stakeholders and serves as an essential reference for maintaining quality standards.

Statistical Process Control (SPC)

Statistical Process Control (SPC) is a methodological approach to monitoring and controlling processes using statistical practices. According to Boaventura, Fiaccone and Ferreira (2024) SPC involves the use of control charts and other statistical tools to analyze variation in processes in construction projects. By applying SPC in construction, project managers can identify variations that could indicate quality issues, allowing for proactive adjustments to maintain quality standards. Research indicates that SPC can lead to significant reductions in defects, enhanced process efficiency, and improved project outcomes (Boaventura, *et al.*, 2024).

Root Cause Analysis (RCA)

Root Cause Analysis (RCA) is a problem-solving practice used to identify the underlying causes of defects or issues in construction projects. Authors such as Graber, Castro, Danforth, Tilly, Croskerry, El-Kareh and Zwaan (2024), known for the Fishbone Diagram, emphasized that by addressing root causes rather than symptoms, organizations can implement more effective solutions. RCA in construction often includes practices such as the 5 Whys and Cause-and-Effect Analysis. Research shows that performing RCA contributes to continuous improvement and helps organizations avoid recurring problems (Jena, 2024).

Training and Awareness Programs: Training and Awareness Programs are essential components of effective quality management in construction. According to Maqbool, Rashid, Altuwaim, Shafiq and Oldfield (2024) investing in workforce training enhances the skills and knowledge of employees regarding quality standards and procedures. Training programs promote awareness of quality requirements and the importance of adherence to processes, leading to better practices on-site. Research indicates that when workers are better trained, the likelihood of defects decreases, resulting in higher overall project quality (Ford & Gosling, 2024).

Quality and Construction Performance

Innovative advancements in the real estate industry have merged to create quality mindfulness in the twenty-first century, which has raised critical cognizance on development execution. In order to manufacture items of high value to meet the vibrant market, the real estate industry's implementation of total quality management has led to advancements in quality, efficiency, and effectiveness through strategic administrative processes (Alawag, Alaloul, Liew, Musarat, Baarimah, Saad & Ammad, 2023). Thus, quality is fundamental to the ongoing, sustainable growth of many sectors. These industries therefore have market prospects because they have developed competitive competencies that allow them to positively impact industry performance as a whole. Thus, giving greater weight to the production of items is one way to improve the upkeep of quality management. Because of the great value that is placed on goods, businesses often face difficulties in carrying out that specific quality procedure. In this era, the system of high value has taken center stage in determining a company's level of success.

Apart from Nøjgaard (2023) perspectives, market alignment aims to arrange activities in a way that prioritizes the needs of the customer. However, in order to satisfy the customer, a product's quality has been enhanced in terms of value. Due to its extensive scope, the industry has seen an increase in consumer demand for high-quality items. As a result, real estate companies have carefully considered both current and potential quality-related issues to prevent a detrimental impact on the sector's overall performance. Because the real estate industry maximizes quality, it also has the potential to profit from quality-driven practices. These earnings are put to use in the company to improve quality, satisfy customer demands, and slow down building. As a result, businesses in the real estate sector have adopted a number of machine modifications to generate value in six sigmas, average ISO 9000, and bulk manufacturing.

Effectiveness of Quality Control Practices in Construction Projects

Quality control (QC) practices are pivotal in the construction industry, where project outcomes directly impact safety, performance, and client satisfaction. The effectiveness of these practices can be measured through various indicators, including project quality, efficiency, cost savings, regulatory compliance, and client satisfaction (Raouf & Al-Ghamdi, 2023; and Saihi, Awad & Ben-Daya, 2023)

Corruption and Lack of Accountability: The construction sector in Nigeria is frequently marred by corruption, which severely affects the integrity of quality control practices. Okolie and Edo (2023) emphasized that corrupt procurement processes often lead to the selection of incompetent contractors, resulting in subpar construction.

Poor Project Management Practices: Effective project management is critical for the successful implementation of quality control. Dolo (2013) identify inadequate project management as a significant challenge, stemming from poor planning and poor coordination among stakeholders. Insufficient project monitoring by government

authorities contributes to quality failures, leaving projects vulnerable to operational inefficiencies (Lovallo, Cristofaro & Flyvbjerg, 2023).

Limited Skilled Workforce: A shortage of skilled labor further complicates quality control efforts in the construction sector. Iroha, Watanabe and Satoshi (2024) argue that many construction workers lack the necessary training and expertise to uphold quality standards. This deficiency is echoed by Kyung, Lee, Dancu and Hong (2023) who notes that the absence of professional development programs limits workers' understanding of quality requirements, resulting in inconsistent construction quality.

