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# IMPACT OF INFORMATION TECHNOLOGY AND DIGITALIZATION OF PROJECT MANAGEMENT EFFECTIVENESS IN ROAD CONSTRUCTION IN SOUTH EAST, NIGERIA

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**Abstract:** This study examines the impact of information technology (IT) and digitalization on project management effectiveness in road construction projects in Southeast Nigeria, specifically in Enugu State. The research focuses on understanding how IT tools and digitalization influence cost overruns and project efficiency. A survey research design was employed, utilizing a quantitative approach with a self-structured questionnaire. The questionnaire was distributed to professionals directly involved in road construction projects, including civil engineers, quantity surveyors, and project managers from Reynolds Construction Company Nigeria Limited, Arab Contractors, and Hapel Nigeria Limited. The study used multiple regression analysis to investigate the factors contributing to cost overruns, including inaccurate cost estimation, scope changes, and poor project management practices, which together explained 80% of the variance in cost overrun occurrences. The findings highlight that digitalized cost control techniques, such as Cash Flow Analysis (CFA), significantly improved financial management and reduced cost overruns. The study also underscores the importance of adopting modern IT tools to enhance cost estimation accuracy, project scope management, and overall project delivery efficiency. The research concludes with recommendations for construction companies to invest in IT training, implement robust project management practices, and adopt advanced cost control tools to mitigate cost overruns and enhance project outcomes. The study emphasizes the need for a strategic shift in the construction industry, particularly in Enugu State, to address challenges like fluctuating raw material prices and poor management practices using digital solutions.

**Keywords:** Information Technology, Digitalization, Project Management, Cost Overruns, Road Construction & Cost Control Techniques.

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## NTRODUCTION

### 1.1 Background of the Study

Road infrastructure development is a cornerstone of economic growth and social progress in any region or nation. It serves as the lifeblood of transportation, facilitating the movement of goods, services, and people, while also connecting communities and enabling access to essential services. The construction industry is one of the most active sectors propelling the Nigerian economy (World Bank, 2021). It is so vital to the nation's economic development which is why it produces nearly 71% of the country's fixed capital formation and accounts for 1.4% of the nation's Gross Domestic Product (GDP) (World Bank, 2021). In Nigeria, a country grappling with infrastructural deficits and burgeoning population pressures, Oladinrin, Ogunsemi, and Aje (2012) take the firm view that the construction and maintenance of roads are of paramount importance for sustainable development. However, the road construction sector in Nigeria faces myriad challenges that impede its effectiveness and efficiency. Among these challenges, cost overruns, delays, and subpar quality stand out as pervasive issues that plague road construction projects across the country. Despite substantial investments in infrastructure development, projects frequently exceed their budgets, suffer from delays, and fail to meet quality standards, leading to significant socio-economic costs and diminishing returns on investment. Ling and Ang (2013) along with Aljohani, Ahiaga-Dagbui and Moore (2017), highlighted the distinctive nature of the construction industry, emphasizing its project-oriented structure, complexity, and inherent uncertainty. This unique aspect has contributed to a higher failure rate compared to other business organizations. Effective cost control mechanisms are indispensable for mitigating these challenges and ensuring the successful delivery of road construction projects. Sanni and Hashim (2013) and Adjei, Aigbavboa and Thala (2015) presumed that ″cost control is a component of financial control since it complements administrative control measure in the organization″. According to Adjei, Aigbavboa and Didibhuku (2018), cost control practice is a process whereby the cost of the construction project is monitored, evaluated and compares the planned budgeted cost with the actual site cost for decisions to be made to bring the cost on track. Opatunji (2018) establish the cost control techniques used among construction Practitioners such as Budgetary control, Cash flow analysis, earned value management, Cost reduction on site, Material management, Risk analysis, Cost planning, Work programmes, Valuation of work in progress few among others. The need to control cost is significant to wipe out the superfluous wastages of resources. It remains fundamental for the construction company to work a successful cost control technique throughout the implementation phase of project to retain the cost of the plan inside the construction preliminary estimates. According to Ademola (2012), by managing costs effectively, project stakeholders can optimize resource allocation, minimize financial risks, and enhance project outcomes. Moreover, robust cost control practices contribute to greater transparency, accountability, and public trust in the management of public funds, fostering an environment conducive to sustainable development and economic prosperity.

In the context of Enugu State, Nigeria, the imperative for strategic cost control mechanisms in road construction projects is particularly pronounced. Enugu State, located in the southeastern region of Nigeria, serves as a vital economic and commercial hub, with a diverse array of industries and vibrant urban centers. However, inadequate infrastructure, including roads, hampers the state's growth potential and constrains its ability to attract investment and foster socio-economic development. Reynolds Construction Company (RCC) Nigeria

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Limited and Arab Contractors are two prominent expatriate players in the Nigerian construction industry, with extensive experience in infrastructure development, including road construction projects. Hapel Nigeria Limited (HNL) is one of the foremost indigenous roads' construction companies in Nigeria with a standard measure for excellence, cost-effectiveness and innovation among indigenous roads construction firms in Nigeria. As key stakeholders in the sector, their practices and approaches to cost control significantly influence the outcomes of road construction projects in Enugu State and beyond. Therefore, understanding the cost control strategies employed by these companies and identifying areas for improvement is essential for enhancing the effectiveness and efficiency of road construction project delivery in the state.

