

## Enhancing Billing and Minimization of Electricity Theft in the Electrical Power Distribution via ICT

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### ABSTRACT

This paper presents the report of survey of the causes and effects of electricity theft from power distribution in Nigeria. Questionnaire was used to gather information from the various electricity consumers around Sango-Ota axis in Ogun state Nigeria. The questionnaire was focused on availability of power, billing processes, and mode of payment for power supply from the Electric Distribution Company (DisCo) to the various consumers sampled. One thousand seven hundred and eighty-five (1,785) residential buildings were sampled, out of which only 37% has electric meter, only 19% of the residential buildings sampled had prepaid meter. About 71% of the population never enjoyed electric power supply for 48hrs in a week. The categories of people without meter and those with analog meter do bribe DisCo officials during routine check to avoid disconnection due to their indebtedness. This activity of consumers in connivance with some DisCo officials has resulted in huge electricity theft, and is affecting the efficiency of DisCos in meeting the user demands due to loss from distribution lapses. Consequently, we propose a full application of Information Communication Technology (ICT) for developing best practice for Effective Billing and Collection of revenue to minimize electricity theft by consumers.

**Keywords:** Electricity consumer, electricity theft, electric meter, ICT, Electric Distribution Company.

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### 1. INTRODUCTION

Effective billing and revenue collection activities have an immediate impact on the performance of a service provider, such as Electric Distribution Company (DisCo) which, in turn, encourage operational efficiencies for aiding the expansion and delivery of improved, reliable, and sustainable services. This annotation draws the attention of the researchers to the evaluation of billing processes and reasons for decline in the ability of the DisCo organization to meet the people's electric power demands.

Electricity power providers in Nigeria are plagued with severe deficiencies in the delivery of quality and satisfactory services. Consumers' access to reliable, sustainable, and affordable electricity supply has been a herculean task for the electric power providers. Electric power providers' worrisome performance is caused, among other reasons, by financial and capacity constraints, including the absence of effective methods for billing and revenue collection. Effective billing and collection systems are a critical component for ensuring the viability of a service provider. Improving billing and collection activities has an immediate impact on the revenue streams of a service provider that can, in turn, help the DisCo in improving services.

Electric meters in the past and today in a few countries, were electromechanical devices with poor accuracy and lack of configurability. The present billing system is minimally able to detect power theft and even when it does that, it is at end of the month. The electric distribution company is unable to keep track of the changing maximum demand for the domestic consumer while the consumer is faced with a lot of problems like receiving "crazy" bills for electric power that was never consumed, and poor reliability of electricity supply and quality (Devidas, & Ramesh, 2010).

This activity of electricity consumers with DisCo officials has resulted in huge electricity theft and is affecting the efficiency of the DisCo in meeting the user demands. Hence, these problems call for complete application of Information Communication Technology (ICT) for developing best practice on effective billing and collection of revenue to minimize electricity theft by consumers.

### **1.1. Aim and Objectives**

The aim of this research work is to: investigate level of availability of electricity power supply, billing system, and revenue collections and to implore the application of ICT in power sector towards reduction of electricity theft in Nigeria.

### **1.2. Problem Statement**

Nigeria electricity service providers are under severe financial constraints, with insufficient funds for routine maintenance, replacement, and expansion. Poor financial status is a result of a number of factors including electricity theft, poor levels and/or absence of metering, poor billing and revenue collection practices.

### **1.3. Significance of Study**

The results of this study will be valuable to Electric Distribution Companies (DisCos) toward the deployment of ICT in their billing and revenue collection systems.

## **2. SURVEY OF RELATED LITERATURES**

### **2.1. Electricity Theft and Loss**

Many residential buildings indulge in different forms of electricity theft and illegal tampering with electric supply. The electrical theft has resulted to distribution system faults and overload as well as loss of revenue by the distribution companies. Dike, Obiora, Nwokorie, & Dike (2015) proposed a design through which GSM module is used to detect electricity theft; the GSM module alerts the electricity company when there is tampering and illegal loading.

Occurrence of electricity thefts has been established from available literature and data gathered from the questionnaire. The common ways of electricity thefts include, but not limited to, the following: illegal tapping of electricity from the feeder; meter tampering and physical methods to evade payment of bills; direct wire-connection to a main power route passing through a shop or a house so that electricity can flow to the consumer without crossing the electric meter installed by service provider. Study has shown that 80% of the total theft detected all over the world is from residential buildings and 20% from commercial and industrial premises. This act results in bypassing of billing processes and then preventing energy from been registered in the meter. Hence, it leads to energy loss and unaccounted energy usage (Sayema, Faeq, & Mohd, 2012; Anyasi, Omijeh, & Ighalo, 2012; Khan, Raza, Jaavaid, Mahmood, Qasim, & Anas, 2012; Smith, ).

