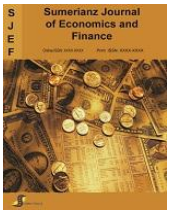
Sumerianz Journal of Economics and Finance, 2019, Vol. 2, No. 3, pp. 26-36
ISSN(e): 2617-6947, ISSN(p): 2617-7641
Website: https://www.sumerianz.com



Original Article Open Access

Analytical Hierarchy Process (AHP) Approach to the Challenges of Electricity Power Generation in Nigeria

Anowor Oluchukwu F.*
Department of Economics, Godfrey Okoye University, Enugu, Nigeria

Ogbe Emmanuel E.
Department of Economics, University of Uyo, Uyo, Nigeria

Abstract

Electricity has risen to be the dominant source of power in the global sphere, hence has become so important in social and economic development of nations. This study seeks to identify the challenges plaguing the electricity power industry in Nigeria, which has made it difficult for electricity power supply to meet its demand. The Analytical Hierarchy Process (AHP) was used to analyze responses gathered from interviews and mails sent out to the respondents in the course of this study. The Chi-square analysis was also used to test the significance of the sample size on the entire population size. The findings include: lack of maintenance, continuous use of obsolete equipment, biased process of staff recruitment, insufficient staff training, and shortage of qualified manpower, lack of staff welfare, absence of equipment upgrade, vandalism and community disturbances. This study therefore recommends that it is imperative for the economy to be restructured and diversified to have a higher energy mix rather than relying on few sources to ensure efficiency in generation and distribution.

Keywords: Electricity; Power generation; Power distribution; Chi-square; AHP; Deadweight loss theory.

1. Introduction

Globalization prompts competition and surviving any competition requires sufficient access to the essential commodities that can propel productivity. Energy, as posited by Anowor *et al.* (2014), is ceaselessly needed for the production of commodities in order to steer the economy towards desired directions. Given the fact that energy derived from electricity provides clean energy, lightening, heats and cools the homes, and has sufficiently breaths lives into the digital world as can be observed from information and computer technologies, it can be affirmed that affordable and reliable electricity is fundamental to living and surviving in the modern-day world. Analysts like Zarma (2009), Attigah (2013), Okoye (2014), Ogunjobi (2015), among others, observed that the growth as well as the development of any nation depend to a large extent on adequate and stable supply of electricity to enhance production.

Obviously, electricity has changed the traditional ways of livelihood and in addition has improved modern living. This gives credence to the claims that electricity could reduce the cost of doing business and revolutionized the development of industrialization of nations. The discovery of the principles of electricity generation through the process of electromagnetic in 1831 by Michael Faraday revolutionized how we use energy. Interestingly, today's power plants have produced much stronger currents on a much larger scale than Faraday's.

The demand for energy, as observed by Abiodun (2012), today is far greater in this highly technological society than in hundred years ago. Evidently the ever-growing application of electricity in every facet of life explains the increasing use of fuels like natural gas, petroleum, coal as well as water and bio resources in electricity power generation. Statistics shows that less than two percent of coal, petroleum and natural gas were used to generate electrical energy a century ago whereas twenty-first century usage made use of more than 30 percent of these resources to generate electrical energy (see (Anowor *et al.*, 2014; Okoye, 2014). The call to end state monopoly of electricity generation, transmission distribution and sales was first made in 1998 because the sector suffered unfavourable and damaging setback under the military juntas such that the consequences were detrimental to the growth and development of the economy. Okafor (2009), noted that the regimes of the military juntas allowed the hydro-electric and the equipments to respectively decay and became obsolete.

Electricity generation in Nigeria as remarked by Kayode (2012), began in 1896. However electricity utility company with the name Nigeria Electricity Supply Company (NESCO) was established in 1929 near Jos in present day Plateau State. NESCO was then set up to harness the hydro-electric power available from Kurra falls, utilizing the water of the Tenti and Sanga rivers and a fall of about 235 meters to build the initial 4 MW (Mega Watt) capacity power station and was latter raised to 6 MW in 1936 in order to supply mining prospecting equipment and machines in the mining areas of Jos Plateau, Nigeria (Adegboyega *et al.*, 2018). Within same period, an additional 4 MW was installed at the Kurra falls; this brought the total installed capacity to 10 MW. Mining and public supply load demands from NESCO system was extended to Jos town in 1936 and work was undertaken on increasing the dry season water storage capacity of Kurra system. In line with this, Jekko I power station generating 4 MW was

*Corresponding Author

commissioned in 1938 and Jekko II power station commissioned in 1954 with a capacity of 4 MW. Furthermore, in 1968 the fourth power plant was built on the Sanga River at Jekko falls of 4MW capacity.

There have been changes in nomenclature as well as operation and regulatory agencies. For instance, Electricity Corporation of Nigeria (ECN) was established in 1951 to replace NESCO and the first 132 Kilovolt-ampere (KVA) line was built in 1962 to link Ijora power station in Lagos to Ibadan station (Kayode 2012). Similarly Niger Dams Authority (NDA) was established in 1962 with the directive of developing the hydro-power sub-sector. The NDA and ECN were however merged in 1972 to become National Electric Power Authority (NEPA). Some decades after, the National Electricity Regulatory Commission (NERC) was formed and NEPA was as well renamed Power Holding Company of Nigeria (PHCN). The PHCN downstream sub-sector which was mainly for distribution was privatized in 2013 to form the present day eleven Distribution Companies (DISCOs) as the search for stable power supply in Nigeria continues.

Obviously, it is quite upsetting that access to electricity remains problematic in present day Nigeria despite countless human, time and financial resources in the power sector reforms. For instance, the National Integrated Power Project (NIPP) funded and fully mobilised in 2009 could only fulfilled a 1,500 MW (a quarter of its target) power generation by March, 2016 (see Edet (2016). Other such target was set in 2014 meant to achieve 12,000 MW power generation by NERC, but eventually it could only achieve 4,000MW. More so, notwithstanding N 2.71 trilion (about USD16.63 billion) spent between 1999 and 2014, the electricity generated and supplied just merely changed from 5888 MW to 5900 MW. The worrying paradox to the whole electricity power generation scenario in Nigeria had been that notwithstanding the enormous investments in the sector by the various Governments, power output was neither constant nor improving and had never reached targeted goals.

