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CAUSES AND CONSEQUENCES OF FREQUENT POWER GRID FAILURES IN NIGERIA

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Abstract

This study examines the causes and consequences of frequent power grid failures in Nigeria. Several causes were responsible for the frequent power grid failure in Nigeria such as infrastructure decay, poor maintenance, poor funding and vandalism which had consequently affect the economic and social lives of the country. The aim of this study was examine the causes and consequences of frequent power grid failures in Nigeria. The study adopted cross-sectional survey research design. The population of this study comprised of managers of Port Harcourt Electricity Distribution Company covering Akwa Ibom, Bayelsa, Cross Rivers, and Rivers States. There were thirty six (36) managers. The Simple Regression Statistical tool was adopted with the aid of Statistical Package for Social Sciences (SPSS version 23). Our findings suggest that infrastructure decay, inadequate maintenance, and vandalism are significant causes of power grid failures, resulting in economic losses and social instability. The study concludes that the causes of frequent power grid failure in Nigeria have significant consequences on the economy, daily life of the people and businesses at large. We recommend that the government invest in infrastructure upgrade, implement effective maintenance strategies, and enhance security measures to prevent vandalism.

Keywords

Infrastructure Deficiencies, Inadequate Funding, Political Cause, Economic Losses, Daily Life, Businesses

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1.0 Introduction

The Electrical Power System is a sophisticated human invention with variety of phenomena (Jimoh & Raji, 2023). Delivering power to end consumers requires a high degree of skill and knowledge, and the Electrical Power System is equipped with controls that limit changes in system parameters to levels considerably below legally mandated thresholds. Due to a rise in load demand, as well as economic, environmental, and other considerations that prevent generating firms (GenCos) from installing more transmission lines and generating stations (Ogunwuyi et al., 2024). The growth and development of any nation depends on the efficiency and effectiveness of their power sector. Electrical Power System drives all major aspects of human endeavours, from health to finance, from engineering to agriculture, electricity permeates human living. The country has a population of over 170 million citizens with the government targeting 10,000MW generating capacity (Ogunwuyi et al., 2024). However, the power generation is fluctuating from time to time based on gas pipeline vandalism and other environmental factors with low values of 1,508.6MW, 2,800 MW and high values of 4,387 MW and 5,000 MW (Adeoye & Adebayo, 2018). Electrical Power System is designed to function by generating and transmitting power to the load centres with specific frequency and voltage (Fasina et al., 2021; Adeoye & Oladimeji, 2018; Samuel et al., 2017).

The national electric grid serves as the backbone to any country's power supply. Nigeria has experienced frequent failures and losses of synchronization of its grid and the corresponding collapse have attracted a lot of attention, especially when compared to other countries on the same continents. The technical and political challenges must be tackled by both government and the management of power grid. Nigeria's power grid has been plagued by frequent failures, resulting in widespread power outages and significant economic losses. The country's power sector has been characterized by infrastructure decay, inadequate maintenance, and vandalism, leading to a decline in power generation and distribution. Factors propelling such unfortunate incidences could be traced to technical, infrastructural, and operational issues that bring to the scene the frailty of the country's power sector. The aged infrastructural facility of the power sector tops the list as most transformers, transmission lines, and substation comes off as being victims of years of total oversight which in turn has become a barricade to steady power supply. Most of this infrastructure comes with an expiry date and must be changed or upgraded when necessary. There is an obvious misplacement of priorities in what should be done at the time with the funds allocated to the power sector. Amidst billions of funding, most projects embarked on do not address the genetic causes of power instability.

The system instability of power grid is based on increased load demand, increased population, industrialization, environmental and economic factors which adversely affect the design and construction of transmission lines and generating stations (Adeoye, 2023). Disturbances in power systems is one of major contributors to power system instability and subsequently grid collapse which leads to both technical and economic losses (Adeoye, 2023). The power grid collapse is vulnerable to geomagnetic storms with the source from solar activity, electromagnetic pulses produced by altitude, cyber-attacks, and physical attack (Weiss & Weiss, 2019). Voltage collapse arises from the inability of heavily loaded power

system network to withstand contingencies and finally result to voltage drop and subsequently grid collapse (Uche & Vitalis, 2018).In a situation where power is and or disconnected from the grid system, a partial or total system collapse is experienced (Adzua, 2021). The power imbalance from the demand and supply end caused system collapse (Ogunwuyi et al., 2024). Alao and Awodele (2018) highlighted the power instability Nigeria and also proposed that, harnessing the solar energy could alleviate the energy poverty. Jimah et al. (2019) enumerate poor maintenance culture, inadequate gas supply, poor staffing and water mismanagement as the cause of power grid failure. Energy poverty is predominant is Nigeria, particularly, acute insufficiency, non-availability and inaccessibility of electricity (Aladejuyigbe & Awolusi, 2021). Samuel et al. (2019) put the installed capacity of Nigeria at about 6000 MW.

