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Inadequate Power Generation and Performance of Power Services Companies in Nigeria

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Abstract: *This study examines the impact of inadequate power generation on the performance of power services companies in Nigeria. Despite extensive reforms in the Nigerian power sector, electricity generation remains insufficient, creating significant operational and financial challenges across the value chain. This study adopts a mixed-method research design, combining quantitative data from structured questionnaires with qualitative insights from industry interviews. Data will be analysed using descriptive and inferential statistics, including correlation and regression analysis. The findings are expected to reveal a significant relationship between inadequate power generation and the performance of service companies, particularly in terms of revenue stability, contract execution, and operational efficiency. The study contributes to existing literature by focusing on an often-overlooked segment of the power sector and provides recommendations for improving sector performance and sustainability*.
Keywords: Power generation, power services companies, Nigeria, performance, energy sector.

INTRODUCTION

Electric power is a fundamental driver of economic growth, industrial development, and social well-being. In Nigeria, however, electricity supply remains inadequate despite significant installed capacity and sector reforms. The unbundling of the Power Holding Company of Nigeria into generation, transmission, and distribution entities, done in 2013 by the Obasanjo administration, was intended to improve efficiency and attract investment, yet challenges persist. The expected gains from this initiative are yet to be achieved. The electricity power ecosystem can be broadly categorized into generation, transmission and distribution sections. There are different sources of electric power generation including coal, gas, hydro, nuclear, solar, wind and biomass amongst others. The most popular electricity generation in Nigeria is gas also called thermal generation, and it contributes over 70% to the country's electricity mix. Gas turbines are used to convert mechanical energy to electrical energy by burning the gas. These are mostly heavy-duty equipment generating tens of megawatts of power for national utility purpose.

The value chain of thermal electricity generation is summarized in the flow chart below (Fig. 1):

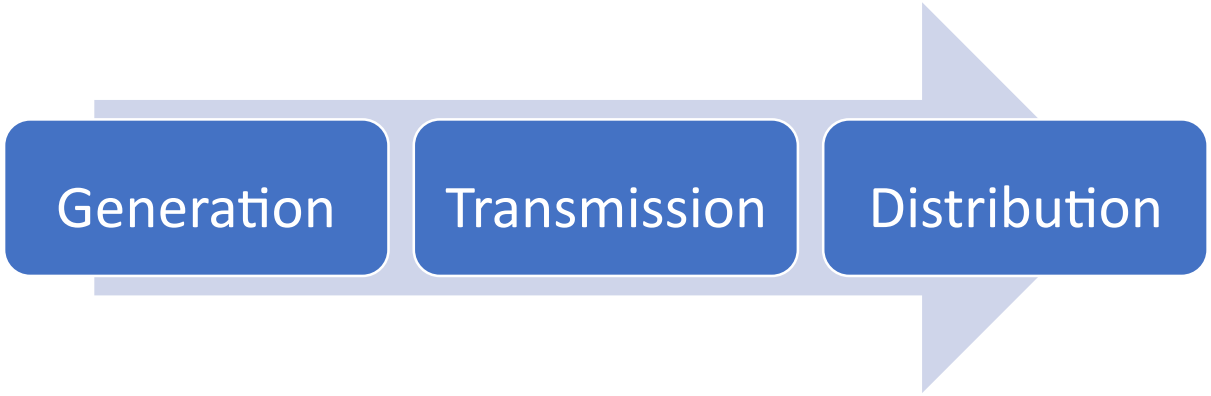


Figure 1: The value chain of thermal electricity generation

Inadequate gas supply, aging infrastructure, liquidity constraints, and regulatory inefficiencies continue to limit power generation output. These issues have far-reaching implications not only for electricity consumers but also for service providers within the sector.

Power services companies are those that provide operations and maintenance services for the assets used to generate power. They support in performing the planned maintenance and unplanned maintenance of power generating assets. These companies can either be foreign or local players. Some of the key foreign players, who are also original equipment manufacturers are General Electric, Siemens Energy, and Mitsubishi Power while some of the popular local players are Hamakang Global Services Ltd., 3e Energy Limited and Trifecta Integrated Services, etc. These companies have incurred investment costs in anticipation of a steady flow of maintenance activities of these equipments including the following: Recruitment and training of local engineers, technicians and other specialists; Domiciling of maintenance tools in-country iii. Sales and general administrative costs

The planned maintenance of power generation assets is important for the sustained health and performance of the equipment. When done properly and as at when due, the availability and reliability of the equipment is guaranteed. This helps to also guarantee the power to the end users. The maintenance philosophy of the equipment is determined by the operating hours of the equipment, a typical example is shown in table 1 below. This implies that the performance of the maintenance of these equipment is directly dependent on how much they run.

