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Exploring the Implementation, Challenges and Opportunities of Life Cycle Costing as a Financial Risk Mitigation Strategy in Nigeria Construction Industry

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ABSTRACT

Life Cycle Costing is a vital tool for estimating building project costs, including construction, usage, maintenance, and end-of-life. It provides insights into long-term costs and savings, and allows for SWOT analysis. The construction industry, which contributes to Nigeria's GDP, faces risks and uncertainties. Despite these challenges, construction contractors have been slow to implement proper management methods, leading to business failures and liabilities. Life Cycle Management (LCM) aims to minimize environmental impacts of products and services throughout their life cycle. This research evaluates the implementation of LCM in Abuja, Nigeria, focusing on external and internal risks such as design errors, material waste, poor time management, administrative lapses, and reckless expenditure. Effective communication and project risk management are crucial for achieving project performance, time, cost, quality, safety, and environmental sustainability objectives. The study explores the implementation of Life Cycle Costing (LCC) in Abuja, FCT, using field surveys, interviews, and questionnaires. It includes registered construction professionals with ten years of experience. Findings revealed that the level of awareness of LCC as a risk assessment method in building construction projects was found to be 35%, 24%, and 21%, indicating a level of awareness among construction stakeholders in Nigeria. However, the majority of respondents were dissatisfied with the implementation of LCC, attributed to factors such as poor knowledge and technical know-how. The study found that the implementation of LCC is significantly related to the successful management of building projects in Abuja, FCT. The barriers against LCC adoption did not have a significant influence on the financial risk management of the building projects in Abuja. The F-statistic results were statistically significant (0.05), rejecting the null hypothesis that all regression coefficients are zero. The model is accepted, indicating that barriers against LCC adoption significantly influence financial risk management in projects. The Nigerian construction industry should adopt life cycle costing (LCC) as a financial risk mitigation strategy, involving education, data management, capacity building, regulatory support, stakeholder collaboration, standardization, incentives, and continuous improvement.

Keywords: Building projects, LCC adoption, Life cycle, Risks, Mitigation strategies

INTRODUCTION

Life Cycle Costing is a crucial tool for determining the costs associated with a building project, including construction, usage, maintenance, and end-of-life. It provides insight into long-term costs and savings associated with a building project and allows for comparison of design alternatives through SWOT analyses. The construction industry, which contributes to approximately 8.74% of Nigeria's GDP, faces risks and uncertainties due to various external and internal factors [1]. Despite these challenges, construction contractors have been slow in applying proper management methods, leading to business failures and liabilities. Factors contributing to this slow progress include unique construction projects, non-repetitive skills, local conditions, and small operations. Risk management should be started at the beginning of a project's life cycle, taking into account stakeholder participation [2]. Life Cycle Management (LCM) is an umbrella concept that aims to minimize environmental impacts of products and services over their life cycle. However, project risk management in Nigeria remains a critical issue, with most construction companies still facing this issue. This research aims to evaluate the implementation of life cycle costing as a financial risk assessment and management strategy in building projects in Abuja, Nigeria. In conclusion, life

cycle costing is essential for assessing and managing the costs associated with construction projects, particularly in developing countries like Nigeria [3]. By implementing effective management practices and addressing the unique challenges faced by construction companies, the industry can improve productivity and contribute positively to the overall economy.

The Nigerian construction industry faces numerous challenges, including inadequate human, material, and equipment resources development, poor implementation of uniform regulations, and poor-quality delivery in public and private projects [4]. These factors contribute to high costs from construction to usage. The construction industry is known for time and cost overruns, but it is also one of the riskiest business types globally. In Nigeria, the industry has faced increased competition, reduced demand, and a shortage of orders, leading to increased pressure to improve quality, productivity, and reduce costs. The concept of risk management in the Nigerian construction industry is relatively new, leading to poor project objectives, poor cost estimates, and adversarial relationships between contractors and clients. Despite the benefits of Life Cycle Costing, the Nigerian construction industry, particularly Abuja, has not implemented it to a reasonable extent [5, 6]. This research aims to explore the implementation challenges and opportunities associated with integrating life cycle costing as a financial risk mitigation strategy within the construction industry of Nigeria, with a focus on identifying barriers, evaluating current practices, and proposing recommendations for enhancing the adoption and effectiveness of this approach.