System collapse has huge consequences on the reliability of a power system. Nigeria. The reliability of the Nigeria power system is below par (Adeoye et al., 2021) assert that the reliability of the Nigeria electricity grid is very low due to frequent power interruptions due to weak power system, obsolete grid equipment, centralized generation system and over-dependence on fossil fuel. The Nigeria National Grid experiences an average of (28) system collapse every year over the past 12 years. The power outages, which prevent people from meeting routine business and household needs, result in huge economic and social costs (Ogunwuyi et al., 2024). Additionally, the pollutants from inefficient fuel generators which are commonly utilized as an alternative to power supply in Nigeria pose a health danger. It is estimated that electricity generator sets consume about $23 billion worth of fuel yearly (Ogunwuyi et al., 2024). The aim of this study was examine the causes and consequences of frequent power grid failures in Nigeria. The specific objectives were:

1. examine the impact of infrastructure deficiencies on economic losses of frequent power grid failures in Nigeria.
2. ascertain the effect of inadequate funding on daily life of frequent power grid failures in Nigeria.
3. determine the consequences of political cause on businesses of frequent power grid failures in Nigeria.

1.1 Research Hypotheses

Based on the literature review, we hypothesize that:

Ho_1: There is a significant effect of infrastructure deficiencies on economic losses of frequent power grid failures in Nigeria.

Ho_2: There is a significant effect of inadequate funding on daily life of frequent power grid failures in Nigeria.

Ho_3: There is a significant consequence of political cause on businesses of frequent power grid failures in Nigeria.

2.0 Literature Review

2.1 Overview of the Nigerian Power Grid

The Nigerian electric power system comprises electric generating plants or stations, transmission lines – high voltage or bulk power substations, sub-transmission and distribution systems. The transmission and distribution lines are categorized by their voltage ratings.

Transmission voltage is defined as 330KV while sub-transmission voltage is 132KV. The distribution system operates at 33KV, 11KV and 415V (Ibekwe et al., 2018). The Nigerian power grid combines generation, transmission, and distribution infrastructure to supply electric power throughout the country. Generation facilities include hydropower stations, thermal power plants, and renewable-energy installations. The electricity produced is transmitted through a high-voltage network of overhead lines, underground cables, and substations. The transmission system comprises 330 kV and 132 kV interconnected circuits delivering bulk electricity from generating stations to distribution companies. A few 330 kV lines transfer power to large industrial users. The high voltage power system remains one of the most important and indispensable infrastructures in modern society (Airoboman et al., 2015). Power transformers are used in the generating stations to raise the voltage of the produced power to the transmission voltage, and in the distribution substations to reduce the voltage of the power delivered to the distribution system voltages.

Okpeki and Efenedo (2013) found that deregulated power systems can work well, but only if the government allows private operators to establish their own method of satisfying the varying system load requirements and ensure that that power quality can remain established. The economics remain important and therefore, it is not always possible to create the best transmission systems. The balancing of the grid is only possible in places like Nigeria, when there is effective fault management and system stability is maintained using effective causes. Bello et al. (2016) performed a detailed research using the power system analysis tool (PSAT) to determine the working parameters of the 330KV network present in Northern Nigeria. They performed the continuous monitoring of the phase angle and the magnitude of the transmission voltage to understand its economics and operational performance. They carried out the IEEE bus test, and found that three operating buses were exceeding the voltage limit set at 1.05 p.u. The reactive power at two of the buses was also high, which created a loss during the transmission. The results of this article found that the power production was inadequate to meet the demand, causing frequent problems in the transmission network.