## 2.2. Metering In Nigeria

Several efforts had been put in place towards metering the various building that are been supplied with electricity, some of the efforts were unfruitful as many residential and industrial area been supplied with power still don't have meter for proper auditing of power supply. Makanjuola, Shoewu, Akinyemi, & Ajose (2015) investigated the problems and challenges faced by the prepaid metering system and efforts geared towards resolving the identified issues using a human-survey approach termed questionnaires to the Eko Electricity Distribution Company (EKEDC) officials and customers. The identified challenges include absence of vending infrastructure, non-tripping of the contractor, the cost of acquiring the meter, and delays in receiving and installation of prepaid meters. Nexang (2004) opined that electric power providers face many difficulties in the distribution of electricity in the rural areas; metering, billing, and collection of revenue accruing from power usage; and this has resulted to failure in rural power supply efficiency.

Electricity is the only commodity of trade for any electric utility. Accurate accounting of every unit of electricity generated, transmitted and distributed is the most important element of sustainable operations. Energy audit is all about metering, which helps to quantify consumption, localize and define loss. Over the years, the DisCos have been gradually losing control over how, when and where consumers connect to the distribution networks; and this has resulted to several loss of electricity through distribution to the consumers (Ike, 2015).

## 2.3. Application of ICT in Power Sector

There is a surplus of ICT options available in the market today for driving changes from manual to automated business operation. The selection of ICT tools should be based on long-term strategic and business continuity perspective by carefully considering the following issues (Sinha, 2015):

- i. Adoption of open architecture and adaptive communication network based on proven standards and specifications;
- ii. Consistent infrastructure for data collaboration, communication and interoperability;
- iii. Authentication and role-based access to the network;
- iv. Robust and scalable architecture to support large volume of transactions;
- v. 3-tier architecture for easy modifications of business logic and SW deployment;
- vi. Platform-independent application components for easy migration to new platforms;
- vii. Disaster Recovery and Continuity Planning.

### 3.0. RESEARCH METHODOLOGY

Questionnaire was used to gathered data on availability of power, billing processes, and mode of payment for power supply from the DisCo to the various consumers sampled. Two thousand sets of questionnaire was prepared and distributed among the researchers to cover various axis of Sango-Ota (Ogba Ayo, Ijoko, Ilo-Awela, and Itele) out of which only One thousand seven hundred and eighty-five (1,785), i.e. 89%, was fully responded to from which we extracted data shown in Tables I, II and III as follows.

**TABLE I**  
**Data On Availability Of Electricity To The Consumer I**

Questions	Responses		
	Q1	< 5years 77 (4%)	5-10 years 889 (50%)
Q2	5hrs - 24hrs 907 (51%)	23 - 45hrs 360 (20%)	46 - 60hrs 518 (29%)
Q3	< 5 107 (6%)	between 6 & 10 999 (56%)	> 10 679 (38%)
Q4	Yes 1607 (90%)	No 178 (10%)	

**Table Ii: Data On Availability Of Electricity To The Consumer II**

Questions	Response				
	Q5	< 1 week 0 (0%)	over a month 1297 (73%)	half a year 203 (11%)	1 year 106 (6%)
Q6	Service Provider 57 (3%)	Community 1399 (78%)	Government 297 (17%)	Philanthropists 32 (2%)	

**Table Iii: Billing Process And Revenue Collection Approach**

Questions	Response	
Q7	Yes 661 (37%)	No 1124 (63%)
Q8	Prepaid meter 126 (19%)	Old analog meter 535 (81%)
Q9	Estimated bill 771 (69%)	Electric Distribution Company read meter 353 (31%)
Q10	Yes 949 (84%)	No 175 (16%)
Q11	Yes 1013 (90%)	No 111 (10%)
Q12	Yes 219	No 907
Q13	Yes 1119 (63%)	No 666 (37%)

### 3.1. Analysis of Data

**Response to Question 1:** From the response to question 1, we observed that 4% of the buildings were connected to National grid less than 5 years ago, 50% have been on the grid between five and ten years, while 46% has been connected for over 10 years.

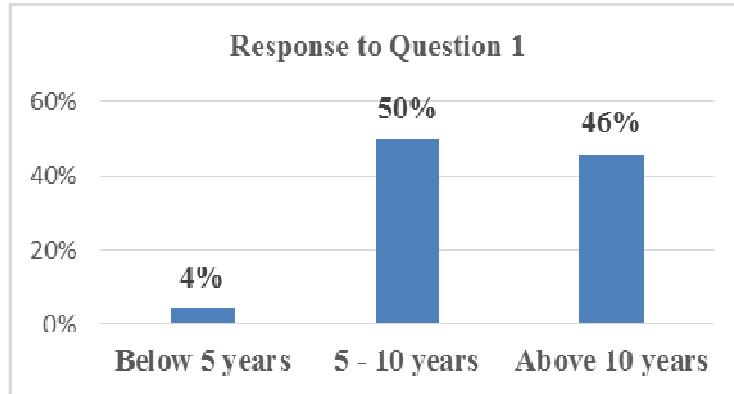


Figure 1: Response to Q1

This implied that majority of the customers in the sampled area are old customers that deserved attention and better services from the DisCo.