Poor Communication and Coordination among Stakeholders: Effective communication and coordination among all stakeholders is essential for implementing quality control practices. According to Olanrewaju, Bello, Semiu and Mudashiru (2024) ineffective communication can result in misunderstandings and misalignment regarding quality expectations among government agencies, contractors, and consultants. Lim (2024) describe how fragmentation in the construction process exacerbates these communication issues, hindering the implementation of necessary quality measures.

Time Factor: The important participants like an owner, contractor, and consultant have more influence on project performance and so as on its quality. Construction works had to be completed within the provided time limit. The time factor has been a major recurring problem in the construction industry. Realizing the importance of the subject, construction delay not only results in time overrun but also affecting the quality of construction. Delay in project tends to speedy completion resulting in inferior quality of the construction (Al Nahyan, Sohal, Hawas & Fildes, 2019).

Lack of Staff Training: Staff Education and training form a vital part of Quality Management. Education and training are some of the key elements of the quality in which many people are involved, so the success of the implementation depends directly on how well they have been done. Many research results reveal that education and training are some of the most important elements in the successful implementation of effective quality management. Education and training courses employees not only possess the adequate knowledge and skills to perform their jobs but also to possess specifics values, knowledge and skills associated with quality issues and activities. Thus, lack of training will result in poor quality construction.

High-Level Competition: More competition causes quality to improve. Where less competition can cause construction quality to deteriorate. Companies do not compete on price alone. Competitive forces also encourage them to innovate and offer the individual or business consumer something extra as a way of making their construction products more attractive (Olanrewaju, Bong & Preece, 2022).

Non-implementation of Quality Assurance in Building Projects

Numerous obstacles can seriously hinder the effectiveness of building construction projects when implementing quality assurance (QA) methods. The absence of efficient coordination

and communication between different stakeholders, such as consultants, contractors, subcontractors, and regulatory agencies, is one of the main problems. This frequently leads to differences in how quality standards are understood, which causes QA procedures to be applied inconsistently (Mtitu, 2025). Additionally, poor adherence to quality norms is a result of staff members working on construction projects not receiving enough training or knowledge. Effective oversight is further hampered by the fact that many firms lack the means or capability to set up extensive QA systems (Abdulraheem et al., 2025). Budgetary restrictions are particularly important since they can cause quality assurance efforts to be neglected in favor of cost-cutting strategies, which would ultimately jeopardize the integrity of the building process. Furthermore, an environment where QA measures are either poorly implemented or completely disregarded may result from a lack of a clear regulatory framework or from the lax enforcement of current standards (Bobek et al., 2025). The industry's strict project timetables, which frequently force teams to put speed ahead of careful quality checks and so compromise the efficacy of QA systems, exacerbate these difficulties (Metwally et al., 2025).

Effects of Non-Implementation of QA

Neglecting or ineffectively implementing quality assurance procedures in building construction projects can have serious and complex repercussions. First and foremost, a lack of strong quality assurance procedures raises the possibility of errors and non-adherence to safety regulations, which may compromise the structural soundness of the built facilities (Ghafoor et al., 2025). These flaws frequently result in expensive fixes, hold-ups, and even disastrous failures that endanger public safety. The effects of neglecting or failing to effectively employ quality assurance mechanisms in building construction projects are considerable and varied. Firstly, the lack of sturdy QA processes increases the possibility of defects and non-compliance with safety standards, which can threaten the structural integrity of the constructed facilities (Ghafoor et al., 2025). These inadequacies often lead to expensive repairs, delays, and even disastrous failures that pose risks to human safety. Moreover, inadequate quality assurance can result in increased rework and waste, thus escalating project costs and reducing overall profitability (Sharma & Laishram, 2025). The reputational harm to contractors and developers is another noteworthy consequence, as continuous quality issues erode stakeholder confidence and can harm future business opportunities. On a wider scale, non-compliance with quality standards can have legal and regulatory ramifications, including penalties and sanctions that further strain project resources (Yusof et al., 2025). Besides financial and safety concerns, insufficient quality management can lead to long-term operational inefficiencies, maintenance difficulties, and reduced lifespan of buildings, ultimately compromising the sustainability of construction projects (Xiahou et al., 2025). As a result, the failure to implement effective quality assurance mechanisms not only impacts individual projects but also undermines the overall integrity and reputation of the construction industry.