2.2 Power Grid Failure

An electrical power system's primary purpose is to supply enough power to all points of utilisation at a rate that is both economically feasible and reasonably reliable, hence preventing system collapse while it is in use. Therefore, every power system is expected to run optimally without experiencing any system collapse during its operations (Ekeng et al., 2024). The nation has been experiencing frequent blackouts, which have disrupted several activities and wrecked numerous industrial processes. Numerous power outages around the country are causing constant voltage collapses. Furthermore, it has led to an inconsistent and unstable electrical supply across the nation. It has raised the nation's unemployment rate and decreased production. The national grid is an interconnecting system that comprises all generation stations, transmission substations, and distribution substations. One of these adverse effects is the inability of electric power to be generated, transmitted, or distributed. In some cases, there is a partial or total blackout on the system. This is known as a grid collapse: which could be partial or total (Adeoye, 2021).

The nation's energy demand has increased at a rate never seen before due to the quick rise in both the population and small- and medium-sized businesses. However, the Nigeria power system components have not witnessed adequate expansion facilities, the non -integration of newer and smart technology, and the non-implementation of robust predictive and condition-based maintenance models thus leading to unprecedented voltage collapse. In addition, the has been the challenge of power system control and management which is becoming a challenge as a result of expansion restriction, demand increase, and the competitive and now deregulated power industry due to current evolution (Ekeng et al., 2024). Ibe et al. (2017) found that such a system reduces the maximum power angle deviation and ensures that the average available power remains at the lowest phase difference by having balanced inductive and capacitive load. Large disturbances are better controlled with the use of such systems. Oleka et al. (2016) argued that it is important to study the Nigerian electric power grid, especially with the rise of population which has resulted in an enhanced demand for electricity in the country. Ajao et al. (2016) presented that problems appear in the Nigerian power sector, which can be resolved by taking a smart grid creation approach. This approach is essential and is perfect for use in countries where transmission losses play an important part in determining the quality of power delivered to the consumers. Akinloye et al. (2016) evaluated the reasons behand the collapses that occur in the Nigeria power distribution system.

2.2.1 Causes of Frequent Power Grid Failures in Nigeria

The causes of frequent power grid failures in Nigeria are multifaceted. Some of the major causes include:

Infrastructure Deficiencies

Nigeria's power grid is outdated and fragile, with many parts operating beyond their intended lifespan. The Nigerian power grid suffered from a fundamental design deficit, which had continued to plague electricity supply. This issue was compounded by transmission stations shutdown, leading to both national and regional system collapses caused by low voltage and sudden frequency drops. Inadequate transmission infrastructure, distribution facilities, and transformers were additional factors (Ekeng et al., 2024). Overhead lines and cables dedicated to the distribution of electric power were of different sizes with insufficient transformer capacity; many distribution facilities were operating well beyond their recommended hourly rating. The grid system components nationwide were, in most instances, stranded with very low or no maintenance exercised on the facilities when in service. The inadequate transmission infrastructure primarily contributed to the system collapse. In addition, a tremendous increase in demand for power with limited grid capacity was a critical factor (Olówósejéjé et al., 2019). A significant percentage of customers were not metered, leading to substantial commercial losses for the providers. Furthermore, many customers manipulated meters to deceive the electricity provision firms. In 2014, an estimate revealed about 46% energy loss through technical (12%), commercial (6%), and collection (28%) channels; consequently, the system was unable to meet the high demand for electricity. Equipment failures have contributed substantially to the unreliability of power supply in Nigeria. Early power infrastructure included distributed generators with a combined capacity of approximately 400 MW. Between 1995 and 2013, the average number of grid disturbances

caused by generation faults increased significantly, from about 16 in the late 1990s to approximately 35 in the early 2000s. The sector's infrastructure is outdated, with SCADA systems built between the 1960s and 1980s now largely non-functional (Airoboman et al., 2015). Poor policy decisions and mismanagement of funds have exacerbated the decline in power generation. Despite billions spent to improve power supply, the situation has worsened across civilian regimes, leading to load imbalances that cause system frequency and voltage collapses. Adequate planning, operation, and maintenance of the substation's electrical equipment are necessary to ensure power system reliability and enhance Nigeria's national grid system. The proliferation of obsolete electrical equipment far in excess of modern specifications has created tremendous hazards to substation personnel and the entire Nigerian power system network.