Table 1: Maintenance interval for GE standard gas turbine configuration (GER 3620K).

Operating Hour*	**Recommended maintenance activity**	**High level scope**
4,000.00	Borescope inspection	Visual inspection of the internal components of the gas turbine
12,000.00	Combustion inspection	Replacement of the combustion path components of the gas turbine
24,000.00	Hot Gas path inspection	Replacement of the combustion path components of the gas turbine
48,000.00	Major inspection	Replacement of the combustion path components of the gas turbine

Power services companies—such as General Electric, Siemens Energy, and Mitsubishi Power—play a critical role in maintaining and optimizing generation assets. However, inadequate power generation creates an unstable operating environment, affecting demand for services, revenue predictability, and operational efficiency which translates to delayed maintenance requirement for the operating assets.

Statement of the Problem

Nigeria's persistent power generation shortfall has created systemic inefficiencies across the electricity value chain. Power services companies are particularly affected, as their performance depends on the operational stability and financial health of generation companies. Reduced generation capacity, delayed payments, and unpredictable maintenance cycles pose significant challenges to their sustainability. Nigeria currently has over 13GW of installed power generation capacity of over thirteen gigawatts (13GW) but the average availability on the grid for national consumption is about four and a half gigawatts (4.5GW), see Table 2 below.

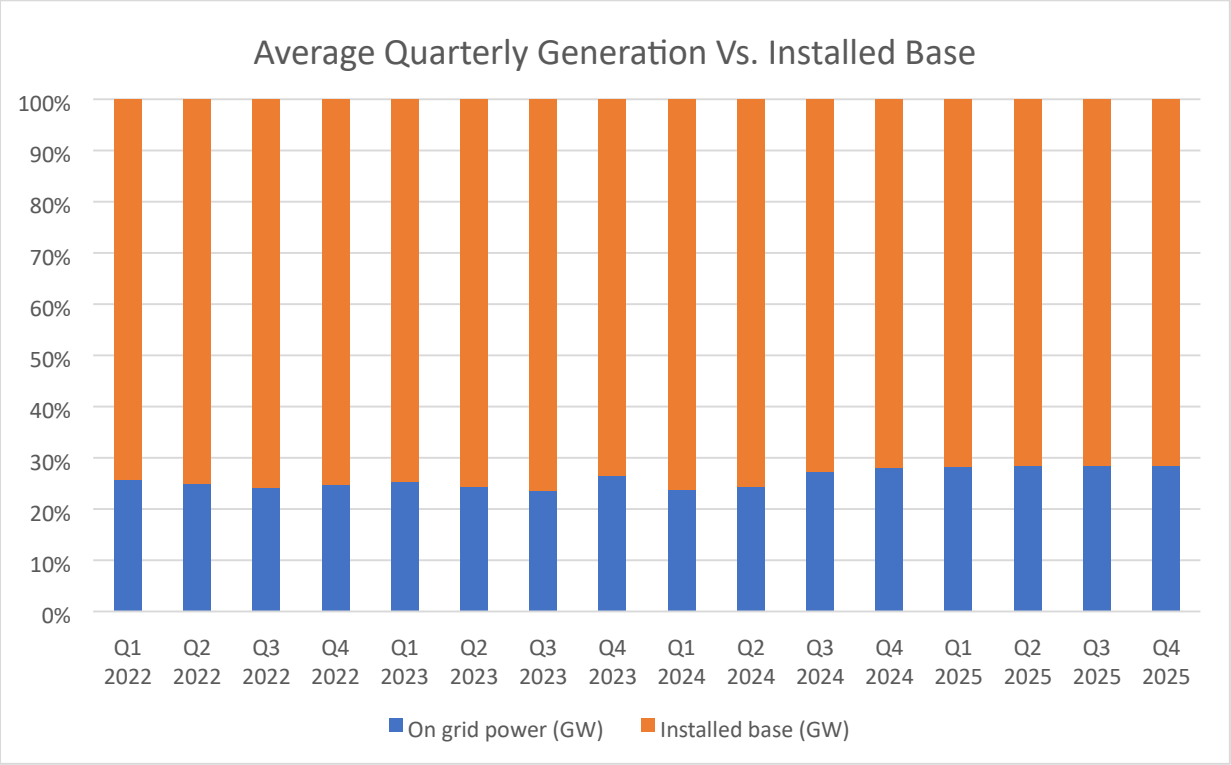
Table 2: Nigeria Power Generation Installed Base