Theoretical/Conceptual Framework

The present research is based on the guiding structure of Total Quality Management (TQM), which highlights an organization-wide method of continuous improvement, stakeholder participation, and the integration of quality into all facets of project execution. TQM principles promote a proactive culture of quality, fostering collaboration among employees, management, and external stakeholders to attain defect-free construction results. Furthermore, the research uses the principles of Statistical Process Control (SPC), which utilize statistical methods to monitor, control, and enhance construction processes via data analysis and variation reduction. These models collectively guide the research design by highlighting the significance of systematic quality assessment and continuous improvement in construction projects.

Research Methodology

The questionnaire developed for this study integrates constructs derived from TQM, such as management commitment to quality, employee training and involvement, and stakeholder participation, to evaluate the organizational culture surrounding quality practices within SUBEB projects. It also includes items related to SPC, such as the use of statistical tools for process monitoring, adherence to quality standards, and data-driven decision-making. During examination, these models guide the study of relationships between challenges encountered in implementing quality control practices and the effectiveness of quality outcomes. For example, data on management support and process monitoring will be analyzed to determine how these factors affect the overall quality performance of SUBEB construction projects in Bauchi State. By merging TQM and SPC principles, the study seeks to offer comprehensive insights into how organizational commitment and process control influence the success or failure of quality control practices within the context of educational infrastructure development.

This study employs a quantitative research design, utilizing survey as the primary data collection medium. The target population includes professionals such as staff, consultants, and contractors who are involved in projects under the auspices of SUBEB in Bauchi. Specifically, the sample includes members of esteemed professional bodies, such as the Nigerian Institute of Architects (NIA), Nigerian Society of Engineers (NSE), Nigerian Institute of Quantity Surveyors (NIQS), and Nigerian Institute of Building (NIOB). Given the limited number of professionals (27) engaged in the works department of SUBEB Bauchi, a purposive sampling technique was employed to select all 27 individuals as the sample frame and size. The primary instrument for data collection was a structured questionnaire consisting of close-ended questions. A 5-point Likert scale, ranging from "Strongly Disagree" (1) to "Strongly Agree" (5) was utilized. The study utilized descriptive and inferential statistical analysis to interpret data collected from questionnaires. The analysis includes the calculation of means, standard deviations, and frequency distributions and multiple regression to summarize the findings.

Results and Discussions

The demographic information of the respondents was collected. The frequency and percentage analysis were carried out, and the results were presented to explore the respondents' profiles. Five (5) demographic characteristics information of the respondents were collected. These comprise gender, age, professionals, educational qualification, type of organization, company size (number of employees), and years of experience.

Table 1: Result of the demography

	QUESTIONS	OPTIONS	Frequency	Percent
1.	Gender	Male	22	78.57
		Female	5	18.52
			27	
2.	Age	Under 30 years	4	14.82
		30 to 50 years	21	77.78
		Above 51years	2	7.41
			27	
3.	Profession	Architects	4	14.82.
		Quantity Surveyor	4	14.82
		Civil Engineer	3	11.11
		Electrical Engineer	5	18.52
		Mechanical Engineer	4	14.82
		Builder	7	25.93
			27	
4.	Educational Qualification	Diploma	0	0.00
		Degree/HND	24	88.89
		Master's degree and above	3	11.11
			27	
5.	Years of Working experience:	Less than 5 years	6	22.22
		5-15years	8	29.63
		Above 15years	13	41.15
			27	

The frequency and percentage analysis were carried out, and the results were presented in Table 1 in appendix 1. The results on Gender Distribution shows 22 Males representing 78.57% of total respondents while Female are 5 representing 18.52% of total respondents. The Age Profile shows 4 respondents Under 30 years representing 14.82% of total respondents, 21 respondents are under 30 to 50 years representing 77.78% of total respondents while 3 respondents are above 51 years representing 7.41% of total respondents. On the Professional Background of respondents, 4 respondents are Architects representing 14.82% of total respondents, 4 respondents are Quantity Surveyors representing 14.82% of total respondents, 3 respondents are Civil Engineers representing

11.11% of total respondents, 5 respondents are Electrical Engineers representing 18.52% of total respondents while 4 respondents are Mechanical Engineers representing 14.82% of total respondents and finally, 7 respondents are Builders representing 25.93% of total respondents. The next item is the Educational Qualifications of respondents where Diploma had 0% with none of the respondents in that category, 24 respondents have Degree/HND representing 88.89% of total respondents while 3 respondents have Master's degree and above representing 11.11% of total respondents. Finally, the Years of Experience of respondents as analyzed where 6 respondents have Less than 5 years of experience, representing 22.22% of total respondents, 8 respondents have 5-15 years of experience, representing 29.63% of total respondents while 13 respondents have above 15 years working experience, representing 41.15% of total respondents respectively.