Inadequate Funding

The power sector suffers from inadequate funding, which hinders efforts to upgrade infrastructure and improve power generation. Funding issues continue to play a critical role in the challenges faced by the Nigerian power grid. Researchers report that electricity infrastructure projects have been sidelined, power outages are common, and grid unreliability significantly hinders business sustainability and profitability (Olówósejéjé et al., 2019). The situation is exacerbated by the fact that most businesses resort to on-site diesel-powered generators for reliable electricity generation (Okafor, 2017). Despite the formulation of energy development policies aimed at diversifying the electricity mix and increasing rural electrification, insufficient investment impedes their effective implementation. Consequently, the sector is burdened by frequent and prolonged power outages that closely follow intertwined funding, technical, and political challenges.

Investment gaps constitute a significant economic cause of frequent power grid failures in Nigeria. Insufficient funding for maintenance and expansion leads to inadequate capacity and system reliability, resulting in persistent outages. The Nigerian National Petroleum Corporation and similar agencies underinvest in power generation despite substantial financial resources, largely due to a failure to prioritize sectoral needs. Investment gaps have hindered the development of new infrastructure and the rehabilitation of existing assets, rendering the power grid incapable of meeting the demands of a growing population and economy. Enhancing investment levels and ensuring efficient capital allocation are critical steps toward addressing these deficiencies and improving overall grid performance (Olówósejéjé et al., 2019).

Political Cause

The robustness of the Nigerian power grid is significantly compromised by political factors, which exacerbate technical and economic challenges. Regulatory uncertainty, corruption, mismanagement, and political interference obstruct the sector's growth and adversely affect operations (Yetano et al., 2019). Deregulation policies introduced in the early 2000s, originally intended to improve efficiency, have inadvertently rendered the industry more vulnerable. Moreover, the allocation of revenues to non-operational companies and a lack of transparent management further weaken the operational capacity and reliability of the power system. Addressing these political impediments is therefore critical to enhancing the stability

and performance of the national grid. The power sector occupies a strategic position in developing economies, and Nigeria is not an exception. Although the sector in Nigeria has attracted enormous attention, the challenges of supply shortage and frequent power grid failures still remain unresolved, with attendant social consequences. Some argue that Nigeria does not have adequate generating capacity or access to natural energy resources, while others place more emphasis on the challenges arising from transmission and distribution networks (Olówósejéjé et al., 2019).

Corruption, aligned with a clear absence of technical competence, threatens the Nigerian power grid's means to sustain irreplaceable machinery and requisite personnel. The Ethics and Anti-Corruption Commission (2015) comments on the progressive emaciation of the power sector and the disestablishment of the corresponding sub-unit under the Ministry of Power. Such discontinuity stifles the reinforcement of corporate ethics. Consequently, corruption flourishes, erecting a barrier to service advancement and straining a nation desperate for power. Administrative personnel lack adequate technical expertise to optimally repair and maintain equipment, a predicament that ensures consistent mismanagement of schedules. Within Nigeria's continually dwindling power generation landscape, political instability remains the greatest catalyst for instability. Power centralization, typified by a deliberate nationwide policy, erects singular points vulnerable to interruptions. Absence of structural reorganization produces a susceptibility that isolates the entire system during discreet collapses. Corruption further perpetuates this cycle, allocating contracts based on deceit rather than technical merit.

2.2.2 Consequences of Frequent Power Grid Failures in Nigeria

The consequences of frequent power grid failures in Nigeria are significant, including:

Economic Losses

Nigeria loses an estimated $26 billion to $29 billion annually due to unstable power supply, which is approximately 2% of its GDP. This translates to around N11.4 trillion to N13.1 trillion (using an exchange rate of 1 USD = 440 Naira). GDP Impact: The power outages affect the country's GDP, as businesses and industries struggle to operate efficiently without reliable electricity. SMS (Small and Medium-sized Enterprises) Impact: Frequent power failures disrupt the operations of SMS, leading to reduced productivity, increased costs, and decreased competitiveness. Economic factors significantly contribute to persistent power outages in Nigeria. Understanding these causes permits targeted strategies to alleviate the problem (Airoboman et al., 2016). Power grid expansions and transmission require substantial capital investments. Current investment levels are inadequate to meet the needs of a growing economy, population, and demand for reliable power. Funding to upgrade and replace aged generation, transmission, and distribution facilities is insufficient while electricity tariffs remain below economically viable levels (Adeoye, 2021). Because of these financial shortfalls, inadequate infrastructure proliferation, and reduced incentives for capital injection exist. Capital shortfalls also hinder the establishment of modern supervisory control and data acquisition systems necessary for efficient grid operation, vis-à-vis legacy analog control paradigms. The siphoning of public funds on which the power sector depends, combined with fiscal mismanagement in public enterprises, further exacerbates funding deficits.