Some of the identified challenges that have made it impossible for supply of electricity to meet demand include generation equipment vandalism, poor maintenance of existing power system, corruption, and low gas supply. Power generation in 2001 went down from the installed capacity of 5,600 Mw to an average of about 2,900Mw, and this is attributed to a number of factors, which include funding, lack in maintenance of equipment, lack of personnel training, obsolete equipment. Sambo (2011), stated that some of the major challenges affecting electricity power supply in Nigeria include poor utilization of existing assets and deferred maintenance, delays in implementing new projects, lack of sustained equipment upgrading, community disturbances, lack of sound and practicable relationship between the Federal Government and stakeholders.

This has generated the motivation for this study as it sought to inquire into the sector with the application of the Analytical Hierarchy Process (AHP) Approach in an attempt to discover the challenges affecting electricity power generation in Nigeria and proffer a way forward towards achieving sustainable economic growth and development while leveraging on sufficient power supply.

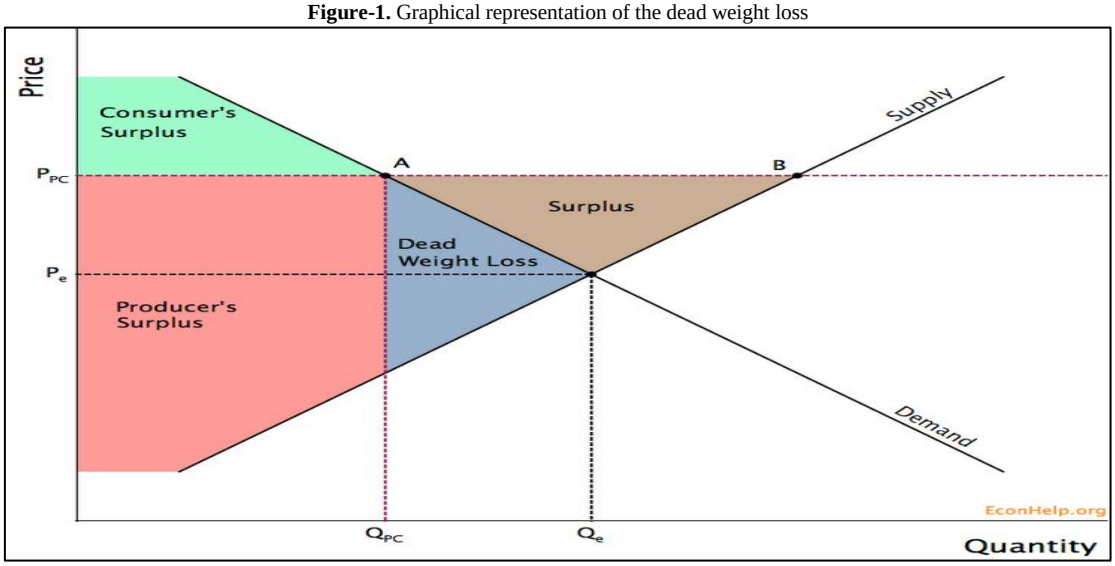
2. Theoretical Literature

2.1. Deadweight Loss Theory

The deadweight loss, also known as excess burden or allocative inefficiency, occurs when there are loss of both consumer surplus and producer surplus. It is a loss of economic efficiency that is regarded as a cost to society created by market inefficiency. This can occur when equilibrium for a good or service is not achieved. This loss can be attributed to restrictions imposed on output by some external factors. Typical example is an industry whose supply of output is based on the production function that combines different inputs which includes capital, labor and infrastructural services etc, may experience a rise in the cost of production through higher costs incurred in the substitution of private for public inputs for supply of goods and services. In some cases as noted by Okoye (2014), firms have had to shut down because they cannot effectively afford substitutes, as a result of the fact that they could not bear the marginal cost burden.

There is often dissatisfaction when the consumer feels the price of a commodity do not justify the perceived utility: this will likely bring about a certain fall in trade; and with the reduction in trade, there is the likelihood that the allocation of resources may become inefficient as such may lead to reduction in the societal welfare. From fig 1 below, the region captured as consumer's surplus depicts the monetary gains obtained by consumers because they are able to purchase a product for a price less than the highest price that they would ordinarily have purchased the goods. Below this segment, there is another region captured as the producer's surplus which is in fact the amount producers would benefit by selling their products at a price higher than the least they would have been willing to sell for. The impact of poor and unreliable supply of infrastructural services like electricity would cause a shift of the supply curve to the left (as shown in fig 1 below). Essentially, this implies that the producer is only willing to supply each previous level of output at higher price. Consequently, the rise in price of the commodity reduces both consumer surplus and producer surplus.

Figure-1. Graphical representation of the dead weight loss



Harberger's triangle (named after *Arnold Harberger*) captured the deadweight loss in figure 1 above. The deadweight is brought about by the impact of insufficient and unreliable supply of infrastructural services like electricity. This can happen through price floors, taxes, tariffs, quotas or as in this case study an insufficient and unreliable supply of electricity to the manufacturing sector. It is prevalent in Nigeria that most firms substitute public electricity with private sources in the production process. Thus the cost of energy, repairs and equipment maintenance is added to the final cost of commodities and this drives the wedge between what consumers pay and what the producers receive, this filled-in wedge shape is equivalent to the deadweight loss incurred from the cost of diesel, repairs and maintenance of equipment.

The area represented by the blue triangle is the deadweight loss. This shows that the intersection of the supply and the demand curves are cut short, hence the consumer surplus and the producer surplus are also cut short.