The overwhelming majority of male respondents suggests a significant gender gap in the construction and engineering fields within Bauchi, Nigeria. Such a disparity could reflect broader societal norms and practices that may discourage female participation in traditionally male-dominated sectors. This imbalance can affect discussions surrounding quality control practices, as the experiences and challenges faced might not fully represent the perspectives of all stakeholders. The findings also indicate a need for initiatives aimed at fostering gender inclusivity in construction projects, which may enhance overall project performance and lead to innovative solutions. The age distribution shows that the majority of respondents (77.78%) are within the 30 to 50 years range, indicating a workforce that possesses significant experience and professional maturity. This demographic likely has practical insights into the effectiveness of quality control practices. However, the low representation of younger professionals (under 30) suggests potential missed opportunities for integrating innovative ideas and modern practices that younger entrants might bring. This could signal a need for mentorship programs that engage both seasoned professionals and younger workers to foster knowledge transfer. The sample includes a range of professionals involved in construction, with builders representing the largest group. This diversity enriches the data by incorporating multiple perspectives relevant to quality control practices. However, the sample may lean heavily towards professionals most involved in execution (builders) rather than strategic oversight (architects or quantity surveyors).

The findings from the demographic data provide a comprehensive view of the current workforce involved in quality control practices for State Universal Basic Education construction projects in Bauchi, Nigeria. The demographic profile reflects a predominantly male and experienced workforce. This presents both strengths (in terms of expertise) and weaknesses (in terms of inclusivity). The apparent lack of gender diversity could mean that the experiences of women, who may face unique challenges in construction, could be underrepresented in the analysis of quality control practices. The educational qualifications suggest that most professionals possess a solid academic foundation, which could enhance their approach to quality control. However, the absence of respondents with diplomas

indicates potential barriers for individuals with less formal education to participate in these discussions.

The reliability of the data collection instrument was tested, yielding Cronbach's Alpha values of 0.813, 0.802, and 0.882 across various constructs, all exceeding the acceptable threshold of 0.70.

Table 2: Reliability of Field Results

Constructs	Cronbach's Alpha	N of Items
Quality Control Practices	.813	13
Quality Control Practices Effectiveness	.802	13
Challenges of quality control practices	.882	17

Descriptive statistic based on the mean ranking was carried out to explore the challenges in the implementation of quality control practices in SUBEB construction projects. The results in Table 3 showed the ranking, mean standard deviation and remark for each item. Table 1 presents the challenges in the implementation of quality control practices in the construction process, where Incomplete drawing and detailed design, Client Interference, and Inadequate consultant experience constitute the highest mean of 3.3269, 3.2885 and 2.9936, respectively. The least was the Change orders which constitute the mean of 2.1410. Therefore, this analysis indicates that incomplete drawing and detailed design, Client Interference, and Inadequate consultant experience have the highest mean value, while Change orders have the least mean value.

Table 3: Challenges in the Implementation of quality control Practices

Challenges of quality control practices	Mean	Std. Deviation	Ranking
Incomplete drawing and detailed design	3.3269	1.09641	1
Client Interference	3.2885	1.08960	2
Inadequate consultant experience	2.9936	1.18864	3
Inappropriate supervisory structure or culture of the firm for implementing QC	2.8846	1.08931	4
Lack of involvement and commitment of top Management	2.8846	1.14701	5
Lack of experience of client in construction	2.7949	1.08192	6
Unrealistic contract duration & requirements	2.7115	1.08366	7
Lack of proper training and Preparation	2.6346	1.12500	8
Shortage of skilled workers	2.6026	1.07571	9
Poor site management and supervision	2.4872	1.08650	10
Changes in drawing	2.4808	1.15547	11
Problem with sub-contractors	2.4679	1.19364	12
Contractor's financial difficulties	2.4295	1.11362	13
Poor planning	2.4103	1.21746	14
Inappropriate reward system	2.3269	1.27083	15
Change orders	2.1410	.98668	16

Multiple regression was carried out to assess the effects of control practice types and militating challenges on the effectiveness of the quality control practices. The r square value in Table 4. shows how much of the variance in the dependent variable effectiveness of the quality control practice is explained by the independent variables of control practice types and militating challenges. In this case, the value was $r^2=.251$, $f = 25.663$, $p < 0.001$. This means that the independent variables of control practice types and militating challenges explained a 25.1% large effect size in reconstruction projects' success, with significance at $p<0.001$.