Effects on Daily Life

Daily life in Nigeria has been in disarray because of the lack of electricity supply. In homes, the inability to operate household equipment constitutes a massive inconvenience. No refrigerator means that food must be prepared in smaller quantities and used within a short period. Others, mostly those that operate small businesses, have encountered huge setbacks because they cannot operate machinery (Adeoye, 2021). Electrical energy shortages have massive social and economic effects. At the social level, deprivation of electrical power limits leisure hours, disturbs social interactions, and increases criminality and insecurity within the society. Most businesses operating in the commercial, domestic and industrial sectors are dependent on electrical power for effective operation. The suspension of electrical power supply therefore presents a major setback in the productivity that directly affects economic growth. Business revenues decline and unemployment is on the increase. The demand for power can be partly met by improving grid power supply, but more by investment in abundant commercial renewable energy technologies. As it stands, however, the reliability and quality of electricity delivered by the national power system falls far below acceptable standards and they are not improving (Nyebuchi, 2015).

Impact on Businesses

The persistent failure of the Nigerian power grid exerts multifaceted pressures on the socio-political and economic landscapes. Businesses in Nigeria wrestle with the financial burdens of a deficient power infrastructure, compelling them to contend with power outages, engage diesel power generators, and invest in expensive uninterruptible power supplies. In the absence of consistent grid power, commercial and industrial enterprises frequently resort to self-generation, utilizing technologies such as diesel, furnace oil, or gas turbines as stopgap solutions. Since these private generation options typically incur costs three times higher than public electricity tariffs, the recurrent outages amplify firms' operational expenditures. Consequently, these inflated energy costs constrain business growth, potentially stifling the expansion of emerging small and medium-sized enterprises (SMEs) and impeding the growth trajectories of already established businesses. Numerous large-scale companies have similarly absorbed substantial infrastructural expenses in response to the inadequacies of the power supply.

The unrelenting energy deficits have propelled some companies to relocate to neighbouring countries endowed with more accessible and affordable power. This migration constitutes a significant loss of value to the private sector, undermining investor confidence and restricting the scale of industrial activity to suboptimal maintenance levels. A cascade of company closures has ensued, intensifying economic challenges. Between 2000 and 2009, over 1,654 manufacturing firms ceased operations in Nigeria, encompassing 820 closures during 2000–2008 and an additional 834 in 2009. These developments underscore the deleterious impact of unreliable electrical services on Nigeria's economic base (Akuru & Okoro, 2017).

2.3 Empirical Review

Several studies have examined the causes and consequences of power grid failures in Nigeria. For example, Ogunwuyi et al. (2024) investigated on the effectiveness of a nation's electricity sector dictates that nation's rate of development. Voltage collapse is a key worry for the daily

operations of the electrical system since it results in a blackout. Nigeria's national grid is known for experiencing disruptions intermittently. Nigeria's national electricity grid has collapsed partially or completely 564 times between 2000 and 2022, and the frequency of such incidents per year is a cause for concern. Over the previous 12 years, the Nigeria National Grid has had an average of 28 system collapses annually. There are significant financial and social costs associated with power outages because they make it difficult for people to meet basic household and business demands. Every 1% rise in power outages (measured in hours) in sub-Saharan Africa has been linked to a 2.86% decline in the region's GDP.

Adeoye (2023) studied on power grid collapse impacts on consumers and utility companies in Nigeria. The paper reviews the causes of grid collapse and its impacts on both consumers and utility companies. The method used in this paper was collection of secondary data on grid collapse from previous literatures, the use of simple mathematical percentage and bar charts to carry out analysis of partial and total grid collapse. Mathematical estimate of economic losses in one hour for domestic consumers was carried out in to estimate the capital cost being wasted at any point that grid collapse occurred which ought to be re-invested into the power sector. The amount estimated was #1,125,000,000($2,450, 000).This paper recommends that there should be power demand and generation gap through vigorous injection of renewable energy into the grid network, adequate power planning with respect to population increase, replacement of obsolete power components and adequate injection of gas into the gas power stations.

