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ANALYSIS OF FACTORS AFFECTING EFFICIENT PRACTICES AND TECHNIQUES FOR ALLOCATING PROVISIONAL SUMS IN CONSTRUCTION MANAGEMENT

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ABSTRACT

Cost estimation for electrical services in construction projects remains a critical challenge, particularly in Nigeria, where cost uncertainties in mechanical and electrical (M&E) services lead to budget overruns and project delays. The estimation of provisional sums for electrical installations is often imprecise due to incomplete design specifications, fluctuating market prices, and the absence of standardized estimation frameworks. These limitations impact financial planning, contractor-client relationships, and overall project efficiency. This study aims to analyse effective cost estimation techniques for allocating provisional sums in electrical installations and to identify causal factors affecting their accuracy. Specifically, it seeks to examine current industry practices, analyze the reliability of various estimating techniques, and propose a refined framework for improving cost estimation accuracy in electrical services. A quantitative research design was adopted, utilizing structured questionnaires administered to 83 professionals, including quantity surveyors, electrical engineers, and project managers involved in residential construction projects in Owerri, Nigeria. Simple random and snowball sampling methods were used to ensure a representative sample of experienced professionals. The collected data were analyzed using descriptive statistics. The findings highlight that engineering cost estimating and resource analysis emerged as the most effective methodologies for determining provisional sums. However, factors such as incomplete design details, unclear specifications, and organizational policies significantly impact the accuracy of estimates. The study concludes that improving the proficiency of estimators, integrating modern computational tools, and ensuring complete project specifications can significantly enhance cost estimation accuracy. It recommends the adoption of digital modeling techniques, increased training for cost estimators, and the establishment of standardized guidelines for electrical service cost estimation. These improvements can help mitigate cost-related disputes, optimize budget allocations, and improve overall project outcomes.

Keywords: Cost Estimation, Electrical Services, Provisional Sums, Construction Budgeting, Estimating Techniques

INTRODUCTION

Building projects in Nigeria, particularly in urban centers like Owerri, Imo State, often experience significant cost uncertainties associated with Mechanical and Electrical (M&E) services. In more developed countries, depending on the type of structure, they may range between 10 to 70 percent (Yusuf and Mohamad, 2012). Electrical services, encompassing supply systems, lighting, and communication infrastructure, contribute substantially to total construction costs. These installations are critical for functional and sustainable residential buildings, yet the estimation of provisional sums for electrical installations often lacks precision (Babalola and Adesanya, 2007).

Accurate cost estimation is crucial in construction projects, particularly in allocating provisional sums for electrical installations. Provisional sums account for cost uncertainties and ensure financial preparedness. However, estimating these sums presents challenges, including incomplete design specifications, variability in market rates, and lack of standardized estimation frameworks (Ashworth, 2016). Inaccurate provisional sums can lead to cost overruns, contractual disputes, and project delays, making it essential to refine estimation methodologies (Ferry & Brandon, 2019). Furthermore, electrical services constitute a significant portion of total construction costs, necessitating more sophisticated and adaptive cost estimation approaches (Smith, 2020).

Provisional sums are mainly assigned to works for which their designs have not been completed at the time the contract is being signed, or in some cases where detailed drawings of such works are not available to the estimator. Provisional sums amount to about 25 percent of the contract sums of most building projects (Okuwoga, 1998). Yusuf and Mohamad, (2012) posits that bills of quantities (BoQ) are still produced in lump sums and provisional sums for Mechanical and Electrical services.

The consequences of poor cost estimation are profound, ranging from project delays to disputes among stakeholders. Hicks (1992) discoursed that devoid of an accurate cost estimate, almost nothing can be done to prevent a loss, notwithstanding the competence of the project manager, the contractor’s economic strength, and technical know-how. Furthermore, the increasing

complexity of modern residential buildings, with features such as advanced lighting systems and renewable energy integrations, underscores the need for updated and effective cost estimation guidelines.