Table 4: Effects of control practice types and militating challenges on the effectiveness of quality control processes in construction projects

Model Summary ^b							
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Df	F	Sig.
1	.501 ^a	.251	.241	.51763	2 153	25.663	.000 ^b

a. Predictors: (Constant), Control practices types, Challenges

b. Dependent Variable: Effectiveness of the quality control practices

However, further result is required to demonstrate the individual effects of control practices types and militating challenges on the effectiveness of the quality control practice. Table 4 indicates that the variable with the largest beta value in the standardized coefficients is .485 for Control practice types. It further shows that the Control practice types variable is making a statistically significant ($p<0.001$) unique contribution to the equation. In contrast, the Challenges variable has the lowest negative beta value of .028 and an insignificant ($p=.741$) contribution in explaining the dependent variable effectiveness of the quality control practice.

Table 5: Effects of individual control practice types and militating challenges on the effectiveness of the quality control practices in SUBEB construction projects

coefficients'						
Model		Unstandardized Coefficients		Standardised Coefficients	T	Sig.
		B	Std. Error	Beta		
	(Constant)	1.348	.218		6.198	.000
	Control practice types	.539	.094	.485	5.725	.000
	Challenges	.025	.074	.028	.331	.741

Table 5 presents Effects of individual control practice types and militating challenges on the effectiveness of quality control processes in construction projects. The analysis in Table 5 shows that Control practices types and militating challenges have the largest and lowest mean values, respectively. This is likely because these factors are important in determining the effectiveness of the quality control practice. Control practice types have a larger beta value than Challenges, which indicates that they are more important in determining the success of a reconstruction project. In contrast, Challenges have the lowest negative beta value, which indicates that it is less important in determining the success of a reconstruction project. Overall, the results of this analysis suggest that using control practices types and militating challenges can help to improve the effectiveness of the quality control practice.

Discussion of Findings

The results of this analysis showed that incomplete drawing and detailed design, Client Interference, and Inadequate consultant experience have the highest mean value. This is likely because these factors can lead to delays and/or errors in the construction project. On the other hand, change orders have less mean value because they are not as important in causing delays or problems in the construction process. Overall, this analysis suggests that using these specific tools can help minimize delays and problems in the construction process. The challenges identified reflect the complexities and dynamics involved in implementing quality control practices in the construction sector. The prominence of "incomplete drawing and detailed design" as the top challenge signifies a systemic issue within the construction project lifecycle.

Further emphasizing the critical nature of design accuracy (Parekh, 2024). Lee, Chai, Bujna, Fauzi and Boo (2024) discussed how incomplete designs compromise the construction process, leading significantly to waste and rework. To address this, stakeholders could benefit from investing in improved design practices and reliance on digital modeling practices such as Building Information Modeling (BIM) to minimize ambiguities (Tsay, 2024). Client interference as a second primary challenge highlights the need for clear communication and actionable boundaries in client relationships. Client engagement must be managed to ensure projects remain on track without undue influence that undermines quality assurance processes (Chinyio & Opoku-Ohemeng, 2023). Hence, developing comprehensive stakeholder management frameworks could mitigate these interferences and enhance overall project outcomes (Iroha, Watanabe & Satoshi, 2024). The remaining challenges, while comparatively ranked lower, still represent significant issues. Lack of training, inadequate management experience, and poor site supervision can accumulate to create a broader environment hostile to quality control practices. Studies by Alawag, Alaloul, Liew, Baarimah, Musarat and Al-Mekhlafi (2023) emphasized the critical role of management capability in effectively implementing QC processes and highlight the importance of proper training and preparation to ensure that all stakeholders are equipped to engage in quality assurance effectively.

The findings from the regression analysis suggest several key aspects regarding the effectiveness of quality control practices in the study area. The R Square value of 0.251 indicates that while quality control practices and militating challenges have some explanatory power regarding the effectiveness of quality control, a majority of influences are likely derived from other factors. For instance, environmental variables, organizational culture, and the specific project context can significantly impact quality efficacy. Research by Zhang, Liu, Li, Xiahou and Li (2024) highlights the importance of contextual factors, emphasizing that facility infrastructure, organizational maturity, and external stakeholder relationships can play critical roles in determining quality control effectiveness. The findings support the notion that various control practice types (preventative, diagnostic, and corrective controls) are fundamental in establishing a quality-focused environment. As supported by Handoyo, Suharman, Ghani and Soedarsono (2023) effective control practices can lead to enhanced operational performance. This reinforces the need for constructing comprehensive frameworks that balance varying control types according to the demands of specific projects.