2.2. Empirical Review

Power is very essential in any nation and is regarded as the major thrust of any industrialized economy. For instance, Folorunso and Olowu (2014) in analyzing the Nigerian power sector states that the electricity power sector represents the key ingredient for the growth of any country. The study insists that the electricity power system plays a major role in the economic development. The study showed that for over twenty (20) years prior to 1999, there was no substantial investment in electricity infrastructural development in the power sector. During that period, new plants were not constructed and existing ones were not properly maintained, bringing the power sector to a deplorable state. The study therefore insists that if the challenges were taken care of, then the supply of electricity would improve.

It must be noted that electricity power generation challenges are not just peculiar to Nigeria alone; it is a global phenomenon. Sun (2012), in understanding the energy challenges in India believe that the India energy sector is increasingly unable to deliver a secure supply of energy amid growing demand and fuel imports. This is in conjunction with a rising subsidy level and systematic failure to ensure proper revenue collection along the value chain, which has caused the financial capacity of the energy sector players to be significantly undermined. Furthermore, lack of sufficient capacity to make timely and adequate investments has given reason to fear that India may be heading towards an electricity crisis. It points out five major challenges affecting the sector and they are; improvement of commercial viability of key players in the sector, rigid pricing mechanism, funding, bureaucratic bottleneck in policy implementation, weak political will to cope with the energy challenges. It argues that if all these challenges are adequately addressed, it would lead to greater achievement of energy policy objectives in India.

Writing in the same vein, Durgesh (2015), argues that despite the fact that India has an installed capacity of 255.012 GW, and was the world's third largest producer of electricity in the 2013 with 4.8% global share in electricity generation, surpassing Japan and Russia, the country still suffers energy shortages of varying magnitude. This it attributes to manpower shortage, financial problems, equipment shortages, land acquisition and environmental clearance, fuel availability etc. It suggests that enhanced training of manpower, procurement of equipment from abroad, more funding, setting up new supply units and removing bottlenecks associated with land acquisition were a few remedies to the problems.

Luay (2015), also stresses that electricity problems are not new to Iraq; it states that the sector has suffered from decades of bad management, poor policies and lack of proper planning for the future. The study points out that the violence and instability engendered by Islamic State (IS) have only exacerbated the problem. The research revealed that as at May 2014, the Iraqi Government was confident of adding an additional 8,000 Mw of generating capacity to the present capacity of about 12,000Mw by November 2015, but the presence and advancement of IS resulted in a grid loss of about 9,000Mw.This has caused electricity power to run 5-8 hours a day at best. The study also discovered that funding of the electricity sector in Iraq after 2003 lacked any coherent policy strategy. It recommends private sector investments in meeting the challenges of the electricity sector both from domestic companies and foreign investors.

Also Ebenezer (2017), in examining the challenges of electricity supply in Ghana is of the opinion that electricity remains one of the major determinants of the economic prosperity of any nation and plays a significant role in undertaking daily activities such as cooking, heating, lighting and powering industrial machines. The study goes further to state that electricity is the central key to quality health care delivery, education, effective communication and transportation. However, the research revealed that there are major issues associated with the power delivery system, these issues include; poor tariff structure, lack of generation mix, funding among others.

Yu and Choi (1985), using the Johansen Co-integration technique to test the linkage between energy consumption and economic growth in the Philippines, discovered a positive relationship between the energy consumption and economic growth. The study showed a unidirectional relationship, where economic growth served as a dependent variable and energy consumption was the independent variable. Hence it was recommended that for a more robust generating capacity, the Government should provide abundant hydro reserve as well as reserve of renewable wind and solar energy. In other words, government should diversify and have a higher energy mix, rather than rely on only one source.

Also towing the same line, Asafu-Adjaye (2000), carried out the same research on Singapore and Indonesia using co-integration and error correction modeling techniques respectively to estimate the causal relationship between energy consumption and economic growth. The study revealed that energy consumption had the same unidirectional causality effect on economic growth. It recommends that a consumer friendly billing system be developed by the appropriate Government agencies, as well as extensive training for personnel so as to boost consumption, thus increasing the generation capacity.

Similarly, Jumbe (2004), using the Granger causality and error correction method (ECM) in a study of electricity consumption in Malawi to test bilateral causality between electricity consumption and GDP in that country, revealed a bi-directional causality between electricity consumption and GDP. The error correction models results showed a one-way causality running from GDP to electricity consumption which suggests that a permanent rise in GDP may cause a permanent growth in electricity consumption, and to sustain this growth, Government should encourage staff training, equipment maintenance and high investment opportunities in the power sector in order to meet economic needs.

Also a study by Nyansu (2016) using the ordinary least square method and chi- square test to investigate the effective power supply in Ghana revealed that electricity supply in Ghana had been marred by low generation, poor supply and frequent power outages. The research also revealed that the situation has compelled firms to adopt strategies in order to cope with the poor public supply of electricity to power their businesses. These strategies included use of generating sets and solar. The results of the study showed that the power outages experienced affected firms productivity negatively and was a source of revenue loss to the Government. Hence, it was recommended that Government should implement policies and programs such as electricity power mix approach and renewable energy as well as bring in private sector participation to encourage competition and efficiency. The electricity power mix approach would make way for diversification and reduce the pressure on the Akosombo Dam, whilst the private sector participation ensures more funds be made available to the sector. This would help curb the power outages and bring about an increase in productivity.

Ologundudu (2014), using the auto-regressive distributed lag (ARDL) bounds test approach to co-integration in his research to test empirically the causal and long run relationship between economic development, industrialization and electricity supply in Nigeria, insists that the supply of electricity in Nigeria is bedeviled with constant crisis as shown by such indicators as electricity black outs and persistence on self-generating electricity. The causality result showed very strongly that electricity supply is crucial in stimulating economic growth and development. He insists that generating and distribution industries must upgrade their equipment and improve on staff welfare to be able to meet up with the demands of its numerous customers for better service.

Similarly, Edet (2016), using the contemporary economic approach of error correction mechanism to investigate the electricity supply growth in Nigeria, maintained that electricity power is key to meaningful growth of an economy, hence advocates for adequate supply of electricity power. The study revealed that adequate generation, transmission and distribution of electricity encourages cottage industries to invest in more commercial and service activities, and also showed that constant electricity empowers people to work at home. The study showed that the weak and inefficient system resulted from old and decaying infrastructure and also poorly maintained generating stations and these contributed largely to the constant black outs. Thus to improve on the inefficiency, most of the equipments need to be overhauled in order to boost electricity power supply in the face of increasing population.