Estimating techniques have evolved over the years, incorporating both traditional and modern computational methods. The advent of Building Information Modeling (BIM) and AI-driven estimating software has significantly improved cost prediction accuracy, reducing errors caused by human judgment (Keraminiyage et al., 2021).

This study aims to analyse industry practices and explores the effectiveness of different cost estimation practises and techniques in achieving accuracy and reliability. Furthermore, it examines the causal factors affecting the effectiveness of these practises and techniques.

LITERATURE REVIEW

2.1 Overview of Electrical Services Electrical services constitute an integral element of a building (Soutos and Lowe, 2011). An element, as defined by Kirkham (2007), is a fundamental part of a structure that consistently serves the same function, regardless of its location or specifications. The term "electrical installation" broadly refers to any fixed appliances, wiring, fittings, apparatus, or other electrical equipment utilized for the conveyance, regulation, and application of electricity within a designated area (Electricity Consumer Safety Regulation, 2015).

Electrical installations are categorized into Electrical Supply/Power/Lighting systems and Communication/Security/Control systems, as outlined in Appendix B of the Building and Engineering Standard Method of Measurement 3 (Nigerian Institute of Quantity Surveyor (NIQS), 2008). Within the Nigerian construction sector, the cost of electrical system installations in buildings represents a significant financial consideration (Olawumi et al., 2016). Simon and Andy (2012) highlighted that building services installations typically account for 20-30% of a project's total cost, with electrical installations alone contributing between 6% and 10% of a standard project's overall expenditure (Keraminiyage, Amaratunga, Haigh, and Perera, 2009).

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Accurate cost estimation of electrical installation work in construction projects is paramount. As noted by Wayne (2015), incorrect estimates often result in customer dissatisfaction, payment disputes, and potential reputational damage for contractors if the project is deemed unsuccessful or experiences excessive cost and time overruns. Although electricity was once considered a luxury in residential properties, it is now an essential requirement for all types of buildings, regardless of their scale or function (Keraminiyage et al., 2009). Despite the availability of various power generation sources, precise estimation of electrical components remains critical, as cost estimation inaccuracies are a common cause of budget overruns in the industry. Lawrence (1993) emphasized that electricity supply is a fundamental household necessity that often intimidates individual homebuilders. This uncertainty and lack of awareness can lead to inflated costs for domestic electrical installations. Consequently, it is crucial for clients to have sufficient knowledge of domestic electrical accessories to optimize installation expenses. The use of an appropriate and effective cost-estimating method is essential for achieving accurate and reliable budget projections in electrical services contracts.

According to Fadamiro and Ogunsemi (1996), the entry point of an electrical system in a building is the service entrance and distribution board, which may be equipped with either circuit breakers or switch-and-fuse mechanisms. Chudley (1988) explained that a building typically receives a single-phase electricity supply from the grid at 240 volts and a frequency of 50 hertz. These electricity grids comprise four lines—three carrying a 240-volt supply each and a fourth serving as the common return or neutral line. For safety purposes, these lines are grounded at the transformer or substation to mitigate faults from electrical appliances. The single-phase 240V supply is achieved by tapping each phase line along with the neutral (Shittu et al., 2008).

The final consumer's circuit, also known as the controller circuit, begins where the service cable enters the building and connects to the consumer's unit or distribution board. A portion of the consumer's controller includes the service fuse and main switch. From the consumer's unit or distribution board, the final circuit extends to the load, incorporating essential components such as fuse circuit breakers, socket outlets, ceiling roses, and lamp holders. The number of final circuits depends on the types of loads supplied and must comply with regulations for overcurrent protection, switching, and conductor current-carrying capacity. Each circuit must be independent

and connected to its respective overcurrent protective fuse or circuit breaker within a switch fuse, distribution board, or consumer's unit (Ogunsina et al., 2019).