Against this backdrop, this seminar paper endeavors to delve into the intricacies of cost control in road construction projects, with a specific focus on Enugu State, Nigeria. By conducting a comprehensive analysis of current practices, challenges, and opportunities in cost control, the study aims to formulate strategic recommendations and frameworks tailored to the unique context of Enugu State. Through empirical research, case studies, and stakeholder engagement, the Seminar paper seeks to generate actionable insights that can inform policy formulation, industry practices, and decision-making processes in the road construction sector. The importance of this seminar paper extends beyond academic inquiry, as its findings and recommendations have the potential to drive tangible improvements in infrastructure development, economic growth, and quality of life in Enugu State and Nigeria as a whole. By promoting effective cost control mechanisms, the research seeks to unlock new opportunities for sustainable development, enhance infrastructure resilience, and foster inclusive growth that benefits all segments of society.

**1.2 Statement of the Problem**

The construction and maintenance of road infrastructure are vital components of socio-economic development in any nation. As Nigeria is rapidly expanding in population and growing in urbanization, the demand for efficient transportation networks is ever-increasing. However, the road construction sector in Nigeria faces numerous challenges that impede its ability to meet this demand effectively. One of the most pressing issues confronting road construction projects in Nigeria, particularly in Enugu State, is the pervasive problem of cost overruns.

Cost overruns in road construction projects occur when the actual expenses incurred during project execution exceed the initial budget estimates (Anyanwu, 2013). These overruns can stem from a variety of factors, including inaccurate cost estimation, scope changes, unforeseen site conditions, inflation, and inadequate project management practices. Regardless of the underlying causes, cost overruns have significant implications for project stakeholders, the economy, and society at large.

Firstly, cost overruns strain project budgets and financial resources, leading to budgetary constraints and financial instability for project owners, contractors, and funding agencies. Sanni and Hasim (2013) stated that misallocation of financial resources can result in delays in project completion, as additional funds must be secured or reallocated to cover the excess costs. Moreover, cost overruns often lead to disputes between project stakeholders, further delaying project delivery and increasing overall project costs.

Secondly, cost overruns undermine the credibility and accountability of project management processes, eroding public trust in government institutions and project delivery mechanisms. Ekpung (2013) was of the view that when projects consistently exceed their budgets, stakeholders perceive inefficiency, incompetence, or even

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corruption in project management practices, leading to disillusionment and cynicism among the populace. This lack of trust can impede future infrastructure development initiatives, hinder public-private partnerships, and deter investment in critical infrastructure projects.

Thirdly, cost overruns have adverse socio-economic impacts on communities and society as a whole. Opatunji (2018) opined that delays in infrastructure projects result in disruptions to transportation networks, causing inconvenience to commuters, businesses, and residents. Moreover, the opportunity costs associated with delayed project completion are substantial, as the benefits of improved infrastructure, such as reduced travel times, enhanced safety, and increased economic productivity, are delayed or forgone entirely. In Enugu State, Nigeria, the problem of cost overruns in road construction projects is particularly acute, given the state's infrastructural deficits and growing population pressures. Despite significant investments in infrastructure development, road construction projects in Enugu State frequently experience cost overruns, delays, and quality issues, undermining the state's efforts to improve connectivity, spur economic growth, and enhance quality of life for its residents.

The consequences of cost overruns in road construction projects are multifaceted and far-reaching, encompassing financial, institutional, and socio-economic dimensions. Addressing this problem requires a comprehensive understanding of the underlying causes, as well as the development and implementation of targeted interventions and strategies to mitigate its impacts and prevent recurrence.

Therefore, the seminar problem at hand can be succinctly stated as follows: How can strategic cost control mechanisms be developed and implemented to effectively mitigate cost overruns in road construction projects in Enugu State, Nigeria, thereby enhancing project delivery efficiency, accountability, and socio-economic benefits for stakeholders and society at large? This Seminar seeks to explore this problem in depth, identify root causes, and propose actionable solutions to address the pervasive issue of cost overruns in road construction projects in Enugu State, Nigeria.

**1.3 Objectives of the Study**

The main objective of the study is to evaluate the impact of information technology and digitalization of project management effectiveness in road construction in south east, Nigeria. The specific objectives of the study are to:

i. analyze the current cost control mechanisms employed by RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in road construction projects in Enugu State.

ii. assess the effectiveness of strategic cost control in improving project delivery timelines and minimizing cost overruns.

iii. examine ways towards enhancing cost control practices in road construction projects in Enugu State.

**1.4 Research Questions**

i. What are the existing cost control mechanisms utilized by RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in road construction projects in Enugu State?

ii. How does strategic cost control contribute to improving project delivery timelines and minimizing cost overruns?

iii. In what ways can we enhance cost control practices in road construction projects in Enugu State?

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### 1.5 Statement of Hypotheses

i. There is significant relationship between cost control practices and occurrence of cost overrun in road construction projects by RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in Enugu State, Nigeria.

ii. There is significant impact of factors such as inaccurate cost estimation, scope changes, and poor project management practices on the occurrence of cost overruns in road construction projects in Enugu State, Nigeria.

### 1.6 Scope of the Study

This study focuses on examining the cost control practices implemented by Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in road construction projects within Enugu State, Nigeria. This study excludes cost control practices used by other Construction Companies in Enugu State and specifically targets Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited as the primary subjects of investigation. These companies represent prominent players in the construction industry and serve as case studies for assessing cost control mechanisms.

The study delves into various cost control techniques employed by RCC Nigeria Limited and Arab Contractors, including Cash Flow Analysis (CFA), Cost Value Reconciliation (CVR), Valuation of Work in Progress (VWP), Material Management (MM), Budgetary Control (BC), and Cost Planning (CP). The analysis examines the effectiveness of these techniques in managing project costs and mitigating cost overruns.