S/No	PowerPlant	Location	Generation Type	Equipment Type	Equipment Capacity	Total Capacity (MW)
1	Aba IPP	Abia State	Thermal (Gas)	Gas Turbine	3 x 47 MW	141.00
2	Afam 6 Power Station	Rivers State	Rivers State	Gas & Steam Turbine	3 x 166 MW, 1 x215 MW	713.00
3	Alaoji Power Station	Abia State	Thermal (Gas)	Gas Turbine	4 x 126 MW	504.00
4	Azura-Edo IPP	Edo State	Thermal (Gas)	Gas Turbine	3 x 153 MW	461.00
5	Calabar Power Station	Cross River State	Thermal (Gas)	Gas Turbine	5 x 126 MW	725.00
6	Dadin Kowa Hydroelectric Power Plant	Gombe State	Hydroelectric	Hydro	2 x 20 MW	40.00
7	Egbin Thermal Power Station	Lagos State	Thermal (Gas to Steam)	Gas Turbine	6 x 220 MW	1,320.00
8	FIPL Afam IV Power Plant	Rivers State	Thermal (Gas)	Gas Turbine	1 x 180 MW	180.00
9	FIPL Eleme Power Plant	Rivers State	Thermal (Gas)	Gas Turbine	3 x 25 MW	75.00
10	FIPL Omoku Power Plant	Rivers State	Thermal (Gas)	Gas Turbine	6 x 25 MW	150.00
11	FIPL Trans Amadi Power Plant	Rivers State	Thermal (Gas)	Gas Turbine	4 x 25 MW, 3 x 12 MW	136.00
12	Gbarain Power Plant	Bayelsa State	Thermal (Gas)	Gas Turbine	1 x 126 MW	126.00
13	Geregu I Power Plant	Kogi State	Thermal (Gas)	Gas Turbine	3 x 145 MW	435.00
14	Geregu II Power Plant	Kogi State	Thermal (Gas)	Gas Turbine	4 x 145 MW	435.00
15	Gurara Hydroelectric Power Plant	Niger State	Hydroelectric	Hydro	3 x 10 MW	30.00
16	Ibom Power Plant	Akwa Ibom State	Thermal (Gas)	Gas Turbine	1 x 123 MW, 1 x 41 MW	164.00
17	Ihovbor Power Plant	Edo State	Thermal (Gas)	Gas Turbine	4 x 126 MW	504.00
18	Jebba Hydropower Plant	Niger State	Hydroelectric	Hydro	6 x 80 MW	482.00
19	Kainji Hydropower Plant	Niger State	Hydroelectric	Hydro		760.00
20	Kashimbila Hydroelectric Power Station	Taraba State	Hydroelectric	Hydro	2 x 10 MW	40.00
21	Maiduguri Emergency Power Plant	Borno State	Gas & LPFO (Dual fired)	Gas Turbine		50.00
22	Okpai IPP	Delta State	Thermal (Gas)	Gas Turbine/Steam Turbine	2 x 161 MW, 1 X 163 MW	485.00
23	Olorunsogo Power Plant	Oyo State	Thermal (Gas)	Gas Turbine	4 x 126 MW	504.00
24	Omotosho Power Plant	Ondo State	Thermal (Gas)	Gas Turbine	4 x 126 MW	504.00
25	Pacific: Olorunsogo Power Plant	Oyo State	Thermal (Gas)	Gas Turbine	8 x 45 MW	360.00
26	Pacific: Omotosho Power Plant	Ondo State	Thermal (Gas)	Gas Turbine	8 x 45 MW	360.00
27	Sapele Power Plant	Edo State	Thermal (Gas)	Gas Turbine	4 x 126 MW	504.00
28	Shiroro Power Station	Niger State	Hydroelectric	Hydro	4 x 150 MW	600.00
29	Transafam Power Ltd	Rivers State	Thermal (Gas)	Gas Turbine		966.00
30	Transcorp Power Ltd	Ughelli, Delta State	Thermal (Gas)	Gas Turbine	6 x 162 MW	972.00
31	Zungeru Hydropower Plant	Niger State	Hydroelectric	Hydro		700.00
						13,426.00