LITERATURE REVIEW

Risk in construction projects

Risk and uncertainty are interrelated concepts in project management literature, with risks being uncertainties or conditions that can have both positive and negative impacts on project deliverables [7]. Risk is defined as the probability of occurrence of uncertain, unpredictable, and undesirable events that could change the profitability of a given investment. Risk is the triple characteristic of any project decision in the situation of uncertainty, consisting of risk event (A), risk probability (P), and function of risk losses (u) [8]. Risks are interrelated to uncertainty, which are events with unknown probability of occurrence. Uncertainties are situations with little knowledge about the extent of their occurrence and only the possibility that it might occur. Uncertainty in construction industries is one of the most important risk factors in projects, as it can be a random event or event with unknown probability. The relationship between risk and uncertainty can be described as a measurable risk of uncertainty, while uncertainty is the greatest risk. Risk is an uncertainty that is important and intended for specific purposes, with the meaning intended for specific purposes [9, 10]. Risks in construction projects can be categorized into external and internal risks. Internal risks include design errors, waste of materials, poor time management, administrative lapses, and reckless expenditure. External risks include unawareness of socio-economic and political conditions, unknown procedural formalities, and regulatory frameworks [11]. Risk assessment can be qualitative or quantitative, with qualitative methods like interviews and brainstorming being used. Risks can be categorized based on project-specific and non-project-specific factors. The project team must define the boundaries of risk events and break them down into independent elements. Examples of typical risks in construction projects include accidents, design failures, delays, price fluctuations, budget exceeding limits, force majeure conditions, and failure to meet quality standards. Dynamic and static risks are also important to consider. Dynamic risk involves making opportunities, while static risk focuses on potential losses. Unsystematic and arbitrary management of risks can endanger the project's success, as most risks are dynamic throughout the project lifetime [12]. Risk management in the construction industry involves a five-stage process, starting with a definition phase to establish the context and objectives for the project. The main risk management process includes identification and classification of sources of risk, analysis of risk assessments, development of a risk management response, and monitoring and control [13, 14]. Risk management practices include identifying, evaluating, and prioritizing risks, followed by coordinated and economical application of resources to minimize, monitor, and control the probability or impact of unfortunate events or maximize the realization of opportunities. The impact of risk management on construction performance is significant, as it directly impacts project success, planned budget, schedule time, and compliance with technical specifications. Minimizing risks in projects improves project output, cost, time, and quality. As the size and complexity of projects increase, managing risks throughout the construction process has become a central element preventing unwanted consequences [15]. Various methods of risk analysis are used, including qualitative, quantitative, direct judgment, ranking options, comparative options, descriptive analysis, probability analysis, sensitivity analysis, scenario analysis, and simulation analysis. Qualitative risk analysis involves identifying a hierarchy of risks, their scope, factors that cause them to occur, and potential dependencies. The management team assesses each identified risk for its probability of occurring and its impact on project objectives [16]. Components of risk analysis include listing activities, tasks, risk factors, developing risk-ranking scales, ranking risks for each activity, and documenting results and identifying potential risk-reduction actions. Effective communication and project risk management are essential for achieving better project performance and achieving project time, cost, quality, safety, and environmental sustainability objectives [17]. Quantitative risk analysis is a method used to estimate the probability of a project meeting its cost and time objectives. It evaluates the impact of identified and quantified risks, resulting in a

probability distribution of the project's cost and completion date. Quantitative methods are preferred by most analysts due to their objective results and ability to consider the range of possible values for key variables. This method uses statistical techniques and specialized software, identifying the severity of each factor [18].