Ekeng et al. (2024) examined the reasons behind Nigeria's power system's voltage fall and proposed some potential fixes. The methodology employed in this study comprised gathering voltage collapse data and performing analysis for the years 2010 through 2023. Outcomes from the study showed that in the period under study, there were a total of 223 voltage collapses, out of which 158 were total system collapses while 65 were partial system collapses also in relative terms, 71 percent and 29 percent were total and partial system collapses respectively. Also in 2010, the highest number of collapses in the grid was recorded with a value of 42, and June 2016 had the highest number of collapses in a single month with a value of 8.

Ibekwe et al. (2018) studied on poor power quality and outage in Nigerian power system industry. The Nigerian power system is bedeviled with series of constant power failures and outage, most of which are either technical or non-technical in nature. These problems can range from tripping of lines on account of faulty equipment to constant increase in load more than the available power supply. Others are natural or weather related problems like wind, flood, earthquakes and the likes. Presented is the data showing the incidence of outages in Nigeria for 2003, 2004 and 2005 and data showing total and partial collapses from 2009 – 2012.

Jimoh and Raji, (2023) investigated on electric grid reliability: an assessment of the Nigerian power system failures, causes and mitigations, quality, reliable and affordable power, is clearly sufficient as a social-economic catalyst to propel any nation's shrinking economy, increase jobs creation and reduce crime. Despite significant investments in the sector over the last two decades, the Nigerian electrical grid continues to be unreliable, experiencing random failures. Between 2000 and 2022, it has partially or completely collapsed 564 times, and the

frequency of such incidents per year is a cause for concern.. This study identifies the limiting variables that have hampered the electricity system's viability, among which are human factors, equipment failure as a result of aging, fuel shortage and sabotage, likewise poor maintenance of transmission infrastructure. These had adverse effect on the productivity of the nation.

3.0 Methodology

For this study, we adopted a cross-sectional design, which can be implemented in a form of survey research. Cross-sectional design allowed collection of data on more than one case at a single point of time in order to collect quantitative or qualitative data in connection with two or more variables, which are used to identify patterns in associations. The population of this study comprised of managers of Port Harcourt Electricity Distribution Company covering Akwa Ibom, Bayelsa, Cross Rivers, and Rivers States. There were thirty six (36) managers (Regional manager, Network managers, Regional Metering Manager, Product managers (Maximum Demand Customers), Regional Customer Service Manager, Product managers (Non MD), Regional MIS Managers, Product managers- Prepaid Meters, and Revenue Protection Managers) of Port Harcourt electricity distribution companies (www.phed.com.ng; www.beninelectricity.com). The researcher studied all the elements in the population because it was small, thus, a census study and it does not call for a sample. Primary data were collected via copies of questionnaire. This study employed the use of frequency and percentages, pie and bar chart for demographic data, simple regression was used in testing the hypotheses.

4.0 Results and Discussions

4.1 Hypotheses Testing

Table 1: Regression Analysis showing effect of infrastructure deficiencies (ID), on Economic Losses(EL)

	R	R Square	Adjusted R Square	F	Unstandardized Coefficients (Beta)	T	Sig.	VIF
	.742[a]	.551	.653	63.318			.000	.532
Constant					4.055	-1.136		
Infrastructure Deficiencies					.841	2.104	.000	

Dependent Variable: Economic Losses

Source: Data Output from SPSS (2025)

Regression line

$Y = a + bX_1$ Where:

Economic Losses = 4.055+(0.841Infrastructure Deficiencies)

$R = 0.742$; $R^2 = 0.551$; F1, 36=63.318; P-value = 0.000

The results above indicated R=0.742, R^2=0.551 which is equal to 55.1% and this is the explanatory power of the model as it is used. It means that only 55.1% variation can be

explained by factors within the model used for the study and the remaining 44.9% can only be explained by other external quantitative and qualitative factors of the model used for the study. The f-ratio (F1, 36=63.318) showed significant effects in existence and this revealed the appropriateness of the model used for the study. For beta coefficient, infrastructure deficiencies had contribution value of 0.841 at 0.000 probability value, meaning it is positively significant on economic losses. Also, the p-value<0.05 and these results means that the null hypotheses (H_{01}) was rejected as regard the economic losses.