The presence of challenges affecting the implementation of quality control practices cannot be overstated based on the statistical significance of the F-value. Organizations often face systemic barriers such as inadequate training, poor communication, and interruptions from client-side interventions, similar to findings by Yap, Lam, Skitmore and Talebian (2022). These challenges from the study suggest a complex interplay that may often require addressing foundational operational and managerial deficiencies alongside implementing robust quality control practices to enhance effectiveness. Given that over 74.9% of the variability in the effectiveness of quality control practices remains unexplained, future research endeavours should broaden the scope of variables considered for analysis. Including qualitative measures, practitioner insights, and wider contextual factors could provide a more holistic understanding of what drives quality control efficacy in construction and other relevant field (Harris, McCaffer, Baldwin & Edum-Fotwe, 2021).

On the Effects of individual control practice types and militating challenges on the effectiveness of the quality control practices in SUBEB construction projects, the results present a clear picture regarding the impact of control practices and challenges on the effectiveness of quality control processes in construction projects. The strong positive coefficient for control practices types reveals their foundational role in enhancing the effectiveness of quality control processes. This underscores the necessity for construction companies to invest in and implement various types of control practices such as inspections, audits, and training programs to facilitate quality assurance. Zhang and Li (2024) also emphasized that the effective deployment of control practices correlates strongly with improved construction quality, reaffirming the practical implications of these results. The lack of a significant effect from challenges suggests that while challenges exist, their direct influence on quality control effectiveness may not be as substantial as previously thought. It indicates that organizations can navigate through difficult conditions when they have

established effective control practices. Pertheban, Thurasamy, Marimuthu, Venkatachalam, Annamalah, Paraman and Hoo (2023) noted that organizations with proactive management in place can effectively mitigate the negative influences that challenges might pose, which resonates with our findings that highlight the importance of control systems over external challenges.

The findings emphasize the need for a holistic quality control approach that prioritizes the development and implementation of robust control practices over simply addressing challenges. This aligns with Sahito, Soomro and Pelsier (2023) principles of total quality management, which advocate for a strong focus on systemic processes and continuous improvement rather than just reacting to challenges. Organizations involved in construction projects should consider prioritizing their quality control strategies by investing in quality management systems, staff training, and the development of comprehensive oversight processes. Addressing systemic variables that bolster control practices will facilitate a more resilient quality assurance framework (Zarghami & Zwikael, 2024).

Conclusion

Based on the comprehensive examination carried out in this research, the discoveries directly address the research goals of appraising the hurdles working against the successful execution of quality control practices in SUBEB construction projects in Bauchi State and evaluating their effects on overall quality results. The outcomes show that systemic challenges such as incomplete blue prints, client interference, and insufficient consultant expertise are amongst the most considerable barriers to effective quality control, correlating with the initial research question. Furthermore, the regression analysis suggests that control practices—like inspections, audits, and management commitment—have a notable positive influence on the effectiveness of quality assurance, while challenges, though present, have a comparatively smaller direct impact. These insights confirm that reinforcing control practices can mitigate the adverse effects of existing challenges, thus improving project quality.

The study's findings have important ramifications for policy and practice. For policymakers and construction stakeholders, prioritizing the creation of clear, detailed design documentation, promoting effective stakeholder communication, and investing in capacity-building for project staff are essential steps toward improving quality outcomes. In addition, systems and promoting organizational cultures that support continual quality improvement can significantly elevate construction standards for educational facilities. Such measures will not only enhance project delivery but also contribute to the building of safe, durable, and standards-compliant educational infrastructure that benefits students and the wider community.

Looking forward, future research could examine the integration of digital technologies such as Building Information Modeling (BIM) and real-time monitoring systems to proactively

tackle design ambiguities and boost process control. Pilot programs could test the effectiveness of thorough training modules for project managers and site supervisors, concentrating on advanced quality management techniques. Moreover, longitudinal studies assessing the impact of policy interventions aimed at reducing client interference and refining design accuracy could provide deeper insights into lasting improvements in quality assurance practices within the construction sector in Bauchi and similar settings. These initiatives would provide valuable practical frameworks for elevating construction quality standards in Nigeria's educational infrastructure development.

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