Additionally, the study explores factors contributing to cost overruns in road construction projects, such as inaccurate cost estimation, scope changes, and poor project management practices. By identifying these factors, the research aims to elucidate their impact on project outcomes and propose mitigation strategies.

Based on the findings, the study provides recommendations for enhancing cost control practices and mitigating the occurrence of cost overruns in road construction projects. These recommendations offer practical insights for industry practitioners, policymakers, and stakeholders to improve project delivery and optimize resource allocation.

## REVIEW OF RELATED LITERATURE

### 2.1 Conceptual Review

Cost control in the construction industry, particularly in road construction projects, is a fundamental aspect of project management aimed at ensuring that projects are completed within budgetary constraints while meeting quality standards and project objectives. This conceptual review provides a detailed exploration of key concepts, theories, and practices related to cost control in road construction projects, with a specific focus on the Nigerian construction industry.

### 1. Cost Estimation

According to the Project Management Body of Knowledge (PMBoK) (Project Management Institute, PMI, 2017), cost estimation is the process of forecasting project expenses based on various inputs such as project scope, design specifications, labor rates, material costs, and overhead expenses. In road construction projects, accurate cost estimation is essential for developing realistic project budgets, securing funding, and ensuring that resources are allocated effectively. Several methods and techniques are commonly used in cost estimation, including: Analogous Estimating, Parametric Estimating and Bottom-Up Estimating. In the Nigerian construction industry, cost estimation in road construction projects is complicated by factors such as fluctuating

material prices, currency devaluation, and uncertainties in project scope. Therefore, construction companies must employ a combination of estimation techniques and rely on historical data, expert judgment, and market analysis to develop accurate and reliable project budgets.

**2. Cost Monitoring**

Cost monitoring is the process of continuously tracking and analyzing project expenses to ensure that actual costs remain within budgetary constraints and to identify deviations from planned costs (Opatunji, 2018). Effective cost monitoring enables project stakeholders to detect cost overruns, assess their root causes, and implement corrective actions to mitigate financial risks and prevent budgetary variances. In road construction projects, cost monitoring involves: Real-Time Data Collection, Performance Analysis and Reporting and Communication.

Challenges in cost monitoring in the Nigerian construction industry include data accuracy, information overload, and integration issues. Construction companies must invest in robust monitoring systems, standardized reporting mechanisms, and data validation processes to overcome these challenges and ensure the effectiveness of cost monitoring efforts.

**3. Resource Optimization**

Resource optimization involves maximizing the efficiency and productivity of project resources, including labor, equipment, materials, and subcontractors, to minimize costs and enhance project outcomes. In road construction projects, resource optimization strategies focus on improving construction processes, streamlining workflows, and eliminating waste through techniques such as: Lean Construction, Value Engineering and Technology Adoption. (Malkoc, 2017). In the Nigerian construction industry, resource optimization is essential for overcoming challenges such as labor shortages, material shortages, and budget constraints. Construction companies must invest in training and development programs, adopt innovative construction technologies, and implement best practices to optimize resource utilization and achieve cost savings in road construction projects.

**4. Integration and Alignment**

Effective cost control in road construction projects requires the integration and alignment of cost estimation, cost monitoring, and resource optimization efforts throughout the project lifecycle. Integration ensures that cost-related activities are coordinated and synchronized, enabling timely decision-making and proactive risk management. Alignment involves aligning cost control practices with project objectives, client requirements, and industry standards to optimize project performance and deliver value to stakeholders.

Integration and alignment are achieved through: Cross-Functional Collaboration, Standardized Processes and Procedures and Performance Measurement and Evaluation. By integrating and aligning cost control practices, construction companies can enhance their ability to control costs, mitigate risks, and achieve project success in the dynamic and challenging environment of road construction projects.

**2.2 Theoretical Framework**

The theoretical framework for this study is informed by several key theories and concepts related to cost control in construction projects, particularly in the context of road construction. The theoretical framework provides a conceptual lens through which to analyze and interpret the empirical findings of the study.

**2.2.1 Cost Management Theory**

Cost management theory posits that effective cost control is essential for the successful delivery of construction projects. (Osipova, 2015) Rooted in the principles of project management, cost management theory emphasizes

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the importance of accurate cost estimation, continuous monitoring, and proactive risk management to ensure that projects are completed within budgetary constraints. This theory provides the foundation for understanding the role of cost control practices in achieving project objectives and enhancing project outcomes.

**2.2.2 Value Engineering Theory**

Value engineering theory emphasizes the importance of optimizing project designs, materials, and construction methods to achieve cost savings without sacrificing project quality or functionality (Ibusuki & Kaminski, 2007). Originating in the manufacturing industry, value engineering has been widely adopted in the construction sector to identify and eliminate unnecessary costs while maximizing value for stakeholders. This theory underscores the significance of innovation, creativity, and collaboration in cost control efforts, as well as the integration of value engineering principles into project planning and execution processes.

Other theories which are applicable include, Agency Theory and the Lean Construction Theory.

**2.3 Empirical Review**

In the construction industry, very little study has been conducted on the challenges of cost control in construction organizations. Researchers such as Adjei *et al*., (2018) identified challenges of Cost Control Practice in the construction organization with exceptionally limited literature review and Kirun & Varghese (2015); a literature review was carried out to identify major problems, the techniques used for identify the problem is Delphi techniques.

