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EFFECT OF PROJECT COST CONTROL ON NIGERIA'S POWER SECTOR. THE CASE OF TRANSMISSION COMPANY OF NIGERIA, ABUJA (2008-2021)

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Keywords: *Cost control, Project, Power sector, Transmission*

Abstract: *This study looked at the effect of project cost control on Nigeria's power sector using the case of Transmission Company of Nigeria (TCN). The motivation for the study was drawn from the persistent low levels of power transmission by the company which has triggered enquiries into what could be the possible causes of this problem. The objective was to find out how cost control measures relate with capacity to wheel power to the distribution companies and the profitability of the company. Method of study was the application of the multiple regression using the Ordinary Least Squares (OLS) estimation method to regress budget values and profitability o quantity of power wheeled by the TCN. Findings revealed that both Budget Value and Profitability, as explanatory variables, maintain significant positive relationship with the quantity of power wheeled by the firm to the tune of BV (0.362) with a probability of 0.0377 and Prof (0.437) with a probability of 0.0438 respectively. The study also found that even though the variables of the study are normally affected by seasonality's and other environmental factors rendering them prone to random effects, they maintain an impressive 52% speed in returning (adjusting back) to their steady state or equilibrium state. The overall explanatory power of the model peaked at 64%. This led to the conclusion that cost control measures which was proxied using budgeted cost figures, otherwise referred to as (BV) in this study have significant positive impact on quantity of power transmitted by the TCN. The study recommended strict adherence to budget figures ad evolution of policies consistent with persistent improvements in budget prudent management.*

1.1 Introduction

Project failure is a rampant phenomenon in Nigeria owing to the various technical and financial pressures, cost limitations and sub-optimality in the final quality presentation. Jagboro and Banalola (2005) wrote that the interim report of the Presidential panel on contracts at the wake of the present democratic government in Nigeria confirmed a staggering amount of over four hundred and fifty billion naira for project which can be classified as failed contracts, spanning from 1979 to 1998. The main reason for this is not far-fetched as many of the professional firms involved in project

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administration lack adequate management inputs in both quantitative and qualitative terms. Another reason for this high rate of projects abandonment and failed contracts in Nigeria, is that in most government projects, the mobilization fee which is given to the contractor is reimbursed to those who awarded the contract as "bribe" usually of huge sums of money and this thereby increases the cost of the project, affects the quality of job executed by the contractor and will also leave the project either unexecuted or abandoned. This is because the money meant for the project execution have been diverted into individual pockets (Osemenam, 2004).

However, the overall design of any infrastructure project is predicated on different contributors exhibiting various professional skills with a view to obtaining an optimum design solution in the end. These inputs are based on the understanding of design and execution parameters ranging from functionality and usefulness of the project, aesthetics and appearance, safety of the structure, quality of workmanship, cost and financial matters and most importantly client's satisfaction with the project on completion. Business everywhere is faced with everyday challenges for survival and the need to adapt is very important. Appointing the project manager at the right time and seeking his professional advice for cost matters is a very key problem in the Nigerian construction delivery.

The processes involved in planning, estimating, budgeting, and controlling costs so that the budget can be completed within the approved budget (Eda Buchner (2015). According to Eda, cost management can only be properly handled in a project if it is done with respect to triple constraint of scope, time, and quality. Due to population growth and subsequent increase in demand for higher efficiency and reliable electricity supply, most power systems in Nigeria and around the world are being forced to operate at almost full capacity (Happ, 2014, and Illic et al, 2017).

Nigeria has made a major transition from a vertically integrated, publicly-owned electricity network to a largely privately-owned unbundled electricity network, with the separation of the different segments of electricity business through a process called 'unbundling'. The reforms have moved Nigerian power sector from a state monopoly to a competitive electricity market. Prior to the 2005 reforms, Nigeria, with a population of over 165 million people then, and an average generation of about 3,800 megawatts (MW), had a very low per capita consumption. Thus, Nigeria embarked on the liberalization and privatization of electricity sector. Since 2005, there has been some move forward in the power sector, with the Nigerian Electricity Regulatory Commission (NERC) having licensed more than 20,000 MW of power that was expected to could potentially come to the grid in a few years. However, the licensees are yet to make real progress in executing their projects.

The electric utility industry is probably the largest and the most complex in the world (Silva, et al, 2018; Park, et al, 2018). The complexity of a power system is directly proportional to the number of buses which it serves. In Nigeria, the electricity industry has been deregulated with the old National Electric Power Authority (NEPA) becoming Power Holding Company of Nigeria (PHCN) which had the responsibility of generation, transmission and distribution of electricity in the entire country. Following the final unbundling of the power generation system

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in Nigeria, finally, the PHCN was unbundled into six generating companies, eleven distribution companies and just one transmission company (PHCN annual report, 2009-2010). These companies need to be result driven and profitable to the investors. Thus, each of them must be able to account for the amount of energy ad power it draws and supplies to its clients.