Having looked at these works and areas, it is seen that most of the authors used contemporary econometric estimation methods to analyze data; hence this study seeks to utilize the Analytical Hierarchy Process (AHP) which essentially assigns numerical weight derived for each element of the hierarchy, allowing for a more diverse comparison between elements in a rational and consistent way. What the AHP basically does is to breakdown decision problems into a hierarchy of more easily understandable sub-problems, each of which can now be analysed independently. Interestingly the elements of the hierarchy can relate to any aspect of the decision problem. The AHP is very important and most useful in research cases relating to very complex issues and involving human perceptions and judgments; usually resolution of these complex issues have long term repercussions on the society.

3. Research Methodology

This work utilizes the survey method to extract responses from the respondents and a tool box has been specially structured which contains the essential kits necessary to analyze data for this particular research.

The kits include: focus group discussions, questionnaire, e-mails and key persons interviews.

This study seeks to identify the challenges plaguing the electricity power industry in Nigeria, which has made it difficult for electricity power supply to meet its demand.

These respondents were targeted across from various locations of the generation companies. The research got responses from (9) nine generating facilities which are Egbin Power plant in Lagos State, Ibom power plant in Akwa-Ibom State, Omoku power plant in Rivers State, Trans-Amadi (1&2) power plant in Rivers State, Eleme power plant in Rivers state, Afam power plants in Rivers State and Transcorp power plant Ughelli in Delta state.

A checklist was prepared and used to guide the research to get answers to the research questions and thus help achieve the set objectives of this research work. The survey method which relies heavily on our checklist needs this kit in order to get the required information.

3.1. Reason for Choice of Method

This method of research also discards any risk of data manipulation because it provides firsthand information to the interviewer and also provides an in depth knowledge into the subject matter as the respondents were able to give more candid and valid responses.

3.2. Reason for Choice of the Analytical Hierarchy Process (AHP)

As earlier mentioned, the method of analysis for this study is the Analytical Hierarchy Process (AHP). The AHP is an important analytical tool based on mathematics and psychology that is used to organize and analyze complex decisions. The AHP has particular application in group decision making and the preferred tool of analysis due to the peculiar nature of our study which is aimed at weighing the various responses from the respondents and isolating the weightiest in the order of priority, this helps in giving better and more effective policy recommendations as priority areas have been duly identified.

While it can be used by individuals working on straightforward decisions, the Analytic Hierarchy Process (AHP) is very useful where teams of people are working on complex problems, especially those with very high stakes, involving human perceptions and judgments, whose resolutions have long-term repercussions. It has unique advantages when important elements of the decision are difficult to quantify or compare, or where communication among team members is impeded by their different specializations, terminologies, or perspectives.

Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to each other at a time, with respect to their impact on an element above them in the hierarchy. In making the comparisons, the decision makers can use concrete data about the elements, but they typically use their judgments about the elements' relative meaning and importance. It is the essence of the AHP that human judgments, and not just the underlying information, can be used in performing the evaluations.

The AHP converts these evaluations to numerical values that can be processed and compared over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. This capability distinguishes the AHP from other decision making techniques.

3.3. Analysis

This study made use of graphs, charts and matrices in the presentation of results and the Analytical Hierarchy Process was used to analyze responses from respondents gathered from interviews and mails sent out in the course of this research work. The chi square analysis was also used to test the significance of the sample size on the entire population size.

3.4. Targeted Respondents

In order to obtain robust responses, our methodology that is mostly participatory survey, targets key stakeholders in the electricity generation sector. These stakeholders are specifically: Nigerian Electricity Regulatory Commission (NERC), power generation companies, Ministry of Power etc. The kits in the tool box were used systematically to facilitate interactive sessions with the various stakeholders in the electricity power industry. They particularly include:

1. Nigerian Electricity Regulatory Commission (NERC).
2. Ministry of Power.
3. NG Power.(Port Harcourt)
4. First Independent Power Consortium (4Power).
5. Ibom Power plant.(Akwa-Ibom)
6. Egbin power plant.(Lagos)
7. Transcorp Power plant, Ughelli.
8. Host Communities (Generating plants).

Firstly, Interviews were conducted with the following officers;

i. Permanent Secretary, Ministry of Power.
ii. Director of Electrical.
iii. Director of Mechanical.
iv. Plant Operators (Generating plants)
v. Electrical Engineers (in the offices and on site)
vi. Mechanical Engineers (in the offices and on site)
vii. Host Communities.

viii. Station Managers (MOP, PHED).

Group discussions were held with mid-level management engineering staff as well as plant operators in all the above organizations (1-8) in order to have their own opinions and contributions on the subject matter.

The study gathered information from the field workers as well as from officers stationed in the various offices and finally also got input from the residents of the host communities. This helped to bridge the lacuna that has so much plagued the power sector.

3.5. Data

In the final step of the process, numerical priorities are calculated for each of the decision alternatives. These numbers represent the alternatives relative ability to achieve the decision goal, so they allow a straight forward consideration of the various courses of action.

A total number of seven hundred and sixty three (763) respondents were involved in this survey and they were drawn from different electricity power generation stations across the nation. Below are the responses from all correspondents.