The scope of electrical services is vast and intricately interwoven into modern infrastructure, influencing nearly every aspect of contemporary life. Before exploring the diverse dimensions of electrical services, it is essential to define the term within the broader professional context. Various authorities and organizations provide distinct interpretations, each addressing specific aspects of this complex field. Fundamentally, electrical services encompass the planning, installation, maintenance, and management of electrical systems. These systems are indispensable to modern society, supplying power to homes, businesses, industries, and critical infrastructure. A comprehensive understanding of electrical services necessitates examining their numerous applications and the evolving technological advancements in the field.

2.2 Provisional Sums in Building Projects Provisional sums are allocations made for work items whose design or specifications are incomplete at the time of contract preparation (Morenikeji, 2006). Defined provisional sums, as specified in industry standards, require detailed descriptions, ensuring a degree of clarity for contractors. Conversely, undefined sums lack comprehensive details, leading to cost inaccuracies and potential disputes during project execution. Accurate provisional sums are essential to bridge the gap between early-stage planning and detailed project design.

2.3 Estimating Practices for Electrical Services Common techniques for estimating costs include resource analysis, elemental estimating, and parametric models. Resource analysis, with a mean score of 4.7 in this study, stands out as a particularly effective method for determining costs based on labor, materials, and equipment (Babalola & Adesanya, 2007). However, factors like ambiguous specifications and inadequate design documentation frequently undermine the accuracy of these estimates. Advanced techniques, such as Building Information Modeling (BIM), have shown promise in enhancing the reliability of cost forecasts by integrating design and cost data (Abiodun B. A & Tochi C. O., 2024).

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Table 2.1 Estimating practices for provisional sums for electrical works

Item	Estimating practices for provisional sums for electrical works
E1	Conference
E2	Financial
E3	Unit
E4	Resource analysis
E5	S/Perimeter
E6	Volume
E7	Enclosure
E8	Systems
E9	T/Breakdown
E10	A/Quantities
E11	Elemental
E12	Superficial floor area
E13	Cost Model

Source: Babalola and Adesanya (2007)

2.4 Cost Estimating Techniques for Electrical Services.

There are several techniques for estimating the cost of electrical services, especially at the early stage of construction projects. Quantity surveyors and other estimators can leverage these methods to develop a cost budget which is usually a provisional sum at the design and pre-contract stages. A single method could be used or a combination of any two of the techniques.

2.4.1 Parametric Estimating

Parametric estimating uses statistical modeling and historical data to develop cost estimates, like analogous estimation (Usmani, 2012; PMS, 2014). It relies on cost estimating relationships (CERs) that translate technical data into cost projections (Keraminiyage et al., 2009; The Association for the Advancement of Cost Engineering, 2004). While its accuracy depends on the assumptions made (Sharma & McDonough, 2013), it is considered highly accurate and time-efficient

(Markgraf, 2015; Billows, 2014). Parametric estimating employs models, regression, and other statistical methods to enhance cost prediction (AcqNotes, 2015a).

2.4.2 Analogous Estimating

Analogous estimating, also known as historical bid-based estimation, uses cost data from past projects to estimate costs for new projects with similar design and operation (Sharma & McDonough, 2013; WSDOT, 2015). This technique adjusts historical costs based on factors like size, technology, and complexity, with quantitative adjustments preferred over subjective expert judgments (AcqNotes, 2015b). While it provides transparency and accurate cost predictions, it is only effective when the compared projects are highly similar (PMG, 2015). Despite its limitations, it is widely used and can significantly improve project success rates (Billows, 2014; Usmani, 2012).

2.4.3 Engineering Cost Estimating

Engineering cost estimating involves breaking down a project into smaller components within the Work Breakdown Structure (WBS) and estimating each separately for labor, materials, and other costs (AcqNotes, 2015c). This method ensures accuracy, identifies overlooked costs, provides insights into major cost contributors, and allows for easy transfer of estimates across programs.

2.4.4 Expert Judgment Estimating

Expert judgment estimating relies on experienced estimators to determine project costs while considering unique project-specific factors. It is a quick method and can be highly accurate when conducted by knowledgeable experts (PMS, 2014; PMG, 2015). However, its limitations include potential bias, reliance on expert availability, and the lack of a structured rationale in some cases (PMG, 2015).