TCN emerged from the defunct National Electric Power Authority (NEPA) as a product of the merger of the Transmission and Operations sectors on April 1, 2004. TCN was incorporated in November 2005. Being one of the 18 unbundled Business Units under the Power Holding Company of Nigeria (PHCN), TCN was issued a transmission License on 1st July, 2006. It was subsequently issued two licenses on June 10, 2013 for electricity transmission and system operations.

1.2 Statement of the problem

Power supply in Nigerian has been unstable, inadequate and unreliable. The problems have been attributed to the power sector's inability to generate enough revenue to maintain the system due to underpricing of electricity service. The industry has not been able to generate enough revenue to cover its operating costs let alone its considerable capital expenditure needs (NERC, 2013). Amadi (2012) maintains that the absence of a cost reflective tariff caused the inability of the power sector to render effective services. The Transmission Company of Nigeria (TCN, 2007), states that inappropriate pricing helped to compound the poor operational and financial performance of the industry. Part of the reform programme of the government is increase in tariffs. Power tariffs in Nigeria before the introduction of Multi-Year Tariff Order (MYTO), was said to be below the cost of supply. The pricing failed to consider commercial viability of the sector and the tariffs were not frequently reviewed. According to Kaitafi (2011), the average tariff in Nigeria was low for a very long time due to government control. The average tariff in Nigeria before 2002 was N4.50/kWh. In 2002, it was increased to an average of about N6.00/kWh (NERC, 2005). The first attempt to prepare an effective cost recovery policy/plan was made by NERC in 2008 when the agency introduced the Multi-Year Tariff Order (MYTO). It was believed that this new tariff order would ensure cost-effectiveness (NERC, 2012). Consequently, the price was increased to an average of N11.20/kWh in 2008 under MYTO. This increase of about 50% was still considered as one of the lowest in the world (Kaitafi, 2011).

It was also below the price paid in most West African countries (The Presidency, 2010). As a result, the MYTO was again reviewed in 2012 which raised the electricity tariff to an average of 23.89/kWh which is currently in use. Efficient power pricing contributes immensely to proper functioning of the power sector (Briceno-Garmendia and Shkaratan, 2011) because it ensures that tariff is cost reflective. It is only full recovery of all costs associated with electricity service that can guaranty sustainability in the power sector under the Public-Private Partnership being arranged by the Federal Government of Nigeria. The question is whether this increase has made full operational cost recovery possible? Has it made any significant impact on the revenue generation of the power sector? Has the increase in tariffs in any way positively affected power generation of the Nigerian power sector? The private sector in business to make profit and will not tolerate non recovery of cost. Thus, this study is an attempt at

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examining how cost control measures impact efficiency in power transmission within the Transmission company of Nigeria.

1.3 Aim and Objectives

The aim of this study is to examine the effect of project cost control on Nigeria's power sector using the transmission company of Nigeria, Abuja as a case study.

The following objectives are pursued in this study:

i) To assess the effect Cost Estimation on the quantity of power transmitted annually.
ii) To assess the effect Cost Planning on the profitability of the transmission company of Nigeria.
iii) To assess the effect of Cost Control on the transmission company of Nigeria.

1.4 Hypotheses of the Study

The following hypotheses were postulated:

i) H0: Cost Estimation has no significant effect on the quantity of power transmitted annually by the TCN.
ii) H0: Cost Planning have no significant effect on the profitability of the Transmission Company of Nigeria.
iii) H0: Cost Control have no significant effect on the transmission company of Nigeria.

Review Of Related Literature

2.1 Conceptual Review

Sources of Energy in Nigeria

Electricity production in Nigeria over the last 40 years has varied from gas-fired, oil-fired, and hydroelectric power stations, to coal-fired stations with hydroelectric power systems and gas-fired systems taking precedence. This precedence is predicated on the fact that the primary fuel sources (coal, oil, water, and gas) for these power stations are readily available. Nigeria is considered as one of the energy rich countries in the world. Nigeria is rated among the top Oil Producing nations in Africa, second in natural gas reserve and estimated 2 billion metric tonnes of coal, especially the enormous coal reserves in Enugu area. In fact, Nigeria has the 10th largest reserves of oil and gas globally, consisting of 36.2 billion barrels of oil and 1.84 trillion cubic feet of natural gas (Briceno-Garmendia & Shkaratan, 2011). At present, the installed and available electrical capacity in the Nigerian generating stations shows that despite a total grid capacity of 5924.7 MW, only 4586 MW is available, i.e., 22% of the installed capacity was unavailable (Abiola & Adebayo, 2015).