3.6. Responses from Interactive Sessions with Various Selected Officers in the Electricity Power Generation Sector

3.6.1. Key Persons Interviews

From the three hundred and eighty six (386) respondents involved in the survey, thirteen (13) were engaged in key persons interviews. These respondents were drawn from different electricity power generation stations across the nation. Their responses are represented below:

Table-1. Results of the key persons interviews

S/N	RESPONDENTS	POP SIZE	NO. OF POP. INTERVIEWED	% OF POP	SUGGESTED DETERMINANTS
1	PERM SEC.	1	1	100	Excellent gas supply, funding, cost reflective tariff
2	DIR. ELECT.	6	4	67	Good government policies, proper funding, maintenance of equipment, reduced corruption.
3	DIR. MECH.	6	3	50	Consistent gas supply, proper funding, improved staff welfare
4	STATION MGRS	7	5	71	Proper funding, sophisticated infrastructure, constant gas supply, equipment maintenance.
	TOTAL	20	13		

Source: Survey 2018

3.6.2. Focal Group Discussions

From the three hundred and eighty six (386) respondents involved in the survey, three hundred and seventy three (373) were engaged in focal group discussions. The respondents were split into smaller groups consisting of between ten (10) to twelve (12) respondents in each group. These respondents were drawn from different electricity power generation stations across the nation. Their responses are represented below:

Table-2. Results of the focal group discussions

S/N	RESPONDENTS	POP SIZE	NO. OF POP INTERVIEWED	% OF POP	SUGGESTED DETERMINANTS
1	MECH. ENGR.	94	50	53	Gas availability, funding, maintenance, staff training, improved staff welfare.
2	ELEC. ENGR.	139	67	48	High capacity power station, standard transmission lines, sophisticated infrastructure, genuine spare parts, funds.
3	PLANT OPR.	161	87	54	Strong political will power, good and effective government policies, gas availability, funds, nearness to water for cooling.
4	SECURITY	46	20	43	Massive infrastructural investment, well-trained staff, funds, reduced corruption, reduced bureaucratic bottlenecks.
5	LINESMEN	174	83	47	Availability of gas, effective staff training, funds, better remunerations.
6	CRAFTSMEN	129	66	51	Constant gas supply, good transmission network, funds, new equipment, genuine spare parts, staff training.
	TOTAL	**743**	**373**		

Source: Survey 2018

From table 1 and 2, it is seen that all the respondents had different suggested determinants of electricity power generation in Nigeria, ranging from excellent gas supply, improved staff training, genuine spare parts, equipment

maintenance, improved staff welfare etc. However, the table shows that determinants such as funding, equipment maintenance and staff training had the highest frequency from the respondents.

3.6.3. Chi Square Analysis

A chi square analysis was carried out to show the significance of the sample selected from the population size, to determine if the sample is the true representation of the population interviewed.

Table-3. Chi Square Analysis

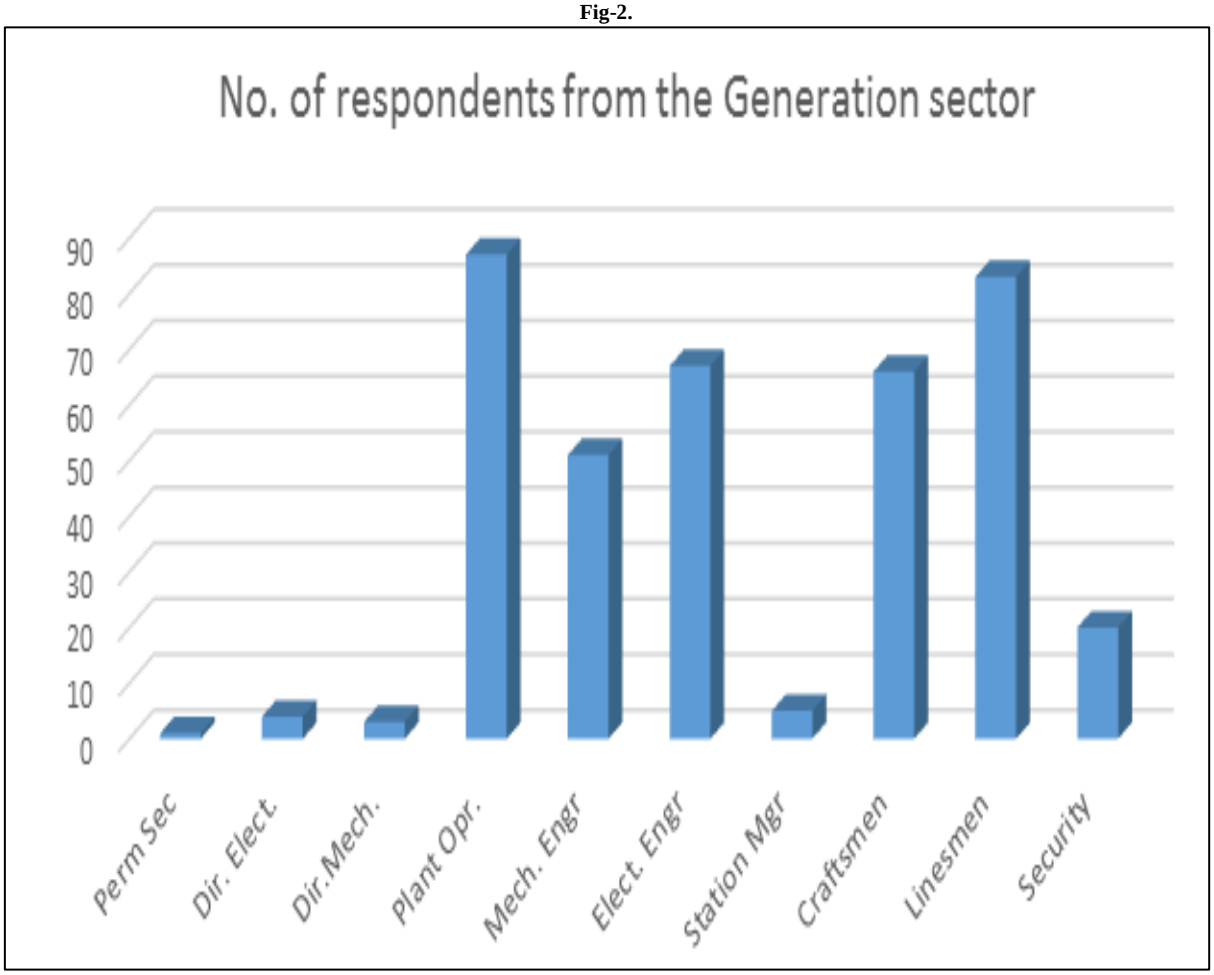
Observed frequency	Expected frequency
1	1
6	4
6	3
7	5
94	50
139	67
161	87
46	20
174	83
129	66
TOTAL 763	386

Table-4. Test Statistics

	Items
Chi-Square	4.722[a]
Df	9
Asymp. Sig.	.858
a. 1 cells (10.0%) have expected frequencies less than 5. The minimum expected cell frequency is 2.0.	