**Response to question 2:** 51% of the sampled population has electricity supply from service provider in the range of 5 to 24hrs per week, 20% percent has electricity supply between 25 to 45hrs, while 29% enjoy electricity supply from service provider between 46 - 60hrs.

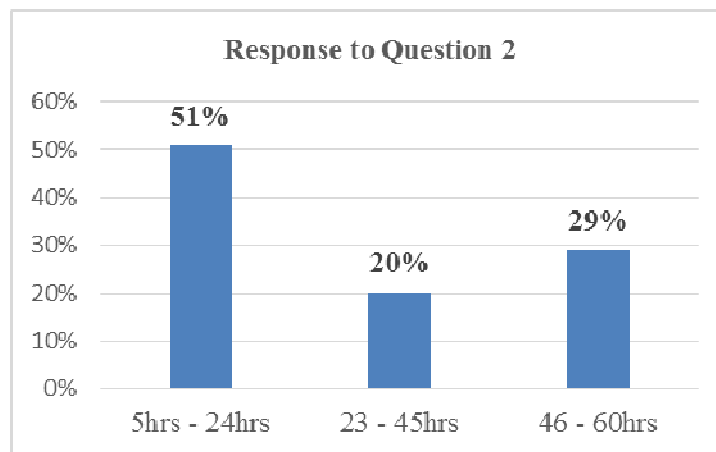
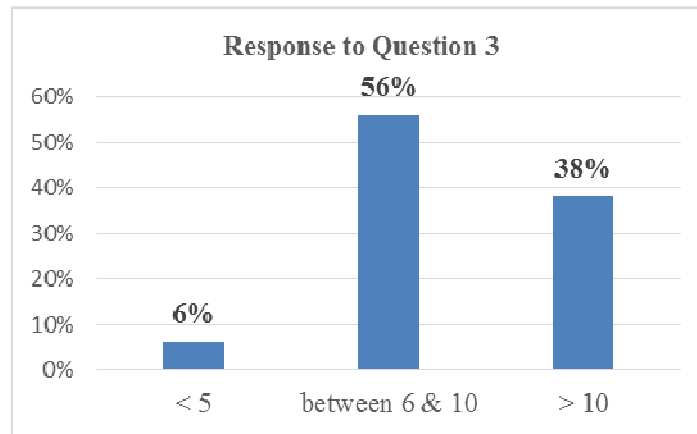


Figure 2: Response to Q2

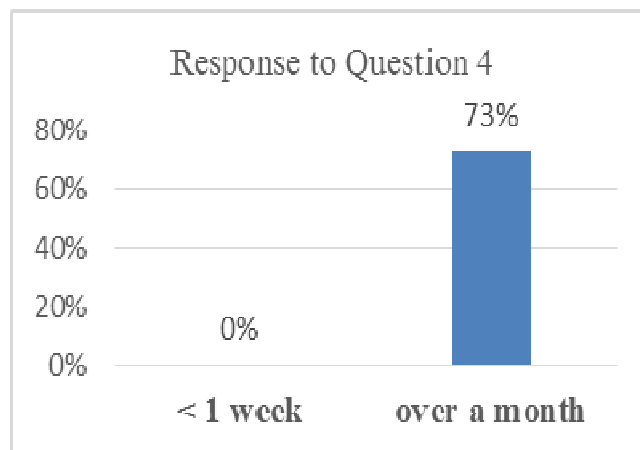
The result obtained from the response to question 2 implied that very small percentage (29%) of the respondents has ever enjoyed stable supply of power for 48hrs in a week. This implied that the electricity supply to the sampled area is epileptic in nature. Hence, the authors are concerned to find out why, with an attempt to find solution to the problem of epileptic supply in the area.

**Response to Question 3:** 6%, 56%, and 38% have inhabitants between 1 and 5, 6 and 7, and greater than 10 respectively living in the building; see Figure 3 This implied that the residents sampled have many people living within the community.