Generation: In Nigeria, Electricity production over the last 40years has varied from gas-fired, oil fired, hydroelectric power stations to coal fired stations with hydroelectric power systems and gas fired systems taking precedence. Electricity is generated at between11.5–16kV and stepped up by a step-up transformer to 330kV at the Power stations. This is done so as to take care of power losses (I2R losses) along the line of transmission since the electricity generated is to be transmitted over long distances. Power generated at various generating stations in the Nation is connected to the National Grid and then transmitted.

Transmission: The next phase of getting power to the consumer is Transmission. Transmission begins with the transportation of voltage, 330kV along transmission lines (otherwise referred to as conductors) and is stepped down by a transformer to 132kV at the Transmission substation, this voltage is further

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transported along transmission lines to Injection substations and stepped down to 33kv.

Distribution: Distribution of electricity starts at this point. The voltage is stepped down by a distribution transformer to 11 kV which in turn is stepped down to 0. 415kV and further stepped down to 240V before it gets to our homes or offices.

About Transmission Company of Nigeria (TCN)

Transmission Company of Nigeria (TCN) manages the electricity transmission network in the country and was incorporated in November, 2005. TCN emerged from the then National Electric Power Authority (NEPA) as a product of the merger of Transmission and Operations Sectors in April 1, 2004. Being one of the 18 unbundled Business Units under Power Holding Company of Nigeria (PHCN), the company was issued a Transmission license on 1st of July, 2006. TCN is presently fully owned and operated by the government and as part of the reform programme of the government, it is to be reorganized and restructured to improve its reliability and expand its capacity. It is responsible for evacuating electric power generated by the electricity generating companies (GenCos) and wheeling it to distribution companies (DisCos). It provides the vital transmission infrastructure between the GenCos and the DisCos' Feeder Sub-stations. Activities carried out by TCN include: Electricity transmission, System operation, and Electricity trading which is ring-fenced. Its major function is to collect generated Electric Power from Generating Companies and wheel it to Distribution Companies. TCN comprises of nine Transmission Regions and the National Control Centre (NCC), viz: Bauchi, Kaduna, Shiroro, Benin, Osogbo, Enugu, Lagos, Kwara and Port Harcourt.

The TCN's vision is to be "a Transmission Company with a solid reputation for delivering reliable, cost-effective Electric power to end users in Nigeria and in West Africa Sub-region". Its mission statement is "to cost effectively provide, operate and maintain the required assets, equipment and transmission grid network for evacuating and dispatching high quality Electricity with minimal losses"

In order to perform its functions effectively, the TCN has two sub-components; Transmission Service Provider (TSP), Independent System Operator (ISO), which is made up of System Operation and Market Operations.

Transmission Service Provider (TSP)

The Transmission Service Provider (TS) was established to provide bulk power transmission infrastructure, operation, maintenance and interconnecting neighboring countries. As a sub-sector, the TSP operates in a semi-autonomous manner. Transmission Service Provider (TSP) is one of the business units of the Transmission Company of Nigeria charged with the responsibility of building, upgrading, maintaining and operating the nation's electricity transmission network.

Geographical Structure of the Transmission Company of Nigeria (TCN)

TCN has created eight Transmission Planning Regions for better planning. The actual regions under the field and maintenance services sector are shown below. Since new regions, Abuja Region (FCT (Abuja), Nasarawa and Kogi states) were settled in July, 2018, there are currently nine Transmission Planning Regions. The electricity supply to Nigerian consumers is

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handled by 11 privatized distribution companies, each with its own area as show I the table below.
Table I

S/N	Disco	Location
1	Abuja Electricity Distribution Company	Abuja
2	Benin Electricity Distribution Company	Benin
3	Eko Electricity Distribution Company	Eko
4	Enugu Electricity Distribution Company	Enugu
5	Ibadan Electricity Distribution Company	Ibadan
6	Ikeja Electricity Distribution Company	Ikeja
7	Jos Electricity Distribution Company	Jos
8	Kaduna Electricity Distribution Company	Kaduna
9	Kano Electricity Distribution Company	Kano
10	Port Harcourt Electricity Distribution Company	Port Harcourt
11	Yola Electricity Distribution Company	Yola

The electricity consumption of the southern DisCos far exceeds their northern equivalents because the former are far more densely populated and most industries are concentrated there.