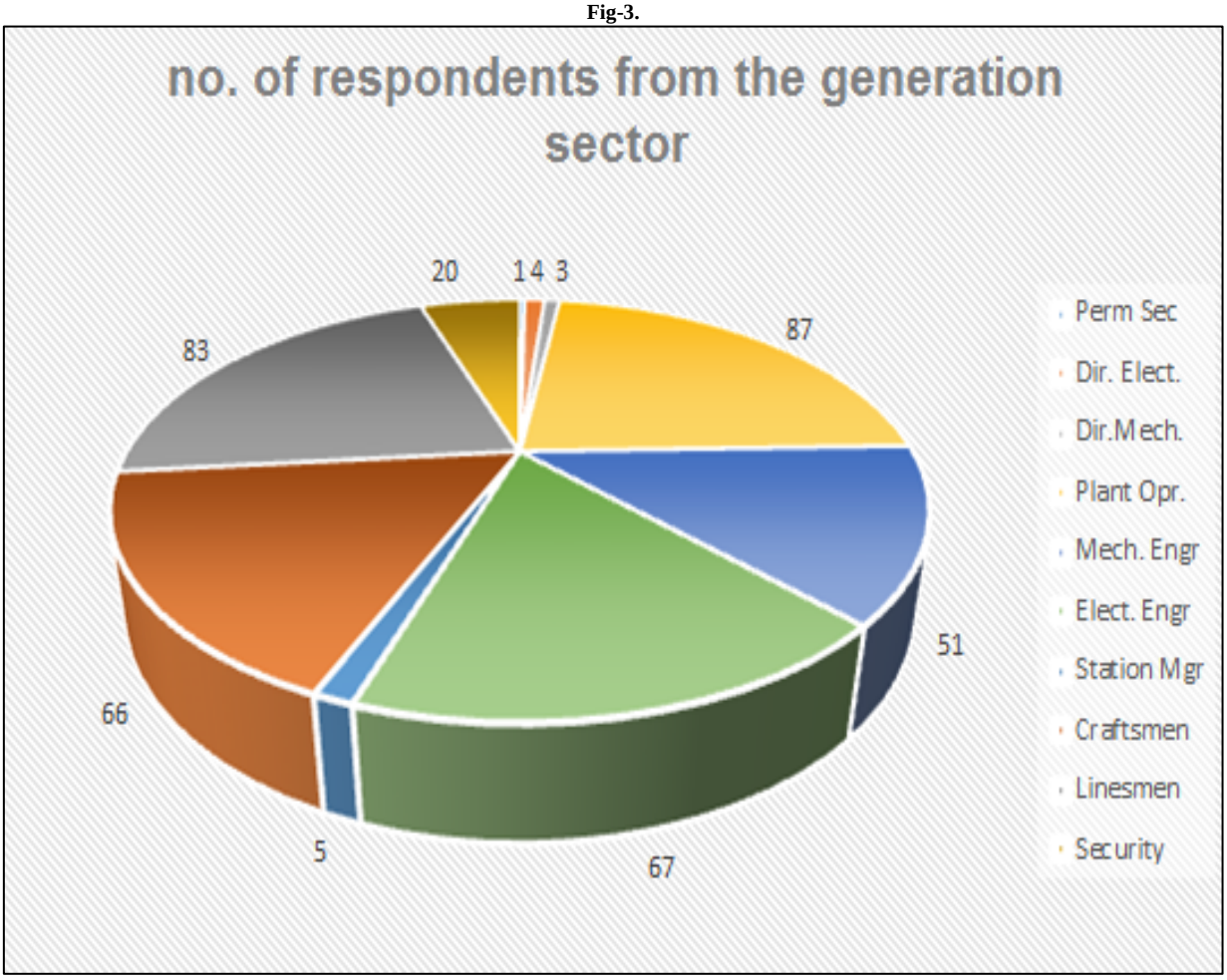
The result shows that the $\chi^2_{calculated}$ =4.722 with the Probability value of 0.858, and since P=0.858>0.05(level of significance), this simply means that the expected frequency is not significantly different from the observed frequency. This implies that the sample is the true representation of the population.

Fig-2.



Source: Survey 2018

Fig-3.



Source: Survey 2018

4. Questionnaire Distribution

There were other key stakeholders that were not captured in the Focal group discussions and did not participate in the key persons interview. These groups of individuals totaling fifty three (53) were eventually captured with the use of the questionnaire. A total of fifty three (53) questionnaires were distributed to the respondents with fifty (50) coming back to the researcher. These individuals were also drawn from the various electricity power generation organizations which include; Staff of the Rivers State Ministry of Power, NG power, Afam Generating station, Omoku Generating station, Eleme Generating Station.

From literature, key challenges had been identified as reasons militating against efficient and effective electricity power generation in Nigeria. The questionnaire was designed with questions drawn out of these challenges to act as a check list in order to sample opinions to further ascertain if these challenges truly impact on the electricity generating capacity in Nigeria.

4.1. Analysis of Questionnaire Responses

4.1.1. Poor Gas Supply

The research discovered that the inability to evacuate 24 hour electricity from the turbines was as a result of frequent gas shortages which were due to failure on the part of the management to honor payment agreements. The generation companies were not getting funds as regularly as they should in order to offset payments as at when due. From the responses, we also discovered that other times it was due to carelessness and a nonchalant attitude on the part of the officers who are in charge of monitoring gas levels as they failed to observe that the gas levels were low. It is recommended that staff in charge of monitoring gas levels should be properly trained and given a better orientation as to the importance of their job responsibilities. Also the unnecessary bureaucratic bottleneck surrounding fund release should be removed so that funds are made more accessible for prompt payments at the due dates to avoid shortages in gas supply.