Table 2: Regression Analysis showing the impact of Inadequate funding(IF), on Daily Life(DL)

	R	R Square	Adjusted R Square	F	Unstandardized Coefficients (Beta)	t	Sig.	VIF
	.763[a]	.582	.720	92.514			.000	.601
Constant					7.187	2.172		
Inadequate Funding					.251	2.226	.000	

Dependent Variable: Daily Life

Source: Data Output from SPSS (2025)

Regression line

$Y = a + bX_1$: Where:

Daily Life = 7.187+(0.251Inadequate Funding)

R = 0.763; R^2 = 0.582; F1, 36=92.514; P-value = 0.000

The results above indicated R=0.763, R^2=0.582 which is equal to 58.2% and this is the explanatory power of the model as it is used. It means that only 58.2% variation can be explained by factors within the model used for the study and the remaining 41.8% can only be explained by other external quantitative and qualitative factors of the model used for the study. The f-ratio (F1, 36=92.514) showed significant effects in existence and this revealed the appropriateness of the model used for the study. For beta coefficient, inadequate funding had contribution value of 0.581 at 0.000 probability value. Also, the p-value<0.05 and these results means that the null hypotheses (Ho_2) was rejected as regard daily life.

Table 3: Regression Analysis showing the consequences of Political Cause (PC), on Businesses(B)

	R	R Square	Adjusted R Square	F	Unstandardized Coefficients (Beta)	T	Sig.	VIF
	.888[a]	.789	.713	27.692			.000	.659
Constant					2.923	-4.564		
Political cause					.777	1.822	.000	

Dependent Variable: Businesses

Source: Data Output from SPSS (2025)

Regression line

$Y = a + bX_1$ Where:

Businesses = 2.923+(0.777Political Cause)

$R = 0.888$; $R^2 = 0.789$; F1, 36=27.692; P-value = 0.000

The results above indicated R=0.888, R^2=0.789 which is equal to 78.9% and this is the explanatory power of the model as it is used. It means that only 78.9% variation can be explained by factors within the model used for the study and the remaining 21.1% can only be explained by other external quantitative and qualitative factors of the model used for the study. The f-ratio (F1, 36=27.692) showed significant effects in existence and this revealed the appropriateness of the model used for the study. For beta coefficient, political cause had contribution value of 0.777 at 0.000 probability value, meaning it is positively significant on businesses. Also, the p-value<0.05 and these results means that the null hypotheses (H_{03}) was rejected as regard the businesses.

4.2 Discussion of Findings

There is a significant effect of infrastructure deficiencies on economic losses.

The first hypothesis states that there is a significant effect of infrastructure deficiencies on economic losses of frequent power grid failures in Nigeria. The R value 0.742 shows a significant effect of infrastructure deficiencies on economic losses of frequent power grid failures in Nigeria. The value of path coefficient between infrastructure deficiencies and economic losses was measured as 0.841. The t-value is 2.104 which was greater than critical value of 1.96 and the p-value of 0.000 which is also significant and less than the threshold value of 0.05 proved the significance of this path. These statistics provided sufficient evidence to reject hypothesis Ho_1 and also determined that there is a significant effect of infrastructure deficiencies on economic losses of frequent power grid failures in Nigeria. From our analysis, the null hypothesis was rejected at 5% significance level, implying that infrastructure deficiencies have significant impact on economic losses of frequent power grid failures in Nigeria. From our analysis, a robustness test was carried out to check for the presence of multicollinearity among the variables. The presence of multicollinearity increases the variance of regression coefficient and invalidates the multicollinearity was analysed using Variance Inflated Factor (VIF) and tolerance values. Based on our analysis, there is no problem of multicollinearity between the variables because the tolerance values are more than .1 and the VIF values are less than 10.

This result was aligned with the findings of Ogunwuyi et al. (2024) who found that there are significant financial and social costs associated with power outages because they make it difficult for people to meet basic household and business demands. Adeoye (2023) result revealed that infrastructure decay affect the econolic healthiness of a country. Jimoh and Raji, (2023) study identifies the limiting variables that have hampered the electricity system's viability, among which are human factors, equipment failure as a result of aging, fuel shortage and sabotage, likewise poor maintenance of transmission infrastructure. These had adverse effect on the productivity of the nation.

There is a significant effect of inadequate funding on daily life.