Cost management and control

The management and control of costs is fundamental to most projects but around the world overruns in project scope and cost are commonplace. This can be broadly attributed to ineffective approaches to identifying, managing and controlling client needs, project scope and project cost (Peter 2014). Numerous cost budget blowouts on major projects around the world in the order of hundreds of millions and billions of dollars have attracted increasing concern and attention at all societal levels. The Global Financial Crisis in 2008 further exacerbated the problem and continues to have a significant impact on project financing around the world as financiers tighten lending controls and avoid lending for projects lacking sufficient risk controls. Governments, major private sector developers, financiers and global entities such as the United Nations, the World Bank and the World Trade Organisation have increasingly recognized the need for more effective cost control on construction projects. This provides an opportune global setting for the project cost management discipline to raise awareness amongst these major organizations on the importance and value of engaging expert cost managers rather than have the role carried out by other professionals as a subset of their overall roles. Major barriers to achieving this are the fact that there is not a single descriptor for the professional discipline that is recognized globally (such as an architect and engineer) and that there is a lack of common professional standards and competencies (such as an ISO standard). The main professional disciplines providing specialist project cost management services around the world are cost engineers, quantity surveyors, construction economists and project

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managers. A relatively new professional discipline of Project Controls has also emerged as a more encompassing descriptor of the role of the cost manager. The fundamental cost management principles and practices of these professions are the same. But cost management is not the exclusive preserve of these professionals and there are few countries that require official registration to practice as a professional in the field. Accordingly cost management is commonly carried out by a range of other professionals that may well lack the specialist technical competencies and expertise that is required for effective cost management.

2.1.2 Basis of Cost Control Analysis

Generally speaking, there is no one standard method of applying cost controls. A lot of intuition and smartness is called for. However, most approached to cost control and cost management would set out by first designing a standard budget for the project. They will make room for contingencies. Contingencies refer to cost of unplanned but required items. At regular intervals, the accountant determines the extent of work done and compares the actual cost at this point with the budgeted cost and analyzes the difference which is also referred to as the gap analysis. It is this gap that determines how far the actual cost has wondered away from the budgeted cost.

Cost management process

In the cost management process, the managers are primarily involved in a three-cycle process; cost estimation, budget determination and cost controls.

i) Cost estimation:

Type of estimate	When it is done	Why it is done	How accurate
Rough Order of Magnitude (ROM)	Very early in the project life cycle, often 3–5 years before project completion	Provides rough ballpark of cost for selection decisions	–25%, +75
Budgetary	Early, 1–2 years out	Puts dollars in the budget plans	–10%, +25%
Definitive	Later in the project, < 1 year out	Provides details for purchases, estimate actual costs	–5%, +10%

ii) Cost estimation methods

- Analogous (Top Down) estimating – Managers use expert judgment or similar project costs [quick, less accurate]
- Bottom-Up estimating – People doing work estimate based on work base suggestion, rolled up into project estimate [slow, most accurate]
- Vendor Bid Analysis – Estimating using bids + allowances for gaps in bid scope [slow, accuracy depends on gaps]
- Reserve Analysis – Adding contingency to each activity cost estimates as zero duration item [slow, overstates cost]
- Parametric estimating – Use mathematical model [accuracy varies] Two types:
  -Regression analysis – based on analysis of multiple data points
  -Learning Curve – The first unit costs more than the 100th, forecasts efficiency gains

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2.1.4 Cost Controls

Most cost control plans would follow the steps as summarized in the table below:

Inputs	**Tools &Techniques**	**Output**
Cost Baseline	Cost change control system	Cost Estimate Updates Cost Baseline Updates
Project Funding Requirements	Performance measurement analysis	Performance Measurements
Performance Reports	Forecasting	Forecasted Completion
Work Performance Information	Project performance reviews	Requested Changes & Recommended Corrective Actions
Approved Change Requests	Project management software	Organizational Process Assets Updates
Project Management Plan	Variance management	Project Management Plan Updates
Estimate cost	**Determine budget**	**Control cost**

In the final analysis, the cost manager does the following using the popular 3+2=5 Key Elements:

BCWS	Budgeted Cost of Work Scheduled	Plaed Value
BCWS	Budgeted Cost of Work Performed	Actual Value
ACWP	Actual cost of work performed	Actual Cost
BAC	Budget at completion	
EAC	Estimate at completion	

Schedule Variance is the difference between work scheduled and work performed (expressed in terms of budget dollars)

Formula: SV $ = BCWP – BCWS

Before the final analysis of project cost is doe, the cost manager must pose and answer the following questions:

Of the work I scheduled to have done, how much did I budget for it to cost?

Of the work I actually performed, how much did I budget for it to cost?

Cost Monitoring and Control System

Controlling and monitoring of projects occurs when you establish ways to track the course of all activities and events in the project. As project is always a dynamic entity since it must respond to changing conditions if it is to be completed successfully. It is carried out in an environment of ceaseless change and there is a continual need for re - assessment and re-appraisal of the project plan.