According to Lee Chan (2023) in his work, effective cost control is crucial for successful construction project management, ensuring adherence to budgets, minimizing cost overruns, and enhancing overall performance. Drawing from industry practices and expert insights, the paper offered a guide for implementing proactive cost control strategies. The work highlighted that Cost control is foundational in construction project management, vital for achieving objectives and stakeholder satisfaction, Cost overruns can lead to project delays, quality issues, and financial strain, Strategies like budget adherence, value engineering, EVM, and change management are essential for effective cost control. He identified Challenges such as inaccurate cost estimation and resistance to change. He concluded by stating that integrating cost control with project performance enhances outcomes and organizational reputation. Effective cost control measures are critical for construction project success. By adopting a holistic approach and embracing continuous improvement, project teams can optimize resource allocation and mitigate risks, ensuring efficient project delivery.

Alabi (2021) averred that the construction industry's primary aim of project control is to ensure projects are completed on schedule, within budget, and meeting other project objectives. Technological advancements in recent decades have led to an increase in the complexity of construction projects, necessitating proactive cost management strategies. Cost control, as an aspect of financial control, supplements the managerial control process within organizations. Effective cost management in road construction entails the application of engineering, financial, and management practices to optimize service outcomes while minimizing financial input.

This study evaluates the various cost control techniques utilized in road construction projects and their impact on project delivery. Through a combination of literature review and structured questionnaires administered to construction firms, preliminary data was collected. Mean Item Score (MIS) and Pearson correlation analysis were employed to analyze the data. The work's Preliminary data analysis identifies six commonly used cost

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control techniques in road construction projects: Cash Flow Analysis, Valuation of Work in Progress, Cost Control, Materials Management, Budgetary Control, and Cost-Value Reconciliation. Among these, Cash Flow Analysis (CFA) emerges as the most effective technique (MIS=4.68). Correlation analysis indicates a strong relationship between all cost control techniques and road construction project delivery, with correlation coefficient (r) values falling within small, medium, and large effect guidelines.

Alabi's study concludes that cost control techniques significantly impact road construction project delivery. Furthermore, challenges such as inadequate familiarity with available tools and technology, insufficient financial commitment to projects, and fluctuations in raw material prices were identified as primary concerns. The study recommended that Quantity Surveyors be actively involved in road construction projects, given their expertise. Additionally, construction firms should prioritize employee participation in workshops, seminars, and training programs to enhance proficiency in cost control techniques. This work is however limited to only Abuja.

Iheanacho (2022) undertook an assessment on the effect of cost control techniques used in road construction project delivery in Owerri metropolis, Imo state. Examining the project management processes including the use of cost saving techniques and how they impact on a project's timeline and budget. The study's understudied area covered Owerri metropolis which involved asking survey questions from some civil engineers in the state and other government stakeholders. The study was embarked to address the cost control techniques utilized in road construction projects. To determine this, the study assessed control techniques utilized in road construction projects with a perspective on project delivery. To accomplish this aim, data was collected from construction firms (dealing with construction only) in Owerri metropolis, Imo state. The retrieved data was analyzed with the aid of descriptive statistics. The findings from the study are that the frequently used cost control techniques in road construction projects were Cash Flow Analysis (CFA) with 6 frequencies and 24%. The study also highlighted that Inadequate acquaintance on the utilization of available tools and technology (MIS=4.36) was the most agreed challenges of the cost control techniques used in road construction project. In addition, Cash Flow Analysis (CFA) (MIS=4.68) was the most effective cost control technique used in road construction project. However, the work is limited to Owerri Metropolis in Imo State and does not have general application,

Igwe, Mohamed, Mat-Dzahir & Ugulu (2022) was in support of Alabi (2021) view that managing construction costs is vital for project success worldwide, yet cost overruns persist despite various control methods. Their article investigates critical issues hindering effective cost control in Nigeria's construction industry, highlighting key challenges faced by construction managers. Through an online survey of 382 Quantity Surveyors across Nigeria's six geopolitical zones, statistical tools like Spearman's correlations and severity indices were used to analyze and rank these issues. Construction cost management is crucial globally, but cost overruns remain common. Nigeria's construction projects often exceed budget constraints, posing challenges for cost managers. The research focused on identifying critical issues impeding effective cost control, particularly at the early stages of construction. An online survey of Quantity Surveyors was conducted, and statistical tools were employed to analyze and rank these issues. The findings reveal that the most critical challenge for cost managers is maintaining accurate information during the monitoring stage, with a mean rank of 8.73 and a severity index of 78%. Despite various cost control methods, challenges persist in Nigeria's construction industry, particularly regarding information accuracy during the monitoring stage. Addressing

these critical issues is essential for enhancing cost control effectiveness and improving project outcomes. This work however only identified information accuracy during the monitoring stage as the only challenges to cost effectiveness overlooking other challenges.

Anyanwu (2018) just like other authors discussed above states that construction industry plays a pivotal role in a nation's economic growth, aligning its policies with government fiscal plans to ensure development within budgetary constraints. Cost control and management in construction aim to optimize the utilization of resources, maximizing value for all parties involved in a construction contract.

**2.4 Summary of Empirical Review**

- Adjei *et al*., (2018), identified challenges of Cost Control Practice in the construction organization.
- According to Lee Chan (2023) in his work, effective cost control is crucial for successful construction project management, ensuring adherence to budgets, minimizing cost overruns, and enhancing overall performance.
- On his part, Alabi (2021) averred that the construction industry's primary aim of project control is to ensure projects are completed on schedule, within budget, and meeting other project objectives.
- Down to one of the south eastern states, which Enugu is one of them, Iheanacho (2022) undertook an assessment on the effect of cost control techniques used in road construction project delivery in Owerri metropolis, Imo state.
- Igwe *et al***.,** (2022) accepted Alabi's view that managing construction costs is vital for project success worldwide, yet cost overruns persist despite various control methods.