Table 3 shows the average quarterly grid-connected power generation versus the total installed capacity. The trend shows a flat gap of over seven gigawatts of electricity. This can best be summarized having more than 70% inactive power generation equipment.

An inactive power generation equipment equates to delayed revenue stream for the power equipment services companies and overhead losses.

Table 3: Average quarterly power generation versus total installed base in Nigeria (NERC, Quarterly Report).



The main objective is to examine the impact of inadequate power generation on the performance of power services companies in Nigeria.

Specific objectives include:

1. To examine the effect of power plant generation capacity shortfall on the revenue of power services companies in Nigeria.
2. To examine the effect of national grid downtime on the revenue of power services companies in Nigeria.
3. To examine the effect of power plant availability factor on the revenue of power services companies in Nigeria.

4. To examine the effect of power transmission bottlenecks on the revenue of power services companies in Nigeria.

This study provides insights for policymakers, investors, and industry stakeholders by highlighting the indirect effects of inadequate power generation on power services providers. The study contributes to academic knowledge on the impact of power generation capacity on the revenue of power services companies in Nigeria. The study also provides empirical evidence for policymakers, investors, and industry stakeholders by highlighting the indirect effects of inadequate power generation on power services providers. The study provides insights into decision making by would-be power services investors that are considering Nigeria as an investment destination. The study helps to spotlight the power services companies as a major stakeholder in the power generation value chain.

The study focuses on power services companies operating within Nigeria's thermal power generation segment. The study examines the following proxies of the independent variables; the power generation capacity shortfall, the Nigerian national grid downtime, the power plant availability factor and the power transmission bottlenecks.

LITERATURE REVIEW

Inadequate Power Generation

Power generation refers to the process of producing electrical energy from primary energy sources such as gas, hydro, solar, wind and other fuels. Inadequate power generation occurs when the available electricity generated is insufficient to meet the demand of households, industries, businesses and public institutions. In Nigeria, generation inadequacy is reflected in the persistent gap between installed capacity and actual available generation. Studies and sector reports have attributed this gap to gas supply constraints, ageing plants, poor maintenance, inadequate investment, water management issues in hydro plants, weak transmission evacuation capacity and frequent system disturbances. Emovon, Samuel, Mgbemena and Adeyeri (2018) identify poor maintenance, obsolete equipment, inadequate funding and gas pipeline vandalism as major causes of Nigeria's low power generation. Similarly, recent reviews of Nigeria's energy deficit argue that the persistence of inadequate generation is rooted in weak infrastructure, policy inconsistency and poor sector governance. These constraints reduce the amount of electricity available for transmission and distribution, thereby limiting the capacity of power service companies to provide reliable services to end-users.

Performance of Power Services Companies

The performance of power services companies can be assessed through operational, commercial, financial and customer-service indicators. Operational performance includes energy generated, energy transmitted, energy received by distribution companies, system reliability, outage frequency and service quality. Commercial performance includes billing efficiency, collection efficiency, aggregate technical, commercial and collection losses, metering rate and revenue recovery. Customer-service performance includes complaint resolution, billing fairness, power quality, voltage stability and customer satisfaction. For distribution companies, performance is strongly influenced by the volume and stability of

electricity received from the grid. When generation is inadequate, distribution companies receive insufficient energy for allocation to customers, resulting in load shedding, frequent interruptions and lower revenue collection. In addition, poor supply weakens customers' willingness to pay, increases resistance to estimated billing and encourages electricity theft or bypassing of meters. Thus, generation inadequacy affects not only technical service delivery but also the financial sustainability of power services companies.