The second hypothesis states that there was a significant effect of inadequate funding on daily life of frequent power grid failures in Nigeria. The R value 0.763 shows a significant effect of

inadequate funding on daily life of frequent power grid failures in Nigeria. The value of path coefficient between inadequate funding and daily life was measured as 0.251. The t-value is 2.713 which was greater than critical value of 1.96 and the p-value of 0.000 which is also significant and less than the threshold value of 0.05 proved the significance of this path. These statistics provided sufficient evidence to reject hypothesis Ho_2 and also determined that there is a significant positive effect of inadequate funding on daily life of frequent power grid failures in Nigeria. From our analysis, the null hypothesis was rejected at 5% significance level, implying that inadequate funding has significant impact on daily life of frequent power grid failures in Nigeria. From our analysis, a robustness test was carried out to check for the presence of multicollinearity among the variables. The presence of multicollinearity increases the variance of regression coefficient and invalidates the multicollinearity was analysed using Variance Inflated Factor (VIF) and tolerance values. Based on our analysis, there is no problem of multicollinearity between the variables because the tolerance values are more than .1 and the VIF values are less than 10.

This finding is consistent with the studies of Ekeng et al. (2024) results showed that in the period under study, there were a total of 223 voltage collapses, out of which 158 were total system collapses while 65 were partial system collapses also in relative terms, 71 percent and 29 percent were total and partial system collapses respectively. Ibekwe et al. (2018) showed that Nigerian power system is bedeviled with series of constant power failures and outage, most of which are non-technical in nature.

There is a significant consequences of political cause on businesses.

The third hypothesis states that there was a significant consequence of political cause on businesses of frequent power grid failures in Nigeria. The R value 0.888 shows a significant consequence of political cause on businesses of frequent power grid failures in Nigeria. The value of path coefficient between political cause and businesses was measured as 0.777. The t-value is 1.822 which was greater than critical value of 1.96 and the p-value of 0.000 which is also significant and less than the threshold value of 0.05 proved the significance of this path. These statistics provided sufficient evidence to reject hypothesis Ho_3 and also determined that there was a significant consequence of political cause on businesses of frequent power grid failures in Nigeria. From our analysis, the null hypothesis was rejected at 5% significance level, implying that political cause have significant impact on businesses of frequent power grid failures in Nigeria. From our analysis, a robustness test was carried out to check for the presence of multicollinearity among the variables. The presence of multicollinearity increases the variance of regression coefficient and invalidates the multicollinearity was analysed using Variance Inflated Factor (VIF) and tolerance values. Based on our analysis, there is no problem of multicollinearity between the variables because the tolerance values are more than .1 and the VIF values are less than 10.

This result was aligned with the findings of Ogunwuyi et al. (2024) who found that there are significant financial and social costs associated with power outages because they make it difficult for people to meet basic household and business demands. Adeoye (2023) result revealed that infrastructure decay affect the econolic healthiness of a country. Jimoh and Raji, (2023) study identifies the limiting variables that have hampered the electricity system's viability, among which are human factors, equipment failure as a result of aging, fuel

shortage and sabotage, likewise poor maintenance of transmission infrastructure. These had adverse effect on the productivity of the nation.

5.0 Conclusion

Frequent power grid failures in Nigeria have significant economic and social consequences. The causes of these failures are multifaceted, including infrastructure deficiencies, inadequate funding, and political cause and they have effect on economic losses, effect on daily life and impact on businesses. The incessant grid collapse in Nigeria will definitely affect socio-economic development adversely. The summary of the conclusion is as follows:

i. The result of hypothesis one concludes a significant effect of infrastructure deficiencies on economic losses of frequent power grid failures in Nigeria.
ii. The result of second hypothesis concludes a significant effect of inadequate funding on daily life of frequent power grid failures in Nigeria.
iii. The result of third hypothesis concludes a significant consequence of political cause on businesses of frequent power grid failures in Nigeria.

5.1 Recommendations

Based on our findings, we recommend that:

i. To address these challenges, the government needs to invest in infrastructure upgrade, implement effective funding strategies, political intolerance and enhance security measures.
ii. Additionally, promoting decentralized power generation and increasing private sector investment in the power sector can help improve efficiency and reliability.
iii. The government implements effective maintenance strategies to prevent power grid failures.
iv. All obsolete transformers and lines should be replaced without any delay.
v. Internal and external faults should be cleared immediately and alternative power grid may be constructed, however, the cost of construction may be on the high side.
vi. Government should encourage the use of alternative sources of energy such as gas for cooking and heating in order to reduce the demand for electricity. This could be achieved if government partners with the private sector to subsidise the product.
vii. Strengthening regulations by the political actors should eradicate to salvage frequent power grid failure.

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