Life cycle costing in construction

Life Cycle Cost (LCC) is a concept that refers to the systematic consideration of all costs, revenues, and performance associated with the acquisition and ownership of an asset over its physical, economic, functional, service, and design life. It helps minimize total expenditure and optimizes the whole life performance of buildings and other structures [19]. LCC is crucial in construction projects as it helps make economic decisions on investments and determines whether a project meets client performance requirements. Maintenance and running costs are significant, accounting for 90% of the total project cost, and overlooking them could detriment the client and the professional competence of the design and construction teams. Life Cycle Costing (LCC) is a modeling technique that focuses on the capital and running costs of buildings and their impact on ownership. It analyzes the effect of using different materials, finishes, and equipment over time, as well as running costs such as water, energy, electricity, heating, and air conditioning [20]. LCC also considers the future value of money. It is used to enhance a building project's sustainability credentials by considering issues related to energy use and maintenance costs of different design alternatives.

Opportunities and challenges in LCC

The LCC model is an accounting structure containing terms and factors that enable estimation of an asset's component costs. It should represent the characteristics of the asset being analyzed, be comprehensive enough to include relevant factors, be easily understood for timely decision-making, future updates, and modification, and provide for the evaluation of specific LCC elements. The LCC process involves assessing costs arising from an asset over its life cycle and evaluating alternatives that impact this cost of ownership [21]. The most suitable approach for LCC in the construction industry is the Net Present Value (NPV) method. Existing mathematical LCC models based on NPV have various advantages and disadvantages, such as distinguishing between energy and other running costs. In conclusion, LCC is a popular technique for evaluating the total design life costs of components or materials in a building project. It helps organizations make informed decisions about the long-term design life of their assets and ensures that the finished built environment project meets the requirements of end-users. The Nigerian construction industry is exploring the use of life cycle costing (LCC) as a financial risk mitigation strategy. LCC involves assessing the total cost of ownership of a construction project over its entire life span, including acquisition, operation, maintenance, and disposal costs [22]. However, the adoption faces challenges such as lack of awareness and education among stakeholders, limited data availability, a short-term focus on cost minimization, complexity of analysis, and resistance to change. The lack of standardized methodologies and guidelines can hinder accurate cost estimations, and the industry's preference for cheaper initial investments may also hinder the adoption of LCC. Despite these challenges, LCC offers valuable insights into long-term financial implications [23]. Life cycle costing (LCC) is a financial risk mitigation strategy that can lead to long-term cost savings, improved risk management, enhanced sustainability, improved decision-making, and a competitive advantage in the Nigerian construction industry. By considering all lifecycle costs upfront, stakeholders can make informed decisions that minimize operational and maintenance expenses. LCC also helps identify potential cost drivers and uncertainties throughout the project's lifecycle, reducing the likelihood of cost overruns and financial setbacks [24]. It encourages sustainable practices and materials, aligning with global trends towards sustainable development and green construction. Adopting LCC can also provide a competitive edge by demonstrating commitment to financial prudence, sustainability, and risk management, attracting clients who prioritize long-term value and reliability in construction projects.

METHODOLOGY

The study combines field surveys, interviews, and questionnaires to gather data on the implementation of Life Cycle Costing (LCC) in building projects in Abuja, FCT. The data needed includes biometric, environmental, socio-economic, feasibility studies, geographic, cost analysis, financial management, and construction management data. The primary data sources include respondents' experiences with LCC implementation, key risk factors affecting LCC, barriers preventing LCC adoption, and effective strategies for financial risk management. Secondary sources include published and unpublished materials and the internet. Data collection instruments include direct observation, oral interviews, and questionnaire administration. The study's population consisted of registered professional bodies with a minimum of ten years of experience in the construction industry. The researchers determined the sample size, sample frame, and sampling technique to ensure a representative sample of professionals with a minimum of ten years of experience. The study aims to determine the sample size of Registered Construction Professionals in Abuja, FCT, who have a minimum of ten years of experience in the construction industry. The sample frame includes registered professionals from the Nigerian Institute of Building (NIOB), Nigerian Institute of Architects (NIA), Nigeria Institute of Quantity Surveyors (NIQS), Nigeria Institute of Surveyors (NIS), Nigeria Institute of Estate Surveyor and Valuers (NIESV), Civil/Structural Engineers/Contractors (463), and Nigerian Institute of Town

Planners (NITP). The researchers used a stratified random sampling technique to sample 283 out of a total of 974 professionals. The sample size was calculated using the Yaro Yamani formula, which gives a margin of error of (0.05)2 or (0.0025). The researchers used a well-structured questionnaire to collect data.