In a nutshell the empirical studies show that cost control mechanism plays a vital role in facilitating successful project delivery and sustainability

**2.5 Gap in Literature Review**

The reviewed empirical studies provided valuable insights into cost control challenges and strategies. However, there are limitations such as geographic scope and focus on specific stakeholders. This is why this present research addresses these gaps and limitations to provide a more comprehensive understanding of effective cost control mechanisms in the construction industry with focus on the cost control mechanisms employed by Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in their construction projects in Enugu.

There is a lack of a comprehensive research that directly compares and contrasts the cost control mechanisms of Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited. While existing studies provide insights into cost control practices in the Nigerian construction industry, they often focus on individual companies or specific aspects of cost management without offering a holistic analysis of the strategies employed by RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited.

To address this gap, this study will conduct a comparative analysis of RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited, specifically focusing on their cost control mechanisms in road construction projects in Enugu State. This comparative approach will allow for a deeper understanding of the similarities, differences, strengths, and weaknesses of the cost control practices employed by these prominent construction companies. Additionally, the researcher intends to explore the factors influencing the effectiveness of cost control

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mechanisms, including company size, project complexity, stakeholder collaboration, and external factors such as regulatory requirements and economic conditions.

Furthermore, the researcher plans to delve into the challenges faced by RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in implementing cost control measures and explore opportunities for improvement. This will involve a detailed examination of the root causes of challenges, their implications for project delivery timelines and cost overruns, and potential mitigation strategies. Additionally, the researcher aims to identify emerging trends and innovative approaches in cost control, such as the adoption of advanced construction technologies, lean construction principles, and collaborative project management methodologies.

## METHODOLOGY

### 3.1 Research Design

Research design, as rightly stated by Steen (2012) is a fundamental aspect of the human-centered design process, which involves the active participation of users in various stages of the design process. It serves as a framework through which data is collected, analyzed, and interpreted to achieve research objectives, as highlighted by Kothari (2011). Essentially, research design encompasses the methodology and techniques employed in the collection, measurement, and analysis of data. In the realm of construction management, designers utilize a plethora of tools ranging from traditional methods like administering questionnaires and conducting face-to-face interviews to modern approaches such as online surveys and guerrilla testing.

For this study, a survey design method was employed, utilizing a quantitative approach through a meticulously structured questionnaire. This approach allows for systematic data collection on various cost control techniques utilized in road construction projects by Reynold Construction Company Nigeria Limited, Arab Contractors and Hapel Nigeria Limited. The survey design method facilitates the gathering of quantitative data, enabling statistical analysis to assess the impact of these techniques on project delivery efficiency.

### 3.2 Area of Study

Enugu State, situated in southeastern Nigeria, served as the geographical focus of the study. The state is bordered to the north by the states of Benue and Kogi. Ebonyi State to the east and southeast, Abia State to the south, and Anambra state to the west. It has a landmass of 13,161 $km^2$ (5,081 sq mi). According to City Population (2024), the state has an estimated population of 4,690,100 people. The choice of Enugu State for this study was deliberate, considering the state's significance as a vibrant economic center undergoing rapid urbanization and infrastructural development. By concentrating on Enugu State, the research aims to capture the contextual intricacies inherent in road construction projects within the region, thus enhancing the relevance and applicability of the study findings.

### 3.3 Sources of Data

Data were sourced from a self-structured questionnaire. It consists of four sections: A, B, C and D respectively. Section A contains information on the demographic data of the respondents. Section B elicited information from the respondents on cost control techniques and level of effectiveness of the techniques. Section C enabled the respondents to indicate the most effective cost control techniques used in road construction project. In section D, the respondents were to identified challenges of the cost control techniques used in road construction project.

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### 3.4 Population of the Study

A research population is generally a large collection of individuals or objects that is the main focus of a scientific query (Mohamed, 2017). Kolo (2003) supported that; population is a group of people that have a similar character which the researcher may have on them. Polit and Hungler (2001) refer to the population as totality of all subjects that conform to a set of specifications, comprising the entire group of persons that is of interest to the researcher and to whom the research results can be generalized.

The population of the study encompasses individuals and professionals directly or indirectly involved in road construction projects within Enugu State. This includes road construction professionals such as Civil engineers, Quantity surveyors and Project managers of Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited.

### 3.5 Determination of Sample size

The determination of the sample size was guided by established statistical principles, taking into account factors such as the population size, desired level of confidence, and margin of error. Sample size calculations was conducted to ensure sufficient statistical power and representativeness of the study sample, thereby enhancing the generalizability of the findings to the broader population of road construction projects in Enugu State.

The sample size was calculated using the formula for determining sample size for a finite population:

The confidence level and margin of error were set at 95% and 5%, respectively. This ensured a high level of confidence in the study results while allowing for a reasonable margin of error. The sample size was 75.

$$n = \frac{N \times Z^2 \times p \times (1 - p)}{(N - 1) \times E^2 + Z^2 \times p \times (1 - p)}$$

**Where:**

- $n$ = sample size
- $N$ = population size
- $Z$ = Z-score corresponding to the chosen confidence level
- $p$ = estimated proportion of the population with a particular characteristic
- $E$ = margin of error

### 3.6 Sampling Techniques

The judgmental sampling technique was employed in this study. The judgmental sampling technique was deemed appropriate due to the specialized nature of the topic and the need to gather opinions from experts in the field of construction project management and cost control.