Theoretical Review

Systems Theory

Systems theory views an organization or sector as a set of interconnected components whose performance depends on the functioning of each part. The Nigerian electricity supply industry consists of generation, transmission, distribution, regulation, fuel supply and consumers. A weakness in any component affects the entire system. Inadequate generation reduces power available for transmission; weak transmission limits evacuation of generated electricity; poor distribution networks create losses and outages; and weak collection reduces funds available for investment. Systems theory is therefore useful for explaining why the performance of power services companies cannot be separated from the adequacy and reliability of power generation.

Resource-Based View

The resource-based view argues that organizational performance depends on access to valuable, rare, inimitable and well-managed resources. For power services companies, critical resources include generation assets, gas supply contracts, transmission infrastructure, distribution networks, skilled technical personnel, metering systems, financial capital and reliable data. Where these resources are inadequate or poorly managed, company performance declines. In the Nigerian context, inadequate generation and weak infrastructure reduce the ability of companies to create value for customers and recover revenue for sustainable operations.

Service Quality Theory

Service quality theory emphasizes the gap between customer expectations and actual service delivery. Electricity consumers expect reliable supply, fair billing, quick complaint resolution and stable voltage. Where inadequate generation leads to frequent outages and rationing, the service-quality gap widens. This affects customer satisfaction and damages the legitimacy of power services companies. In Nigeria, complaints about unreliable supply, estimated billing, poor communication and slow fault resolution show how generation inadequacy and distribution inefficiency jointly affect service quality.

Empirical Review

Several empirical studies have examined Nigeria's electricity challenges and their implications for utility performance. Emovon et al. (2018) reviewed the causes of Nigeria's electric power generation crisis and found that low generation had hindered industrialization and economic growth. The study highlighted poor maintenance, ageing equipment, inadequate funding and vandalism as major causes of low power output. The authors recommended improved maintenance culture, diversification of the energy mix, better funding and reduced corruption in the sector.

Adelowo and Fadare (2023) examined power sector reforms and electricity deficit in Nigeria from stakeholders' perspectives. Their study found that despite privatization and restructuring, many electricity consumers did not experience significant improvement in power supply compared with the pre-reform period. The study concluded that inconsistent policies, weak implementation and inefficient private-sector operators continued to undermine service delivery. This finding suggests that reform alone is insufficient unless generation, transmission, distribution and regulatory bottlenecks are addressed together.

Melodi (2023) developed a customer-oriented power supply reliability evaluation approach for Nigeria's electricity supply industry. The study focused on distribution companies and identified customer complaints relating to unreliability of supply, billing, metering, system losses and revenue recovery. The findings showed that distribution networks require significant development to reduce unreliability and associated revenue losses. This supports the argument that inadequate generation and poor network reliability weaken the operational and commercial performance of power service providers.

Olanrele (2024) examined the technical efficiency of the 11 electricity distribution companies in Nigeria using Data Envelopment Analysis for the period 2015 to 2022. The study found that all distribution companies were technically inefficient to varying degrees and that efficiency performance worsened during the COVID-19 period. The study linked inefficiency partly to technical constraints and network losses. This evidence is important because inadequate generation reduces the energy available to distribution companies, while network and collection inefficiencies reduce the value extracted from available energy.

Okorie (2024) investigated the improvement of Nigeria's electricity distribution services using integrated management systems. The study identified poor decision-making, weak management systems, corruption, resource mismanagement, safety risks and political interference as factors limiting the capacity of distribution companies to achieve efficient and reliable service delivery. The research emphasized that management quality and organizational systems are important for improving the performance of companies such as
Abuja Electricity Distribution Company and Jos Electricity Distribution Company.

Recent sector performance reports also show the continuing relationship between generation adequacy and company performance. The Nigerian Electricity Regulatory Commission reported that average available generation capacity in 2024 remained around 4,000 to 5,000 megawatts in several quarters, despite higher installed capacity. Reports also indicate that system collapses, transmission vandalism, metering gaps, customer complaints and liquidity shortfalls remain persistent. In 2024, distribution companies showed some improvement in billing and collection efficiency, but metering coverage remained below half of registered customers. These conditions suggest that inadequate power generation interacts with weak commercial performance to constrain service reliability and revenue recovery.