2.4.5 Cost-based Estimating

Cost-based estimating focuses on calculating the contractor's cost for materials, labor, and equipment, with added overhead and profit. It prioritizes high-cost items, which typically make up 20% of the work but account for 80% of the total project cost (WSDOT, 2015). The remaining costs are estimated using historical bid data, making the process more efficient and reducing

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estimation time and cost. Additionally, it helps validate historical prices for large work items, ensuring accuracy in electrical installation cost estimation.

2.4.6 Reserve Analysis

Reserve analysis determines the contingency reserve needed to address cost uncertainties in a project (PMS, 2014). Though considered fundamental, it involves guesswork, assessing project risks to establish a reserve of time, resources, or performance to manage unforeseen costs (PMG, 2015).

Table 2.2 Summary of cost estimating techniques

Item	Technique	Source (s)
CE1	Parametric Estimating	(Usmani, 2012)
CE2	Analogous Estimating	Sharma and McDonough (2013)
CE3	Engineering Cost Estimating	(AcqNotes, 2015)
CE4	Expert Judgment Estimating	PMG, 2015
CE5	Cost-based Estimating	WSDOT, 2015
CE6	Reserve Analysis	PMG, 2015

2.5 Critical causal factors affecting electrical cost estimating techniques.

Effective cost estimation is crucial for construction contracts, impacting pricing, cost control, contract awards, valuation, and final accounts (Olubola & David, 2016). Accurate estimation helps companies determine their direct costs and establish a minimum viable project cost (Smith, 2015). According to CIOB (1997), estimates should be explicit, consistent, and account for construction methods and project conditions. Williams (2006b) emphasized the need for a structured system ensuring no cost elements are omitted, maintaining simplicity and efficiency.

Research on electrical services estimation highlights limitations in traditional budgeting methods for mechanical and electrical services (Swaffield & Pasquire, 1996). They found that standard building cost estimation methods were unsuitable for these specialized services, necessitating improved understanding and methodologies. Swaffield and Pasquire (2000) proposed enhancing

early design stage communications to better interpret mechanical and electrical service requirements, leading to more accurate cost estimates. Additionally, Kitschker and Swaffield (2003) examined the adoption of Egan's recommendations in the mechanical and electrical sector, finding positive responses alongside persistent industry challenges such as payment withholding, contract disputes, and poor site conditions.

Table 2.3 Factors affecting electrical cost estimating techniques.

Item	Causal factors
CF1	Estimator's inadequate proficiency in electrical services estimating
CF2	Absence of electrical design drawings.
CF3	Incomplete details in electrical working drawings.
CF4	Unclear or ambiguous electrical specifications
CF5	Organizational policy on electrical service costing
CF6	Volatile market conditions
CF7	Ever-changing client's needs during the project.
CF8	The type/size or complexity of such Electrical installation project.
CF9	Unavailability of historical records or data on electrical estimates jobs.
CF10	The need for precision in estimating
CF11	The need to reduce the time spent on estimating
CF12	Undefined project scope
CF13	Type/complexity of electrical installation

2.5 Factors affecting the allocation of accurate cost estimates for electrical services.

The review of extant literature showed limited studies on estimating the process of electrical services cost in building works. Like other building items, the estimates for electrical services are

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influenced by certain factors requiring consideration in this research. To achieve this, some research works were consulted. Babalola and Adesanya (2008) found that the major factors affecting the production of cost estimates for electrical services are estimator competence, project technicality, economic requirements, and contract requirements. According to Olawumi (2016), the factors that influence the choice of method of estimating the cost of electrical service in building projects are; the estimator's inadequate proficiency in electrical services estimating, absence of electrical design drawings, incomplete details in electrical working drawings, unclear or ambiguous electrical specifications, organizational policy on electrical service costing, volatile market conditions, estimator unfamiliarity with M&E systems and equipment, ever-changing client's need during the project, unavailability of historical record or data on electrical estimates jobs, the need for precision in estimating, the need to reduce the time spent on estimating, and undefined project scope.