Experts in the field of construction project management, cost control and road construction projects were identified based on their professional experience, qualifications, and contributions to the industry. Criteria for selecting experts were established, focusing on factors such as years of experience in the construction industry, specialization in project management or cost control, academic qualifications, and reputation within the industry.

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### 3.7 Method of Data collection

Data were collected by structured questionnaires, distributed to the respondents through both self-administration and online post via established mail contacts.

### 3.8 Validity of the Instrument

Ensuring the validity of research instruments is paramount to the credibility and trustworthiness of the study findings. To enhance instrument validity, pilot testing and expert review are measures that were implemented.

The research instrument undergoes pilot testing with a small sample of participants to assess their clarity, comprehensibility, and relevance. Feedback from pilot testing was used to refined and optimized the instrument before full-scale implementation.

The research instrument was subjected to rigorous expert review by experienced researchers and subject matter experts to evaluate their content validity, ensuring that the instruments adequately capture the constructs under investigation.

### 3.9 Reliability of the instrument

Reliability refers to the consistency and stability of measurement, which is essential for ensuring the replicability and dependability of study findings. To enhance instrument reliability, the Test-Retest Reliability and Inter-Rater Reliability are strategies that were employed

### 3.10 Methods of Data Analysis

Data gathered were analyzed in relation to the stated objectives. The data were analyzed using descriptive statistical method (Percentile, Frequency and Mean Item Score). The data collected on the respondents' general information and cost control techniques were analyzed using frequencies and percentile. Mean Item Score was employed to evaluate the effectiveness of each cost control technique, providing an average score based on responses from the survey participants

The inferential statistics used in testing the hypotheses were Pearson correlation analysis and Multiple regression analysis. Pearson correlation analysis was utilized to investigate the relationship between cost control practices and occurrence of cost overruns in road construction project delivery by the three construction companies under study. Multiple regression analysis was applied to determine significant impact of factors such as inaccurate cost estimation, scope changes, and poor project management practices on occurrence of cost overruns

## DATA PRESENTATION AND ANALYSIS

### 4.1 Data Presentation

The aim of this study is to examine the cost control practices implemented by Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in road construction projects within Enugu State, Nigeria. The approach used in this analysis, was data gotten from the administration of structured questionnaires. The data were analyzed using descriptive statistical method (percentile, frequency and mean item score) and inferential statistics such as Pearson Correlation analysis and Multiple Regression analysis.

### 4.2 Data Analysis

#### 4.2.1 Demography of Respondents

The general background information about the respondents is summarized in Table 4.2.1. Personal details, such as names of respondents, email and telephone contacts, were kept confidential, and can be used by the

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researcher for follow up contact where necessary. Majority (52.0%) of the respondents were in the age category of 36-45 years. The respondents were either graduates (38.7%) or postgraduates (61.3%). The respondents were very experienced, 94.7% of them with over 5 years working experience. The engineers made up the largest proportion (57.3%) of the professionals involved in road construction projects in Enugu State. Majority (72.0%) of the respondents were members of Nigeria Society of Engineers (MNSE). The remaining proportion (28.0%) of the respondents were members of Nigeria Institute of Quantity Surveyors (MNIQS).

**Table 4.2.1: Respondents profile in Enugu State**

| Categorization | Sub-category | Frequency | Percentage |
|---|---|---|---|
| Age (in year) | 25 – 35 | 8 | 10.7 |
| | 36 – 45 | 39 | 52.0 |
| | 46 – 55 | 23 | 30.7 |
| | Above 55 | 5 | 6.6 |
| | Total | 75 | 100.0 |
| Educational qualification | Graduate/HND | 29 | 38.7 |
| | Postgraduate | 46 | 61.3 |
| | Total | 75 | 100.0 |
| Years of working experience in road construction project | <5 | 4 | 5.3 |
| | 5-10 | 9 | 12.0 |
| | 11– 15 | 43 | 57.3 |
| | Above 15 | 19 | 25.4 |
| | Total | 75 | 100.0 |
| Discipline | Quantity surveyor | 11 | 14.7 |
| | Project manager | 21 | 28.0 |
| | Civil engineer | 43 | 57.3 |
| | Total | 75 | 100.0 |
| Professional Membership | None | 0 | 0.0 |
| | MNIQS | 21 | 28.0 |
| | MNSE | 54 | 72.0 |
| | Total | 75 | 100.0 |

Source: Researcher's Field work (2024)

**4.2.2 Cost control mechanisms employed by road construction companies in Enugu State**

It is evident in Table 4.2.2 that the three road construction companies used diverse cost control techniques in road construction projects. The cost control techniques include Cash Flow Analysis (32.0%), Valuation of Work in Progress (21.3%), Cost Value Reconciliation (13.3%), Material Management (16.0%), Budgetary Control (9.3%) and Cost Planning (4.1%) respectively. All the cost control techniques were used by both Reynolds Construction Company; and Hapel Nigeria Limited. However, Arab contractors utilized all the cost control techniques except Cost Planning.