4.1.2. Lack of Maintenance

The study showed that in recent time equipment undergo frequent maintenance, but the only challenge was that it may not have been properly supervised because most of the equipment maintenance was done by consultants who are not answerable to the staff of the electricity generation stations. So in most cases the consultants may not necessarily work in line with the best practices obtainable. It is recommended that there should be effective monitoring and supervision of all equipment maintained. Also staff of the organisation should be given more supervisory roles as they are usually held responsible for any broken down equipment.

4.1.3. Obsolete Equipment

The research showed that indeed a lot of equipment were either worn out or obsolete and were not replaced on a regular basis; this was mostly as a result of difficulty in accessing the necessary funds as a lot of bottlenecks are involved in the paper works and also as a result of a poor orientation towards maintenance culture. There is a mindset that equipments are used till they break down. It is recommended that staff be properly informed on the need for prompt and timely maintenance in order to change their mindset from the normal "use till break down syndrome". This will ensure a longer life span of the equipment and also reduce downtime. Also the bottleneck surrounding accessibility to funds should be cut off.

4.1.4. Staff Recruitment

The study revealed that a lot of staff recruitment were done without due diligence and a lot of the engineers employed did not really know their onions. Most had paper qualifications and not the essential experience required. Also it was discovered that most of the station managers were not involved in the recruitment process, hence they had no level of authority over who is employed at their station. Thus it is recommended that recruitment should be done under strict supervision of the station managers as they end up working with these new recruits. Also due diligence should be employed in the recruitment process, as this would make the process more transparent and the best hands would eventually be pulled into the system.

4.1.5. Staff Training

From responses it was gathered that indeed a lot of training is structured for the engineers every year as part of keeping them abreast with new technology in the industry, but this research discovered that only favorites of the station managers or top management are selected for such trainings. The study further revealed that all year round, only a selected few get to undergo training. Hence a lot of the other engineers are cut off. This is as a result of the selection process not been truly transparent. This scenario diminishes the performance capacity of the work force as a whole. It is recommended that the training selection be more transparent so that every staff has one form of training or the other as this will in fact expose most of the engineers to new technology in the electricity industry.

4.1.6. Manpower Shortage

The research showed that presently the manpower in the electricity generation sector is relatively stable as the system allows for engineers and technical staff to work in shifts. But then the study further revealed that over time a few incentives had been taken away from them and this had dampened the prompt response to work. These entitlements include meals during shifts, off days, study leaves, overtime payments etc. therefore it is recommended that these incentives be re instated in order to bring out the best in the engineers.

4.1.7. Staff Welfare

The survey revealed that only Government workers in the electricity power sector were not reasonably paid. They had no health insurance cover, no life assurance cover in case of death, as compared to their counterparts in the private sector. And most of their maintenance kits were totally worn out and in need of replacements. But the study showed that they enjoyed opportunities to improve on their present qualifications, and this was sometimes sponsored by the Government. The private sector staffs on the other hand were well remunerated, had health insurance as well as life policies and given adequate kits for their maintenance jobs, but then had no opportunity to further their studies, in fact most had to resign in order to study. It is therefore recommended that Government as a matter of urgency replace all worn out maintenance gears as well as provide health insurance schemes with life assurance policies inclusive for her workers to act as a cushion incase of accidents or death. Also employers in the private sector should consider allowing their staffs embark on further studies without having to resign as this would help strengthen their knowledge base.

4.1.8. Equipment Upgrade

The survey showed a great rise in the use of state of the art equipment which are truly of international standard and also compatible with transmission and distribution equipment. It also revealed that a lot of the upgrade was done by expatriates. This made it rather difficult for the local engineers to acquire versatile knowledge about the machineries. It is recommended that should endeavor to add a training clause to the agreement embarked upon by the management so as to expose the local engineers to the working dynamics of the equipment. This will ensure that the local engineers are kept abreast of such upgrades and can now do the much needed upgrades in future. This would actually cut down on running cost of the organisation.

4.1.9. Vandalism

It was revealed that despite security, issues of vandalism were still experienced. It was also discovered that even when some of the culprits are caught, it is often difficult to persecute them as they may be community thugs and as such they are protected by the community heads. Other times huge bribes are paid to the enforcement agents and these vandals are released without ever getting charged to court. It is strongly recommended that the proper enforcement agencies be transparent in discharging their duties as this will serve as a deterrent to other miscreants that may want to commit similar offences.

4.1.10. Funds

From the responses pulled from the survey, it was discovered that funds may not necessarily be the key challenge. Clearly there are monies set aside to handle maintenance and procurement issues, yet access to these monies seems to be the bane of the system. It is increasingly difficult to access these funds, presumably due to the time lag experienced from identifying a much needed procurement or replacement and the time setting up a committee to investigate the challenges on ground. A lot of bureaucratic bottleneck is actually experienced during this time frame and thus a lot of delay was experienced in replacing worn out or obsolete parts. A change in administration also triggers off such delays as committees upon committees are set up to look into pending cases. It is recommended that in order to facilitate prompt release of funds the management should cut down on the number of committee set up so as to reduce the obstacles to getting quick access to funds. This will ensure that maintenance and procurement challenges are promptly handled.

4.1.11. Community Disturbances

The survey conducted showed that community youths were considerably engaged in certain department of the stations mostly as security personnel and environment maintenance officers. Also it revealed that a few of the youths who had the proper qualifications were indeed absorbed into the organisation as management staff. The survey further revealed that a lot of community projects had been executed as part of the community development programs, but then there were a few miscreants always ready to ferment trouble and this usually led to few issues at the stations. Most times these youth actually vandalized the organizations' equipment and are often protected by the community elders, hence they are never prosecuted. It is strongly recommended that these youths be adequately punished in order to forestall more cases of vandalism. Also more community projects should be embarked on.