The study of Oladiran (2012), revealed that the Factors that affect the accuracy of Electrical Services Cost Estimates are; The use of prime cost sums for electrical services, Variation in design and specification, Preparation of tenders using sketch drawings, Inadequate time allowed for the design of electrical services drawings, Usage of foreign materials which is prone to inflation and exchange rate, Preparation of electrical services cost estimate by professionals other than the Quantity Surveyor, and Delay in Payments, Twenty-three factors influencing the cost estimates of the cost of electrical services, and these were from the work of (Babalola and Adesanya, 2008).

Table** Error! No text of specified style in document..**1: Factors affecting the cost estimates for electrical services.

Item	**Factors**
ES1	Location of Site

ES2	Availability of Resources
ES3	Extent of completion of pre-contract design
ES4	Type of structure
ES5	Project team experience of installation
ES6	Installation team capability
ES7	Site constraints
ES8	Estimating method
ES9	Purpose of estimate
ES10	Competitiveness
ES11	Firm's workload
ES12	Historical cost data
ES13	Estimator's expertise
ES14	Type of client

Source: Babalola and Adesanya (2008)

2.6 Critical causal factors affecting electrical cost estimating techniques.

In practice, several factors must be considered if an estimate produced is to fulfill the needs of the end-users (Olubola B., and David A. A., 2016). Cost estimating is very important to every facet of a construction contract – pricing, award of contract, cost control, valuation, and final account. Smith (2015) corroborated the fact that the cost estimating process is very important as it enables construction companies to determine their direct costs and to provide a ‘‘bottom line’’ cost below which it would not be economical for them to carry out the work. CIOB (1997) advised that an estimate must be prepared in a way that is explicit, and consistent and takes account of methods of construction and circumstances that may affect the execution of the work on a project. In estimating the total project cost, Williams (2006b) suggested that a system should be formulated whereby every element of the cost is allowed for in one way or another. In estimating therefore,

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the following should be put into practice: no element of the cost is omitted; the system is simple to operate; and the system is quick in operation. Among the few research works on estimating for electrical services are those by Swaffield and Pasquire (1996) who evaluated methods used to produce budget estimates for mechanical and electrical services by examining the availability and suitability of historic cost data for mechanical and electrical services. They found that the current methods of budget estimating for building structure and fabric work are inappropriate for use with the mechanical and electrical services elements and that there is a need for an improved understanding of the factors that affect the cost of mechanical and electrical services. Likewise, Swaffield and Pasquire (2000) proposed a method for improving early design stage communications to improve the interpretation of mechanical and electrical services quality requirements and lead to more accurate cost estimates. They suggested the proposed method as a valid method of improving early design stage communications between clients and building professionals that could lead to improved early cost advice for mechanical and electrical services. Furthermore, Kitschker and Swaffield (2003) investigated the implementation of Egan's recommendations within the mechanical and electrical sector and analyzed relationships with mechanical and electrical contractors' profits. They noted that there was a positive response to Egan's report with the mechanical and electrical sector accepting and using many of the techniques and that familiar construction industry traits of withholding payment, tender disparity, contract dispute, unequal standing, and poor site facilities were discovered within the mechanical and electrical sector.

Table** Error! No text of specified style in document..**2: Critical causal factors affecting electrical cost estimating techniques.