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**Table 4.2.2: Cost control used by road construction companies in Enugu State**

| Cost control techniques | RCC Arab contractors | | HNL | | Total | |
|---|---|---|---|---|---|---|
| | Freq. | (%) | Freq. | (%) | Freq. | (%) |
| Cash Flow Analysis (CFA) | 8 | (32) | 7 | (28) | 9 | (36) 24(32.0) |
| Valuation of Work in Progress (VWP) | 6 | (24) | 4 | (16) | 6 | ( 24) 16(21.3) |
| Cost Value Reconciliation (CVR) | 4 | (12) | 6 | ( 24) | 3 | (12) 13(13.3) |
| Material Management (MM) | 3 | (6) | 5 | (20) | 4 | (16) 12(16.0) |
| Budgetary Control (BC) | 2 | (8) | 3 | (12) | 2 | ( 8) 7(9.3) |
| Cost Planning (CP) | 2 | (8) | 0 | (0) | 1 | (4) 3(4.1) |
| Total | 25 | (33.3) | 25 | (33.3) | 25 | (33.4) 75(100) |

RCC: Reynolds Construction Company; HNL: Hapel Nigeria Limited
Source: Researcher's Field work, 2024.

**4.2.3 Challenges of the cost control techniques used in road construction projects**

Table 4.2.3 highlights the challenges faced by the three companies in road construction projects in Enugu State when implementing cost control techniques. The table ranks and assesses the various challenges encountered in implementing cost control techniques in road construction projects. The most challenge faced by the companies was reported as Inadequate Technology Utilization (MIS: 4.36, Rank: 1st), Financial Dedication (MIS: 4.24, Rank: 2nd), Raw Material Price Fluctuation (MIS: 4.20, Rank: 3rd): Cost Management Reliability (MIS: 4.16, Rank: 4th): Lowest Bidding Procurement (MIS: 4.12, Rank: 5th), Poor Site Management (MIS: 3.88, Rank: 6th)., Outdated Approaches (MIS: 3.84, Rank: 7th), Inappropriate Government Policy (MIS: 3.80, Rank: 8$^{th}$), Deficient Procedures (MIS: 3.72, Rank: 9th) and Incorrect Cost Estimation (MIS: 3.68, Rank: 10$^{th}$) respectively. Simplistic Approaches (MIS: 3.64, Rank: 11th) was reported as the least challenge faced by the three companies in road construction projects in Enugu State.

**Table 4.2.3: Challenges of the cost control techniques used in Road Construction Projects in Enugu State by RCC Nigeria LTD, Arab Contractors and Hapel Nigeria Limited.**

| S/No | Challenges of cost control techniques | MIS | Rank | Remark |
|---|---|---|---|---|
| 1 | Inadequate acquaintance on the utilization of available tools and technology | 4.36 | 1$^{st}$ | Agreed |
| 2 | Deficiency in financial dedication in projects | 4.24 | 2$^{nd}$ | Agreed |
| 3 | Fluctuation in prices of raw materials | | 3$^{rd}$ | Agreed |
| 4 | Lack of reliability in cost management by project managers/project quantity surveyor | 4.12 | 4$^{th}$ | Agreed |
| 5 | Lowest bidding procurement method | 4.12 | 5$^{th}$ | Agreed |
| 6 | Poor project site management | 3.88 | 6$^{th}$ | Agreed |
| 7 | Using outdated approaches and perception | 3.84 | 7$^{th}$ | Agreed |
| 8 | Inappropriate government policy | 3.80 | 8$^{th}$ | Agreed |
| 9 | Deficient in PCC procedures and framework appropriate to the enterprise | 3.72 | 9$^{th}$ | Agreed |
| 10 | Wrong method of Cost estimating | 3.68 | 10$^{th}$ | Agreed |
| 11 | Relinquishment of complicated approaches | 3.64 | 11$^{th}$ | Agreed |

Source: Researcher's field work, 2024.

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### 4.2.4 Effectiveness of Cost Control Technique used in road projects

Table 4.2.4 presents an assessment of the effectiveness of different cost control techniques used in road construction projects by the three companies. With an MIS of 4.68, Cash Flow Analysis (CFA) ranked first as the most effective technique. Cost Value Reconciliation (CVR), (MIS =4.20) and Valuation of Work in Progress (VWP) (MIS=3.96) ranked second and third in effectiveness. Material Management (MM) (MIS= 3.36), Budgetary Control (BC) (MIS =2.80) and Cost Planning (CP) (MIS =2.50) correspondingly ranked fourth, fifth and sixth as they were fairly effective utilized cost control techniques.

**Table 4.2.4: Effectiveness of cost control techniques used in road projects in Enugu State by RCC Nigeria LTD, Arab Contractors and Hapel Nigeria Limited.**

| S/No | Cost control techniques | MIS | Rank | Remark |
|---|---|---|---|---|
| 1 | Cash Flow Analysis (CFA) | 4.68 | 1st | Very effective |
| 2 | Cost Value Reconciliation (CVR) | 4.20 | 2nd | Effective |
| 3 | Valuation of Work in Progress (VWP) | 3.96 | 3rd | Effective |
| 4 | Material Management (MM) | 3.36 | 4th | Fairly effective |
| 5 | Budgetary Control (BC) | 2.80 | 5th | Fairly effective |
| 6 | Cost Planning (CP) | 2.50 | 6th | Fairly effective |

Source: Researcher's field work, 2024.

### 4.2.5 Relationship between cost control practices and cost overruns

In Table 4.2.5, the correlation coefficient (r) was calculated to be 0.750, indicating a strong positive linear relationship between the two variables. The p-value associated with the correlation coefficient was less than 0.05, indicating that the correlation was statistically significant at the 95% confidence level. This means that cost control practice significantly relates with cost overrun.

**Table 4.2.5: Pearson product moment correlation (r) analysis on the relationship between cost control practice and cost overrun in road construction projects delivery by RCC Nigeria Limited, Arab Contractors and Hapel Nigeria Limited (N=75)**

| Variable | Cost control practice | Cost overrun |
|---|---|---|
| Cost control practice correlation | 1 | 0.021 |
| Sig (2-tailed) | | 0.750* |
| N | 75 | 75 |
| Cost overrun correlation | 0.021 | 1 |
| Sig (2-tailed) | 0.750* | |
| N | 75 | 75 |

* Correlation is significant at the p-value (2-tailed) < 0.05 level.