5. Conclusion and Recommendations

The supply of adequate and stable electricity to consumers is the back bone of socio-economic growth of any nation and Nigeria is not an exception. The electricity power sector in Nigeria has multi-dimensional problems such as bribery, corruption and mismanagement of funds for execution of electricity power projects. The escalating cases of illegal connections that lead to overloaded distribution transformers, equipment maintenance, staff training, vandalization of power lines by thieves, winds, construction projects, soil erosion etc. are not unconnected with power problems faced in Nigeria. These factors are seriously affecting the performance indices of electricity utilities in the country. The performance indices include efficiency, number of consumers connected to distribution line per transformer, high maintenance cost, and transmission line losses (Copper losses). To improve the delivery of electricity to consumers in Nigeria the civil liberty organizations, the Non-governmental organizations and ordinary citizens have to cooperate and work together for good maintenance culture and good governance since the government is not delivering well the dividends of democracy. To maintain adequate power supply to the consumers in any part of the globe is a very challenging task, which requires dedication, political will, political stability etc. For citizens to have adequate electricity supply this study recommends the followings:

1. The funding in the electricity sector should be properly managed to ensure efficiency in supply.
2. Proper maintenance of equipment should be done regular at when due to avoid breakdown as this leads to downtime and energy loss in the supply chain.
3. Staff welfare and training should also be made top priority. This will ensure that the staff has the appropriate and adequate training as well proper exposure to carry out their duties more effectively.
4. The restructuring of the Nigerian radial interconnected electricity generation station grid system which has National Control Centre at Oshogbo and replace it with a regional interconnected grid system in order to reduce transmission line losses and improve reliability of the Nigerian grid system.
5. The Government should diversify the sources of fuel for electricity generating stations. Encourage energy mix because Nigeria has abundant coal reserve, Uranium, bio-mass, wind potentials, which can be used for generating electricity instead of relying only on gas, oil and hydro potentials.
6. The electricity consumers in Nigeria should show patriotism through prompt settlement of electricity bills as this will generate revenue and thus ensure that the electricity industry is sustained.
7. The successive governments in Nigerian should have to be more committed to the execution of good electricity developmental projects left behind by past administrations. This will ensure that the expansion plan is accomplished within the stipulated time frame.
8. A consumer friendly billing system should be developed by the appropriate government agencies. This will ensure prompt payment by the electricity consumers.

References

Abiodun, O. (2012). Review of renewable energy sources in Nigeria - security and challenges. *International Journal of Advanced Renewable Energy Research,* 2(2): 10-20.

Adegboyega, B. E., Ufondu, M. N., Aliyu, M. A. and Oyewole, A. (2018). Energy poverty and the security challenges in Northern Nigeria-Incidence and the potential for renewables. *Covenant Journal of Engineering Technology,* 2(2): 40-51.

Anowor, O. F., I., A. I. and Ezekwem, O. S. (2014). Sustainable sources of energy and the expected benefits to nigerian economy. *International Journal of Sustainable Energy and Environmental Research,* 3(2): 110-20.

Asafu-Adjaye, J. (2000). The relationship between energy consumption, energy prices and economic growth: time series evidence from Asian developing countries. *Energy Economics*, 22(6): 615-25.

Attigah, B. (2013). Electricity power insecurity and smes growth: A case study of the cold store operators in the asafo market area of the Kumasi Metro in Ghana. *Open Journal of Business and Management*, 3(3): 18-29.

Durgesh, K. D. (2015). Issues and challenges in the electricity sector in India. *The Business And Management Review*, 5(4): 161-74.

Ebenezer, N. K. (2017). *Electricity situation in ghana: Challenges and opportunities. Center for global development, Washington. Paper 109.* Center for Global Development: Washington, DC. https://www.cgdev.org/publication/electricity-situation-ghana-challenges-and-opportunities

Edet, O. A. (2016). Power sector reforms and electricity supply growth in Nigeria. *Asian Journal of Economics And Empirical Research*, 3(1): 94-102.

Folorunso, O. and Olowu, T. (2014). The Nigeria Power System till date: A review. *International Journal of Advance Foundation and Research in Science and Engineering (IJAFRSE)*, 1(5): 137-421.

Jumbe, C. (2004). Cointegration and causality between electricity consumption and GDP: empirical evidence from Malawi. *Energy Economics*, 26(1): 61-68.

Kayode , T. (2012). The current and future challenges of electricity market in Nigeria in the face of deregulation process. *African Journal of Engineering Research*, 1(2): 33-39.

Luay, A. K. (2015). *Turn a light on: Electricity sector reform in Iraq.* Brooking institution: Doha.

Nyansu, F. (2016). *Effect of Power supply on the performance of small and medium size enterprise: A comparative analysis between SME's in Tema and the Northern part of Ghana.* Munich personal RePE archive: Ghana.

Ogunjobi, J. (2015). Electricity supply and manufacturing output in Nigeria: AutoRegressive Distributed Lag (ARDL) bound testing approach. *Journal of Economics And Sustainable Development*, 7(6): 33-39.

Okafor (2009). Gender related differences in the operating and performance, characteristics of small business in Nigeria. *International Journal of Arts, Physics, Management and Social Sciences*, 6(2): 2192-204.

Okoye, C. U. (2014). A study and performance evaluation of Olorunsogo thermal power plant in Nigeria. *International Journal of Engineering Sciences And Research Technology*, 6(12): 115-38.

Ologundudu, M. M. (2014). The Epileptic nature of Electricity supply and its consequences on industrial and economic performance in Nigeria. *Global journal of researches in Engineering*, 14(4): 15-28.

Sambo (2011). Nigerians should accept deregulation of the Power sector. Available: http://www.thenigerianvoice.com/nvnews/70962/1/nigerians-should-accept-deregulation-of-power-sect.html

Sun, J. A. (2012). *Understanding energy challenges in India.* International Energy Agency OECD/ICA India.

Yu, E. S. H. and Choi, J. Y. (1985). The causal relationship between energy and GNP: An International Comparison. *Journal of Energy and Development*, 10(2): 249-72.

Zarma, I. H. (2009). *Small scale hydro electric power plants for self-reliance and sustainable development.* World federation of Engineering organizations congress: Kuwait.