Steps of Project Cost Management

In accordance with the principles of dynamic cost management and the content of cost management, the project cost management

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process of contracted enterprises includes six procedures, such as cost estimation, cost planning, cost control, cost accounting, cost analysis, cost assessment.

i) **Cost Estimation**

Cost estimation methods can be divided into qualitative forecast and quantitative forecast. As the qualitative prediction relies mainly on the qualities and assessment capabilities of the managers, so this approach should on the basis of a profound understanding about historical data, status and impact factors of the project cost. This method is simple and easy to apply, it is the best used when the data is lack and quantitative prediction is the most difficult to apply. Using the historical cost statistics information and quantitative relationship between cost and influence factors, quantitative prediction presumes and calculate the possible results of future cost by setting up a mathematical model. The common quantitative prediction methods include weighted average method, regression analysis method and so on.

ii) **Cost Planning**

Cost planning is an expression of the target cost , is the basis to establish the project management responsibility and carry out cost control and accounting, and it is for the main basis for cost control. After project manager accepted the commission of the legal representative of enterprise, he/she should organize the compiling of construction budget and determine the project cost of planning objectives by the auspices of the project management implementation plan to seek ways to reduce costs. Base on the auspices of the project management implementation plan, the project manager should make a practical planning cost of each item, including annual, quarterly and monthly liability cost plans. During the compiling of practical planning cost, project manager should decompose the controlled liability target cost and then devolves out into the relevant departments, the construction teams and the groups. The ways to make the compiling of practical planning cost are various, such as the target profit method, technological progress method, calculation in reality, fixed rate estimation, etc, these methods can be used according to the different situations of project

iii) **Cost Control**

According to the principle of cost management of whole process, cost control should be run through the various stages of construction, which is the core of the project cost management and the most complex and content-based management content with the most uncertain factors. The center of cost control should be placed on the project management department, including three important aspects such as plans to pre-control (prior control), process control (a matter of control), corrective control (subsequent control). The management of risk cost and the cost of uncertainty should be considered at the same time, in order to achieve the overall management of the project cost. The ways and methods of project cost control are the following:

Costing Accounting

The basic accounting range of Project cost accounting should be based on the responsible cost objectives of the project manager, the accounting's objects are controllable cost that is corresponding with the authorized domain of the project manager (Yang 2005). The whole process of accounting should be tracked monthly. The cost accounting methods include "form

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accounting method" and "accountant accounting method". Form accounting method is easy to operate and form format is free, it is more practical to carry out a responsibility accounting of each station of the project because it can set up a variety of forms according to the business management and requirements. Accountant method makes use of the integrated features of its unique debit and credit book-keeping method and full accounting of income and expenditure, according to the project cost content and the range of income and expenses, organizes the project construction cost accounting, including the accounting of direct cost and indirect cost (KPMG 2017).

Cost Analysis

Technical methods of cost analysis include comparative method (mainly including the comparative analysis between the actual project quantity and the estimated project quantity, the comparative analysis between the actual consumption and planned consumption, the comparative analysis between the actual price and planned price and the comparative analysis between the actual expenditure and the planned expenditure), factor analysis method, margin calculation method, ratio method (Han Yan-Feng, Duan Xiang-Qian 2017). In this, factor analysis method will be introduced in details through the regression analysis approach. Factor analysis method is a cost expense analysis method, which divides the integrated indexes of construction cost into the original factors of the connection of each item, in order to determine influence degree of each factor that caused the changes of each index. It can measure the influence degrees of the various factors so as to ascertain reasons for cost movements, and then propose improvement measures to reduce cost. For example, the planned brick construction volume of the project is 200m^3, in accordance with the provisions of the budget scale, 510 red bricks per cubic meter are used, the planned price of a red brick is N0.25; But the actual amount of bricks construction volume is 250m^3, real consumption of red brick per cubic meter is 500, the actual price of red brick is N0.30. To analyze the cost with factor analysis method, the actual cost of bricklaying is N12,000 higher than planned cost, mainly due to increased work and higher prices of red brick; In addition, since economizing the consumption of red brick, so that the cost of economize saves N625. According to IPMA (2013), the ways to analyze comprehensive cost such as sub-part project cost, monthly (quarterly) cost and annual cost is: make a comparison of the estimated cost, target cost and the actual cost, calculate the deviation of the actual cost and the estimated cost, the actual cost and the target cost, analyze the reasons of deviation for the sake of providing evidence of making effective measures to save the project cost.

Cost Recovery

Cost recovery simply means recouping what was invested in providing services. Cost recovery is closely related to tariff. Tariffs mean payments made by beneficiaries of the service. They are streams of revenue from the users that would enable investment cost to be recovered (Mannapbekov, 2011). Tariff in the power sector is defined according to Kaitafi (2011) as the aggregate price paid by the final consumer of electricity for a It is through this that the provider of electricity whether public or private investor will be able to recover costs of energy consumed. Obviously, the public sector finances invested in electricity supply are provided from tax payers'

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money and other sources of Government revenue. To ensure continued supply of the service and long-term sustainability, there is the need to recover all costs associated with the power service (IRC, 2013). Sustainability according to (IRC, 2013) connotes that the power programme is able to deliver as appropriate level of service in terms of quality, quantity, convenience and continuity. Cost recovery becomes imperative now that the Federal Government wants to hand over the power sector to private operators.