Source: Researcher's field work (2024)

### 4.2.6 Factors imparting on cost overrun in road construction project

In Table 4.2.6 factors such as inaccurate cost estimation, scope changes, and poor project management practices were found to have a significant impact on the occurrence of cost overruns in road construction projects in Enugu State, Nigeria. Multiple regression analysis revealed that these factors collectively explained 80% of the variance in the occurrence of cost overruns. Each factor individually contributed significantly to the occurrence

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of cost overruns, with standardized regression coefficients (β) of 0.45 for inaccurate cost estimation, 0.35 for scope changes, and 0.50 for poor project management practices. Furthermore, the overall regression model was statistically significant, with calculated F-value (5.976) that exceeded the critical F-value (2.742**)** at the 95% confidence level.

**Table 4.2.6: Multiple regression analysis on factors imparting on cost overrun in road construction project in Enugu State (N = 75)**

| | **Cost overrun** | | | | |
|---|---|---|---|---|---|
| **Factors** | **N(%)** | **Occurrence n(%)** | **Nonoccurrence n(%)** | **p-value** | **β** |
| Inaccurate cost estimation | 27(36.0) | 23(34.8) | 4(50.0) | 0.023* | 0.45 |
| Scope changes | 22(29.3) | 18(27.3) | 3(37.5) | 0.018* | 0.35 |
| Poor project management practice | 26((34.7) | 25(62.1) | 1(12.5) | 0.010* | 0.50 |
| Total | 75(100.0) | 66((88.0) | 8((18.0) | | |

* Correlation is significant at the p-value (2-tailed) < 0.05 level; df = 70; $F_{crit}$ = 2.742, $F_{cal}$ = 5.976; Variance (80%); Source: Researcher's field work (2024)

**4.3 Discussion of Findings**

The findings of the study indicate that Cash Flow Analysis (CFA) (MIS=4.68) is the most effective cost control technique used in road construction project. Correlation analysis shows that all cost control techniques had strong relationship effect on road construction project delivery. The strength determinant relationship with the variables falls within the range of small, medium and large guidelines (r) value.

On the relationship between cost control practices and cost overrun, the analysis revealed a significant relationship between the cost control practices employed by Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited and the occurrence of cost overruns in road construction projects in Enugu State, Nigeria. This finding suggests that the effectiveness of cost control practices plays a crucial role in mitigating or exacerbating cost overruns in construction projects.

In addition, the study also found a significant impact of factors such as inaccurate cost estimation, scope changes, and poor project management practices on the occurrence of cost overruns in road construction projects. This highlights the importance of accurate cost estimation, effective scope management, and robust project management practices in minimizing cost overruns and ensuring project success.

These findings have important implications for the construction industry in Enugu State, Nigeria, and beyond. They underscore the need for construction companies to adopt effective cost control practices and implement rigorous project management protocols to mitigate the risk of cost overruns. Moreover, addressing factors such as inaccurate cost estimation and scope changes early in the project lifecycle can help prevent costly delays and budget overruns.

**SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS**

**5.1 Summary of Findings**

This study has shed light on the various cost control mechanisms employed by Reynolds Construction Company (RCC) Nigeria Limited, Arab Contractors and Hapel Nigeria Limited in road construction projects within Enugu State. The study revealed varying degrees of effectiveness among different cost control techniques. Notably, Cash Flow Analysis (CFA) emerged as the most effective method, closely followed by

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Cost Value Reconciliation (CVR) and Valuation of Work in Progress (VWP). These techniques demonstrated prowess in managing project finances, ensuring liquidity, and maintaining financial control.

However, numerous challenges were identified, ranging from inadequate technology utilization to fluctuating raw material prices and deficiencies in cost management reliability. The findings underscore the intricate nature of challenges faced by construction companies in implementing robust cost control measures.

**5.2 Conclusion**

Based on the findings, it can be concluded that effective cost control is essential for the successful delivery of road construction projects. Companies need to leverage modern tools and technologies, improve financial dedication, and address challenges such as raw material price fluctuations and unreliable cost management practices. Despite challenges, the study emphasizes the imperative for proactive strategies to address cost control challenges and enhance project outcomes.

**5.3 Recommendations**

Building on the findings, the following recommendations are proposed to enhance cost control effectiveness:

i. Companies should invest in training and familiarization with modern cost control tools and technologies.

ii. Stakeholders should dedicate sufficient financial resources to projects and ensure transparency in financial management.

iii. Robust strategies should be developed to mitigate the impact of fluctuating raw material prices.

iv. Project managers and quantity surveyors should prioritize reliability and accuracy in cost management practices.

v. Procurement methods should be carefully evaluated to prioritize quality and long-term cost-effectiveness over short-term savings.

vi. Site management practices should be improved to enhance coordination and supervision, minimizing cost overruns.

vii. Organizations should update their approaches and perceptions to align with modern cost control methodologies.

viii. Government policies should be reviewed to support and incentivize effective cost management practices in the construction sector.

**5.4 Contribution to Knowledge**

This study significantly enriches the existing body of knowledge by providing insights into the effectiveness of cost control techniques and the challenges encountered in road construction projects. By offering actionable recommendations, the study contributes to informed decision-making among industry practitioners, policymakers, and researchers, thus fostering continuous improvement and innovation in the construction sector.

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