Item	Causal factors

CF1	Estimator's inadequate proficiency in electrical services estimating
CF2	Absence of electrical design drawings.
CF3	Incomplete details in electrical working drawings.
CF4	Unclear or ambiguous electrical specifications
CF5	Organizational policy on electrical service costing
CF6	Volatile market conditions
CF7	Ever-changing client's needs during the project.
CF8	The type/size or complexity of such Electrical installation project.
CF9	Unavailability of historical records or data on electrical estimates jobs.
CF10	The need for precision in estimating
CF11	The need to reduce the time spent on estimating
CF12	Undefined project scope
CF13	Type/complexity of electrical installation

Source: Field Survey, 2023

RESEARCH METHODOLOGY

3.1 Research Design A quantitative research design was adopted, utilizing structured questionnaires to collect data from 83 respondents. These respondents included quantity surveyors, electrical engineers, and project managers actively involved in residential building projects in Owerri. The design enabled a systematic examination of factors affecting cost estimation practices.

Table 3.1 Respondents profile

Variables	Category	Frequency	Percentage
Profession of respondents	Quantity surveyors	50	60.25

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	Electrical engineers	20	24.10
	Project Managers Consultants/Contractors	9 4	10.84 4.81
	Total	83	100
Years of experience	5 - 10	48	57.83
	11 – 15	35	42.17
	Total	83	100
Highest academic qualification	B.Tech/B.Sc	59	71.08
	MSc.	24	28.91
	Total	83	100

3.2 Sampling Technique Simple random and snowball sampling methods were employed to ensure a representative sample of professionals with relevant expertise. Simple random sampling was chosen for its ability to eliminate selection bias, ensuring that every individual in the population had an equal chance of being included. Meanwhile, snowball sampling was particularly effective in identifying professionals with specialized knowledge, leveraging referrals to access hard-to-reach respondents and enhancing the richness of the data collected. These techniques facilitated the inclusion of diverse perspectives, enhancing the reliability of the findings.

3.3 Data Analysis Descriptive statistics, including frequencies, percentages, and mean score analysis, were used to interpret the data. This analytical framework ensured that the findings were both valid and actionable.

Results and Discussion

4.1 Significance of Cost Estimating Techniques

Table 4.1 presents the significance ranking of cost estimation techniques based on respondents' evaluations.

Table 4.1 Cost Estimating Techniques and their Significance in Estimating Provisional Sums

Technique	Mean Score	Standard Deviation	Rank
Engineering Cost Estimating	4.8	0.6	1
Parametric Estimating	4.2	0.9	2
Expert Judgment Estimating	3.7	1.1	3
Cost-Based Estimating	3.2	1.3	4
Analogous Estimating	2.9	1.2	5
Reserve Analysis	2.5	1.4	6

Engineering cost estimating ranked highest, indicating its reliability and precision, while reserve analysis was least preferred due to its limited applicability in direct cost estimation. The findings suggest that integrating AI-based models into engineering cost estimation could further improve accuracy and efficiency.

4.2 Effectiveness of Estimating Practices

Resource analysis was identified as the most effective method is estimating cost of provisional electrical installations, as shown in Table 4.2.

Table 4.2: Effectiveness of Cost Estimating Practices for Electrical Services

Estimating Method	Mean Score	Standard Deviation	Rank
Resource Analysis	4.7	0.55	1
Elemental	4.5	0.64	2
Systems	4.2	0.73	3
Unit	3.8	0.82	4
Approximate Quantities	3.5	0.91	5

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4.3 Critical causal factors affecting electrical costing techniques.

As seen below under analogous estimating; the respondents identified unclear/ambiguous electrical specifications (RII=0.818 R=1), the absence of electrical design drawings (RII= 0.798 R=2), and incomplete details in electrical working drawings (RII=0.710 R=3) has been critical to the usage of analogous estimating as revealed. Going further, under parametric estimating; organizational policy on electrical service costing (RII=0.790 R=1), the absence of electrical design drawings (RII=0.786 R=2), and the estimator's inadequate proficiency in electrical services estimating (RII=0.776 R=3) in descending order were ranked by respondents has been quite critical of the usage of parametric estimating technique. For expert judgment estimating, the critical causal factors to the usage of expert judgment estimating techniques include the absence of electrical design drawings (RII=0.816 R=1), incomplete details in electrical working drawings (RII=0 R=2), and the estimator's inadequate proficiency in electrical services estimating (RII=0.790 R=3). Analysis of reserve analysis (Provisional sum) shows that incomplete details in electrical working drawings (RII=0.908 R=1), undefined project scope (RII=0.898 R=2), and unclear or ambiguous electrical specifications (RII=0.896 R=3) are the three most critical causal factors to the usage of reserve analysis (provisional sum).