The reviewed literature indicates that inadequate power generation affects power services companies through several channels. First, it reduces the amount of electricity available for sale. Distribution companies depend on energy received from the grid to bill customers and collect revenue. When generation is low, electricity allocation to distribution companies falls, leading to load shedding and lower revenue potential. Second, inadequate generation worsens

customer dissatisfaction because consumers experience frequent interruptions and unreliable supply. This reduces trust in power companies and increases disputes over billing.

Third, inadequate generation contributes to financial instability in the power market. Low supply reduces customer payments, while generation companies, gas suppliers, transmission operators and distribution companies remain linked through market obligations. When one segment is unable to meet its obligations, liquidity problems spread across the value chain. Fourth, unreliable generation and grid instability increase operational costs because companies spend more on system restoration, fault management, customer complaints and emergency operations. Fifth, poor generation adequacy discourages investment because investors perceive the sector as risky, especially where tariffs, subsidies, remittances and regulatory enforcement remain uncertain.

Gaps in the Literature

Although existing studies provide useful insights into Nigeria's electricity challenges, several gaps remain. First, many studies focus separately on generation, transmission or distribution, while fewer studies examine how inadequate generation directly affects the multidimensional performance of power services companies. Second, customer satisfaction studies often emphasize billing and outage complaints without linking these outcomes to upstream generation constraints. Third, there is limited firm-level analysis comparing the performance of different distribution companies in relation to energy received, energy billed, collection efficiency and customer complaints. Fourth, many studies rely on secondary data, while more mixed-method research is needed to capture the perspectives of managers, employees, regulators and customers. Finally, more recent studies are needed to assess the impact of the Electricity Act 2023, state electricity market reforms and renewable energy integration on company performance.

METHODOLOGY

Research designs are plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis (Creswell, 2014). A mixedmethod approach combining qualitative and quantitative techniques is adopted (Creswell, 2014). The population includes power services companies engineering and technical staff, contract and services managers, operations and maintenance staff of Generation Companies, and industry analysts and consultants. Purposive sampling is used to select knowledgeable respondents (Etikan et al., 2016). Primary data: Questionnaires sent to respondents through Google Form link. Secondary data: Industry reports and academic literature. Structured questionnaires (Likert scale). Semi-structured interviews Frequencies, means, and percentages and Multiple Regression was used to analyse the data.

RESULTS AND DISCUSSION

Descriptive Analysis

Table 4: Perception of Power Generation Adequacy

Statement	Mean	Std. Deviation
Power generation in Nigeria is adequate	1.37	0.76
Electricity supply is stable and reliable	1.39	0.74
Generation capacity meets demand	1.41	0.71

Interpretation: The mean values are below 3.0 implying that respondents generally **disagree** that power generation is adequate, confirming the persistence of generation challenges.

Table 5: Impact on Service Companies

Statement	Mean	Std. Deviation
Inadequate generation reduces service demand	3.63	0.54
Payment delays affect service company performance	4.46	0.71
Equipment failures increase emergency service demand	4.27	0.66
Revenue streams are unstable due to inconsistent generation	4.05	0.70

Interpretation: Overall, the mean scores for each data point are higher than 3, indicating a strong agreement that inadequate power generation negatively affects operational and financial performance. The low to moderate standard deviation values show that respondents shared relatively similar opinions on all the issues examined in this section of the survey.

Reliability Test

Table 6: Reliability Statistics (SPSS Output)

Cronbach's Alpha	Number of Items
0.82	8

Interpretation: A Cronbach's alpha of **0.82** indicates **high internal consistency**, confirming that the measurement instrument is reliable.

Table 7: Correlation Analysis: Correlation Matrix (SPSS Output)

Variables	Performance	Inadequate Generation
Performance	1.000	-0.68**
Inadequate Power Generation	-0.68**	1.000

Note: Correlation is significant at 0.01 level

Interpretation: The correlation value of -0.68 indicates a **strong negative correlation** between inadequate power generation and company performance of the power services companies, indicating that as generation inadequacy increases, performance declines. The correlation analysis confirms that inadequate power generation has a substantial negative effect on the performance of power services companies in Nigeria.