DATA ANALYSIS

The study investigates the implementation of Life Cycle Costing (LCC) in Abuja, Federal Capital Territory. Out of 283 distributed questionnaires, 244 were retrieved, with 86% completed and returned. The remaining 14% were not retrieved. The total sample size was 283, representing the entire investigation as shown in table 1.

Table 1: Response of respondents

Questionnaires	Frequency (F)	Percentages (%)
Questionnaires Retrieved	244	86%
Questionnaires Not Retrieved	39	14%
Total Sampled Questionnaires	**283**	**100%**

The table shows a high response rate from respondents, indicating significant interest in the investigation, contributing to the reliability and validity of the study's findings.

Years of Experience of Practicing in your Profession

The study reveals that 4% of respondents have over 40 years of experience, indicating their ability to provide accurate life cycle costing information in the building construction industries.

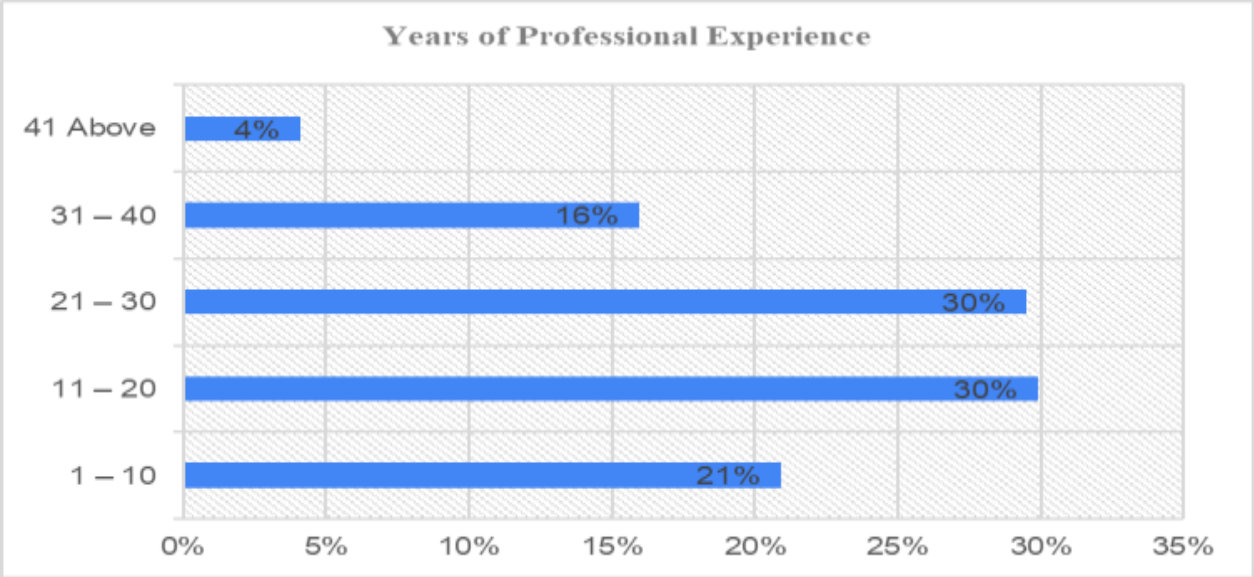

Fig. 1 – years of experience of the respondents

Level of Awareness of Life Cycle Costing as a Method of Risk Assessment in Building Construction Project in FCT.

Figure 2 study reveals that 35% of respondents in FCT were slightly aware of life cycle costing as a risk assessment method in building construction projects, while 24% were moderately aware, 21% somewhat aware, and 10% and 9% were not at all aware.