Looking at Cost-based estimating, three critical causal factors were identified by respondents (as shown in Table 4.11) as being responsible for the usage of cost-based estimating technique as the preferred option by some estimators for electrical estimating jobs; this includes the organizational policy on electrical service costing (RII=0.828 R=1), incomplete details in electrical working drawings (RII=0.826 R=2) and unclear or ambiguous electrical specifications (RII=0.810 R=3).

Engineering cost estimating; Organizational policy on electrical service costing (RII=0.812 R=1), the type/ complexity of such electrical installation project (RII=0.798 R=2), and the need for precision in estimating (RII=0.790 R=3) in that order were identified by respondents (as revealed in Table 4.11) has been critical to the usage of engineering cost estimating as the preferred option by quantity surveyors or estimators. Irrespective of the ratings of these factors, they are critical to the estimating of electrical services in projects.

Table** Error! No text of specified style in document..**3: Impact critical factors directly on one or more electrical costing techniques.

S/N	Causal factors	Analogous		Parametric		Expert judgment		Reserve analysis		Cost based		Engineering cost	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank	RII	Rank
1	Estimator's inadequate proficiency in electrical services estimating.	0.678	5	0.776	3	0.790	3	0.656	11	0.706	7	0.490	11
2	Absence of electrical design drawings.	0.798	2	0.786	2	0.816	1	0.822	5	0.662	10	0.510	10
3	Incomplete details in electrical working drawings.	0.710	3	0.682	5	0.800	2	0.908	1	0.826	2	0.596	6
4	Unclear or ambiguous electrical specifications.	0.818	1	0.582	10	0.776	4	0.896	3	0.810	3	0.666	4
5	Organizational policy on electrical service costing.	0.700	4	0.790	1	0.520	10	0.742	9	0.828	1	0.812	1
6	Volatile market conditions.	0.496	12	0.456	13	0.510	12	0.758	8	0.516	12	0.622	5
7	Estimator unfamiliarity with M & E systems	0.630	9	0.748	4	0.518	11	0.800	7	0.620	11	0.478	13

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	and equipment.												
8	Ever-changing client's needs during the project.	0.488	13	0.570	11	0.510	12	0.610	13	0.796	6	0.520	9
9	Unavailability of historical records or data on electrical estimates jobs.	0.652	6	0.642	6	0.588	8	0.698	10	0.670	9	0.580	7
10	The need for precision in estimating.	0.612	10	0.548	12	0.578	9	0.616	12	0.798	4	0.790	3
11	The need to reduce the time spent on estimating.	0.636	7	0.602	9	0.630	7	0.802	6	0.682	8	0.488	12
12	Undefined project scope.	0.632	8	0.606	8	0.658	6	0.898	2	0.512	13	0.528	8
13	The type/size or complexity of such electrical installation project.	0.542	11	0.642	6	0.712	5	0.890	4	0.798	4	0.798	2

Conclusion and Recommendations

In conclusion, this study delved into the complex landscape of existing practices in estimating the cost of electrical services, as well as the factors affecting such estimates for electrical services in construction projects, in a bid to develop a guideline for estimating provisional sums.

Engineering cost estimating and resource analysis emerged as the most effective methodologies. Addressing incomplete design details and improving estimator expertise are critical for enhancing cost estimation accuracy. The findings, derived from a comprehensive analysis of survey data, illuminate crucial insights for cost practitioners and project managers in the construction industry.

This study recommends the adoption of digital modeling techniques, increased training for cost estimators, and the establishment of standardized guidelines for electrical service cost estimation. These improvements can help mitigate cost-related disputes, optimize budget allocations, and improve overall project outcomes.

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