Difficulties and Challenges Faced by TCN

The electric power system of Nigeria has long suffered from a lack of generation capacity which requires permanent load shedding. Furthermore, frequent transmission and distribution system disturbances exacerbate the unreliability of the power system.

The main reasons for power shortages are outages of generation units and a lack of gas to generate power. The gas supply is frequently interrupted due to the pipeline network being sabotaged. The main concern for the future expansion of generation, however, is the availability of gas for additional generation capacity and the expansion of the gas pipeline network. Currently, most power plants are installed in southern Nigeria close to oil and gas fields. To ensure a reliable and optimally expanded transmission system, there will be a need to install new power plants also elsewhere in Nigeria.

In terms of generation and load balance in the eight TCN planning regions, four or five have a significant generation deficit. With the exception of Benin and Port Harcourt regions, demand exceeds available generation power in all others. In the Shiroro region however, the situation will be reversed once new HPP plants (e.g., Zugeru) come into operation.

Theoretical framework

Game Theory

Game theory has developed in two currents. The non-cooperative game theory analyses the agents' interactions (individual or group) in a competitive environment, and the cooperative game theory analyzes their interaction in a cooperative environment. The characteristics to create coalitions, payment factors and general features of cooperative games have specific structure and concepts. The most characteristic ones and the ones used. For any coalition S , the summation of the final cost assignments of the agents that form part of it, must be less or equal to the characteristic function of that coalition, Evans, Zolezzi and Rudnick (2003).

Grey System Theory

Grey system theory is a method to study the modeling of uncertain systems, small samples and poor information. Through the processing of some known information, we can find useful information. The grey prediction model is widely used in industry, agriculture, economy and other fields Xiao (2019). The grey prediction model can remove the old data in the data series and constantly supplement new data. The continuous addition of new data to the grey prediction model can meet the requirements of self-study. By continuously removing the old data, the model can reduce the storage space, which makes the operation convenient.

Methodology

The study adopted the Ordinary Least Squares (OLS) estimation method of multiple regression in the data analysis. This study is designed as a time series study with data spreading through 2008 and 2021. This study is a secondary data

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based study. It was not involved in questionnaire development for primary data generation but collected polished data on the relevant study variables from cognate secondary sources like the annual statistical bulletin of the National Bureau of Statistics and the annual report of the Transmission Company of Nigeria.

In order to analyze the effects of the independent variables on the depended variable of this study, we specify the following OLS linear regression estimation model:

$$Qpw = f(Bv, Prof) \quad \ldots\ldots(3.1)$$

Where Qpw = Quantity of Power Wheeled (Dependent Variable)

While the explanatory variables are

Bv = Budget Value of TCN project (Proxy for cost of outsourced services)

Prof = Profitability

Put differently, we have:

$$Qpw = \Omega + \beta_1 Bv + \beta_2 Prof + \mu_i \quad \ldots\ldots (3.2)$$

Where Ω is the constant and β_s represent parameters measuring impact cycles, elasticities and movements between the dependent and the explanatory variables of the model. μ_i is the stochastic error term which absorbs the effects of excluded variables ad all other likely errors.

For our data, to test the stationary properties of the series, the standard Augmented Dickey-Fuller (ADF) test will be applied. The general Augmented Dickey-Fuller equation is:

$$\Delta y_t = a_o + a_1 y_{t-1} + \sum_{i-1} a\Delta y_i + e_t \quad \ldots\ldots (3.3)$$

$$\Delta y_t = a_o + a_1 y_{t-1} + \sum_{i-1} a\Delta y_i + \delta_i + e_t \quad \ldots\ldots (3.4)$$

where: y_t = time series

Δ = 1st Difference Operator

a_o = Constant

n = Optimum Lag Length in the variables

δ_i = Deterministic time trend

e_t = Random error term and

y_i in this study is a vector of explanatory variables.