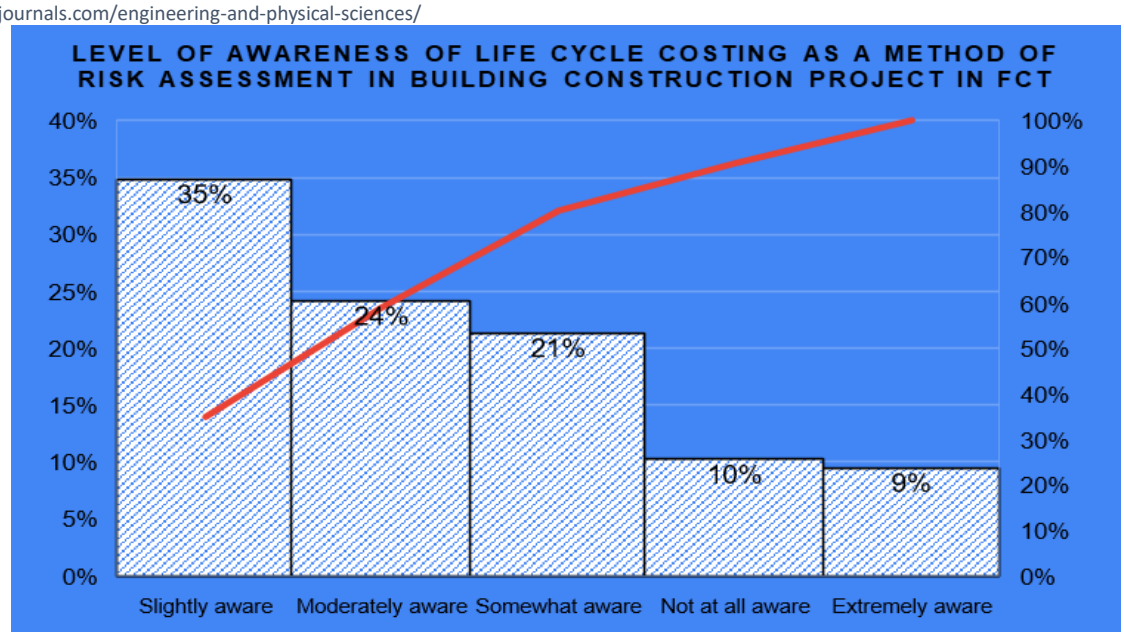

Fig 2. Level of Awareness of Life Cycle Costing as a risk mitigation measure

The overall analysis indicates that 35%, 24%, and 21% were aware of LCC as a risk assessment method in building construction projects. This collaborate the previous work by [26, 27] showing that there are levels of awareness of life cycle costing among the construction stakeholders in Nigeria construction industry.