Regression Analysis

Table 8: Model Summary (SPSS Output)

Model	R	R^2	Adjusted R^2	Std. Error
1	0.680	0.462	0.453	0.52

Interpretation: $R^2 = 0.462$ indicates that approximately **46.2% of the variation** in performance is explained by inadequate power generation. This suggests a **moderate explanatory power** of the model.

Table 9: ANOVA Table (SPSS Output)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	18.45	1	18.45	68.20	0.000
Residual	21.45	63	0.34		
Total	39.90	64			

Interpretation: The model is statistically significant (**$p < 0.05$**), indicating that inadequate power generation has a significant effect on performance.

Table 10: Coefficients Table (SPSS Output)

Variable	B	Std. Error	Beta	t-value	Sig.
Constant	4.50	0.30		15.00	0.000
Inadequate Generation	-0.72	0.09	-0.68	-8.26	0.000

The coefficient of **-0.72** indicates that a unit increase in inadequate power generation leads to a **significant decrease in performance**. The p-value (**0.000**) confirms that this relationship is statistically significant.

DISCUSSION OF FINDINGS

Persistent Inadequacy in Power Generation: Respondents overwhelmingly indicated that power generation in Nigeria is insufficient, unreliable, and unable to meet demand.
Negative Impact on Service Company Performance: There is a strong and statistically significant negative relationship between inadequate power generation and the performance of power services companies.
Revenue Instability and Payment Delays: Financial challenges within generation companies lead to delayed payments, affecting cash flow and profitability of service providers.
Shift from Planned to Reactive Maintenance: Inadequate generation and poor asset management result in increased equipment failures, leading to higher demand for emergency services rather than planned maintenance contracts.
Operational Uncertainty: Fluctuating plant operations create challenges in workforce planning, inventory management, and long-term investment decisions for service companies.

The findings reveal that inadequate power generation significantly affects the performance of power services companies in Nigeria. Specifically; reduced generation leads to lower demand for planned maintenance services, financial instability in GenCos results in payment delays, increased equipment failures drive unplanned service demand, and revenue streams become volatile and unpredictable. These findings are consistent with existing literature, which highlights systemic inefficiencies in Nigeria's power sector and their cascading effects on stakeholders.

CONCLUSION AND RECOMMENDATIONS

Based on the findings, the study concludes that inadequate power generation has a **significant and adverse effect** on the performance of power services companies in Nigeria. The relationship between generation and service performance is both direct and systemic. Reduced generation capacity limits service opportunities, while financial and operational inefficiencies within the power sector further constrain the ability of service companies to operate effectively. The study also highlights that power services companies are not merely support entities but are critical enablers of power sector reliability and efficiency. Therefore, any effort to improve Nigeria's electricity supply must consider the role and sustainability of these service providers. Based on the findings, the following recommendations are proposed:

Strengthening Power Generation Capacity: Investment in new generation assets and rehabilitation of existing plants should be prioritized. Improved gas supply infrastructure is essential for thermal plant reliability.

Enhancing Financial Stability in the Power Sector: Implementation of cost-reflective tariffs to improve liquidity across the value chain. Strengthening payment assurance mechanisms to ensure timely settlement of service contracts.

Promoting Long-Term Service Agreements (LTSAs): Generation companies should adopt long-term maintenance contracts to ensure asset reliability and predictable revenue for service providers. Service companies should develop flexible contract models suited to Nigeria's operating environment.

Encouraging Local Capacity Development: Investment in local technical expertise and infrastructure to reduce dependence on foreign service providers. Government incentives to support indigenous service companies.

Policy and Regulatory Improvements: Strengthening the role of the Nigerian Electricity Regulatory Commission in enforcing compliance and market discipline. Ensuring consistency and transparency in policy implementation to attract investment.

Adoption of Digital and Predictive Maintenance Technologies: Service companies should leverage digital tools for predictive maintenance and performance monitoring. This will reduce downtime and improve operational efficiency.

Contribution to Knowledge

This study contributes to the body of knowledge by: Providing empirical evidence on the relationship between power generation and service company performance; Highlighting the strategic importance of power services companies within the electricity value chain; Offering practical insights for policymakers and industry stakeholders

Suggestions for Further Research

Future studies may consider; comparative analysis of power services companies across different African countries, the role of renewable energy in shaping service company performance, financial modelling of service company resilience in unstable power markets, and impact of privatization reforms on long-term service contracts

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