To test the presence of co-integration among the variables, procedure developed by Johansen (1988, 1991), Johansen and Juselius (1990). The purpose of co-integration test is to determine whether a group of non-stationary series is co-integrated or not. The method comprised of maximum likelihood procedure for the estimation and determination of the presence of co-integration. In our study Johansen co-integration test is used with a view to estimating the long-run impact of public fiscal policy on economic growth. The vector error correction method is applied to find out the speed of adjustment the variables to shocks affecting the model. The long-run cointegrating equation is given as follows:

$$X_t = \delta Y_t + \mu \quad \ldots\ldots (3.3)$$

Where X_t represents the natural log of Quantity of Power Wheeled and Yt represents the natural log of a matrix of the explanatory variables in the model. Xt and Yt are both nonstationary variables and integrated of order one, ie, I (1). The necessary condition for cointegration is that the estimated residual from equation (1) be stationary (that is, μt = I (0)). If the above conditions are met, ECM is estimated from this model as stated below:

$$\Delta GDP_t = \delta 1 \Delta Yit + \delta 2 \omega t\text{-}1 + \mu t \quad \ldots\ldots (3.4)$$

where:

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Δ = 1st Difference Estimator
Y_t = Matrix of explanatory variables.
μ_t = Error Term
ω = Estimated Residual from equation 1
Y_t requires that the coefficient δ in the short-run equation (2) be negative and statistically significant to confirm the cointegration of the variables. Note that the estimation of the ECM precludes the question of spurious regression since the variables are stationary and equally incorporates both the static long-run and dynamic short-run components.

A-priori Expectations about the Parameter Estimates
Table 1 Variables and their a-priori expectations

Variable	Constant	Bv	Prof	μ_i
Expectation	+ ($0 \leq \Omega \leq \infty$)	+ ($\beta_1 > 0$)	+ ($\beta_2 > 0$)	0

In order to run the statistical analysis of the data set as collected and specified, the data is fed into the system using the Econometric Views (E-Views) statistical software, version 9 for the data analysis. This is no office job report. It is the normal statistical process for reporting secondary data research jobs.

Data Presentation and Analysis of The Results
Descriptive Analysis

	QPW	Bv	Prof
Mean	9.974194	1769.343	3741.625
Median	11.20000	1018.000	2843.560
Maximum	23.90000	5185.320	14537.12
Minimum	1.900000	16.22000	69.89000
Std. Dev.	6.096664	1884.813	3613.694
Skewness	0.392261	0.747836	1.177634
Kurtosis	2.231330	1.961888	3.949878
Jarque-Bera	1.558175	4.281503	8.330678
Probability	0.258825	0.061756	0.015524
Sum	309.2000	54849.63	115990.4
Sum Sq. Dev.	1115.079	1.07E+08	3.92E+08
Observations	14	14	14

Source: E-views 9 output by the author.
QPW and BV figures reached average maximum of 23.9 and 5185.3 respectively.

Analysis of Unit Root Tests
Table 4.1 ADF Unit Root Result Summary Table

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Testing the Variables at levels 1(0)				Testing the Variables at first difference 1(1)		
Variables	**5% Critical Level**	**t-stat**	**Proby.**	**5% Critical level**	**t-stat**	**Proby.**
Qpw	3.603202	4.178218	0.8803	3.603202	2.283931	0.0422
Bv	3.595026	4.807308	0.6072	3.603202	2.541495	0.0207
Prof	3.595026	4.545405	0.6552	3.603202	2.555670	0.0201

Source: extracted from ADF e-views result

From the ADF table above, it could be seen from the probability columns that the variables failed the stability test at their levels but passed the test at their first difference.

Given that the variables were not stationary at levels but at their first difference, a cointegration test is conducted to know whether the variables share a long-term equilibrium property.

Table 4.2 Cointegration Test Result for Model 1 (Abridged)

Hypothesized No of CE Equations	Egenvalue	Trace Statistic	0.05 Critical Value	Probability
None *	0.916132	135.1945	69.81889	0.0000
At most 1 *	0.698329	63.31767	47.85613	0.0009
At most 2	0.517538	28.56355	29.79707	0.0689
At most 3	0.224538	7.426814	15.49471	0.5286
At most 4	0.001799	0.052212	3.841466	0.8192

Max-egenvalue test indicates 3 co integrating eqn(s) at the 0.05 level.

*Denotes rejection of the null hypothesis at the 0.05 level. **Mackinnon-Haug-Michelis (1999) p-values

The Error Correction Model (ECM)

Error correction models are constructed to establish the speed of adjustment of the series (i.e., the variables of the study) back to equilibrium after a period of systemic shock. To construct an ECM, the model is first run on its Ordinary Least Squares (OLS) platform, the residual generated is then incorporated into the initial list of series and allowed to function as the ECM. Thus, in practice, it is much like deducting the variables from the value of the error term so that the coefficients automatically become the adjustment or error-corrected coefficients of the model.