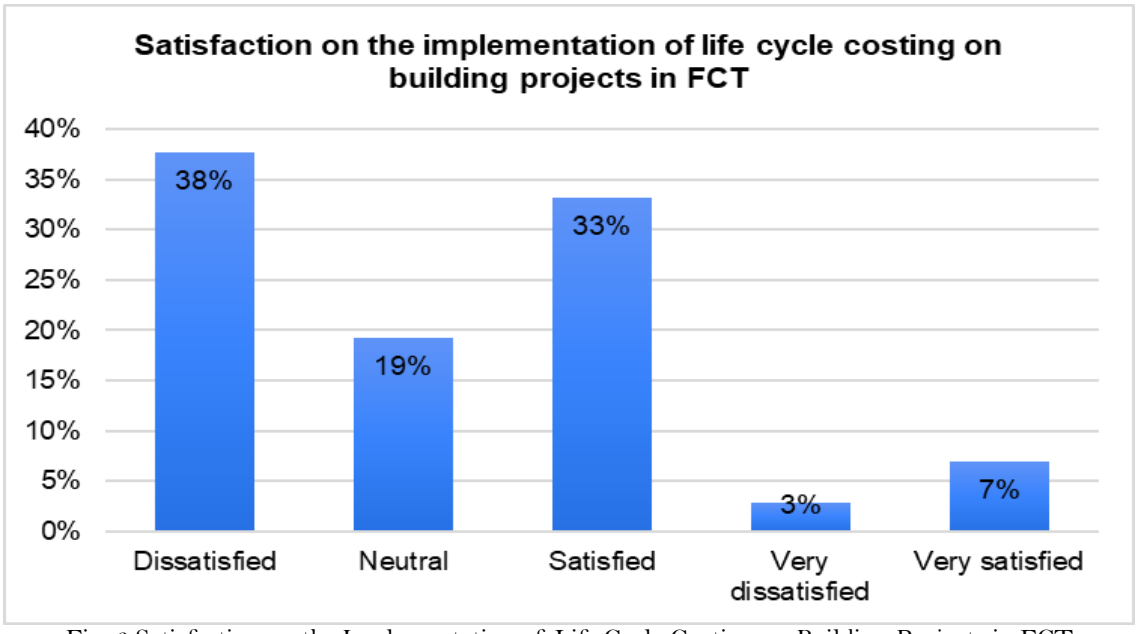

Fig. 3 Satisfaction on the Implementation of Life Cycle Costing on Building Projects in FCT

Figure 3 shows that 38% were dissatisfied with the level of LCC implementation, 19% reported neutral, 33% reported satisfied while 3% and 7% reported very dissatisfied and very satisfied respectively. Thus, majority of the respondents were dissatisfied with the implementation of life cycle costing on building projects in FCT as respondent indicated 38%. The level of dissatisfaction is clear due to several factors such as poor knowledge and technical know how as opined by [28,29]. The significant of Implementation of Life cycle costing to the successful management of building projects in Abuja, FCT.

Table 2: showing Analysis Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.627[a]	.393	.390	1.05286

Table 3: Showing ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	173.544	1	173.544	156.555	.000[b]
	Residual	268.260	242	1.109		
	Total	441.803	243			

Table 2-3 shows the Sig. F (0.000) is less than the alpha level required is 0.005. The null hypothesis (H_o1): Life cycle costing has no significant relationship with the implementation of building projects in Abuja, FCT is rejected and the Alternate Hypothesis (H_a1): Implementation of Life cycle costing is statically significantly related to the successful management of building projects in Abuja, FCT as affirmed by [30].

The barriers militating against the adoption of Life Cycle Costing (LCC) do not have significant influence on the financial risk management of the building projects in Abuja.

Table 4: showing Regression Model on barriers to adopting LCC

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.590[a]	.348	.345	.47991

Table 5: showing ANOVA of barrier

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29.751	1	29.751	129.177	.000[b]
	Residual	55.736	242	.230		
	Total	85.487	243			

The F-statistic results in Table 4-5 are statistically significant, with a p-value close to 0.000, rejecting the null hypothesis that all regression coefficients are zero. This indicates that at least one independent variable is related to the dependent variable. The hypothesis (H0.3) that barriers against the adoption of Life Cycle Costing (LCC) have a significant influence on the adoption of LCC in building construction projects in FCT, Abuja is rejected, as the Sig F. is less than the alpha (0.05). Therefore, the model is accepted, indicating that barriers against LCC adoption significantly influence financial risk management in Abuja building projects.

CONCLUSION

The Nigerian construction industry is exploring the use of life cycle costing (LCC) as a financial risk mitigation strategy. Despite challenges like lack of awareness, limited data availability, and resistance to change, LCC offers numerous benefits such as long-term cost savings, risk mitigation, sustainability, improved decision-making, and competitive advantage. To fully harness the potential of LCC, stakeholders should address these challenges through awareness campaigns, data management improvements, and industry-wide collaboration. This approach can drive positive change in the Nigerian construction sector, ensuring the industry's long-term success. The research recommends that The Nigerian construction industry should adopt life cycle costing (LCC) as a financial risk mitigation strategy, involving education, data management, capacity building, regulatory support, stakeholder collaboration, standardization, incentives, and continuous improvement to ensure long-term value creation and mitigate financial risks.

Contribution to knowledge

The study examines life cycle costing (LCC) implementation in Nigeria's construction industry, identifying challenges and opportunities, providing recommendations for improvement, and highlighting potential benefits like cost savings and sustainability enhancements, while addressing knowledge gaps.

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