The ECM Result for the Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.267602	8.670449	-0.607535	0.5500
QPW(-4)	-0.024886	0.106631	0.124437	0.0077

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Bv (-4)	0.217084	0.867049	0.105360	0.0080
Prof(-4)	0.375005	3.18E-05	0.202552	0.0122
ECM(-1)	-0.520796	0.266843	-0.277852	0.0451

R-squared	0.723925	Mean dependent var	4.70000 0
Adjusted R-squared	0.644664	S.D. dependent var	7.665156
S.E. of regression	7.983045	Akaike info criterion	7.185647
Sum squared resid	1338.309	Schwarz criterion	7.473611
Log likelihood	-91.00623	Hannan-Quinn criter.	7.271274
F-statistic	0.594112	Durbin-Watson stat	1.665895
Prob(F-statistic)	0.704688		

The table above presents the ECM result. It shows that the ECM coefficient turned up with -0.520796. This implies a speed of adjustment back to equilibrium after a shock of about 52% within a given horizon. The ECM also turned up with the correct sign since by tradition, it should have a negative sign so that the build-up of errors in the system of equations is gradually deducted from the system within a given horizon thus returning the system back to equilibrium level. The coefficient of the ECM is also significant at the 5% critical level which also satisfies the traditional requirement for a functional construction of an ECM model. The D.W statistic is 1.66 which is indicative of an insignificant positive autocorrelation.

4.5 The Estimated Model

Dependent Variable: D (Qpw (-1)).
Method: Least Squares
Date: 10/03/23 Time: 22:04
Sample (adjusted): 2008-2021
Included observations: 13 after adjustments

Source: Extracted from regression result in E-views V9.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Bv (-1))	0.362817	0.001519	1.854873	0.0377
D(Prof (-1))	0.437312	0.002244	3.258481	0.0438
R-squared	0.695888	Mean dependent var		0.109824
Adjusted R-squared	0.648158	S.D. dependent var		0.074717
S.E. of regression	0.050777	Akaike info criterion		-2.977117
Sum squared resid	0.054143	Schwarz criterion		-2.782097

Hypotheses Testing

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Log likelihood	31.21797	Hannan-Quinn criter.		-2.923027
Durbin-Watson stat	2.102100			

Decision Rule:
Reject Ho if the p-value of the parameter estimate is < 0.05. Do not reject if the reverse is the case.
Table 4.13 Test of hypotheses of the estimated Model.

Variable	**Parameter estimate (Coefficients)**	**P-value**	**Remark**
BV	0.362	0.0377	Significant
Prof	0.437	0.0438	Significant

From the table, Ho is rejected in both tests since both of the variables have significant outcomes and possess the correct signs and the overall explanatory power of the model is 0.0.648 which is approximately 65%.
This implies that BV and Prof as cost control mechanisms do significantly contribute to improving power supply by improving the total amount of power transmitted by the company.

5.1 Summary of Findings

Findings from the study revealed the following:

i) The coefficient estimate for Budget Value (BV) in this study shows a positive value of 0.362817 which implies that for any a unit change in the value of the project budget, there will be a corresponding change in the quantity of power transmitted by the TCN to the tune of 0.362817 put differently, a unit change in the value of the project budget triggers a less than proportionate positive change in the quantity of power wheeled by the TCN to the tune of 36%.

ii) Again, the parameter estimate measuring the impact of Profitability (Prof) on quantity of power transmitted (QPW) turned up a value of 0.437312 which also meets the apriori expectations of the study. This result implies that a unit change in the volume of profits realized by the company would induce higher performance in the TCN to the tune of 0.437 or 44% approximately.

iii) The overall explanatory power of the model is 0.648159 net of adjustments. This implies that, overall, the model explains 65% of the behaviour of the dependent variable.

iv) The variables of the study adjust back to their steady state after each horizon of shock at the rate of 65% per horizon.

5.2 Conclusion

From the results of the regression used to test the hypotheses of this study, it is concluded that both profitability (Prof) and the Budget Value (BV) of TCN projects trigger positive consequences on the power wheeling capacity of the company within the period under review. This implies that these variables maintain positive relationship with the dependent variable. Put differently, this study reveals that cost controls exert positive impact on the productivity of the TCN. This

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conclusion is based on the fact that all the parameter estimates measuring the impact of the explanatory variables on the dependent variable turned up with positive values indicative of a direct relationship with the dependent variable.

5.3 Recommendations

Based on the findings of this study, the following recommendations are made:

i) The management of the TCN should constantly evolve policies that improve its cost management capabilities.

ii) The TCN should maintain strict adherence to budget figures since this has proved to be the main source of cost controls. What this means is that while preparing the budget, effort must be made to envisage all possible factors that might derail the cost control project on time ad factor them in so that there may be no need for frequent cost adjustments in the course of the project execution.

iii) Significant parts of the Profits made should be ploughed back. Give that the TCN is currently very low in investments as was found in the literature review which explains why it cannot wheel sufficient quantities of power to the distributors even if such have been generated, there is need for planned reinvestment of the profits to support expansion and further profitability.

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