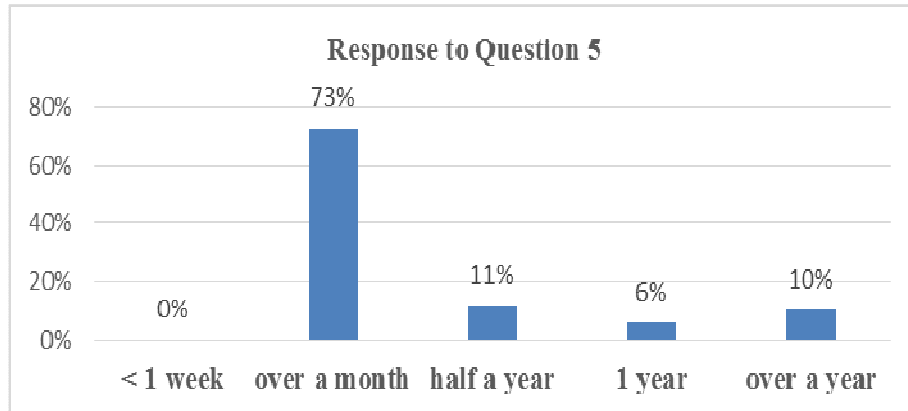
**Figure 3: Response to Q3**

**Response to question 4:** This shows that majority of the sampled population, approximately 90% had experienced major fault that had left the community in darkness for some period. See Figure 4.



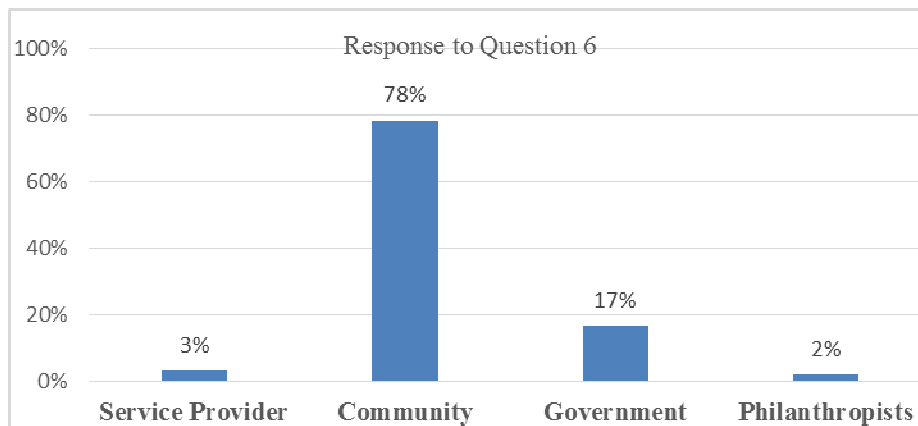
**Figure 4: Response to Q4**

**Response to question 5:** This shows that the fault/s in question 4 has led to blackout in the area for over a month, half a year, 1 year, and over a year with following percentage respectively 73%, 11%, 6%, 10% respectively. See Figure 5. The results implied that there is no quick response to power failure due to fault/s in the area sampled.



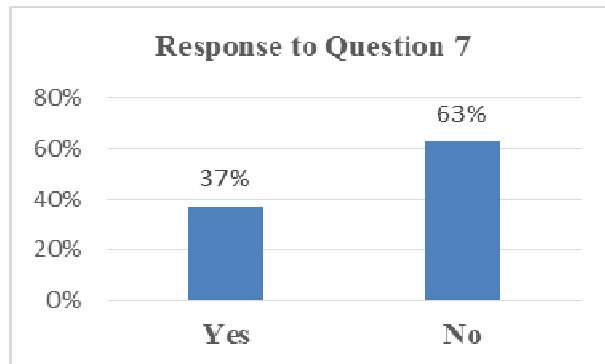
**Figure 5: Response Q5**

**Response to question 6:** The response shows that larger percentage of repair of major fault/s were borne by the community, with about 78%. Only 3% was borne by the DisCo, 17% by government, and 2% borne by philanthropists in the community. The question that bothered the authors based on this response is why the cost of major fault/s should be borne by the community and only 3% borne by the service provider see figure 6. Does that mean that the customers don't pay for the service or the DisCo is not making gain?



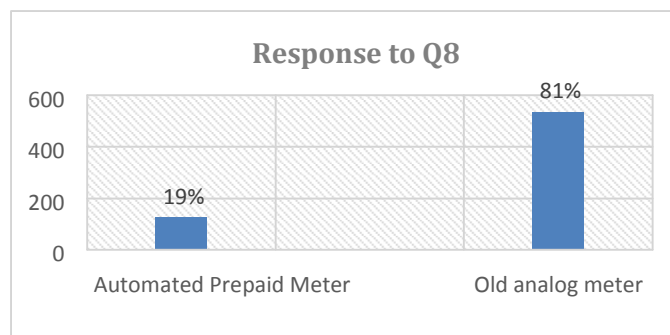
**Figure 6: Response to Q6**

**Response to question 7:** Only 37% of the respondents has electric meter, 63% does not have meter. The implication of this result is that there is no proper auditing of power supply to almost 63% of the sampled population and that may affect the efficiency of the DisCo. See Figure 7.



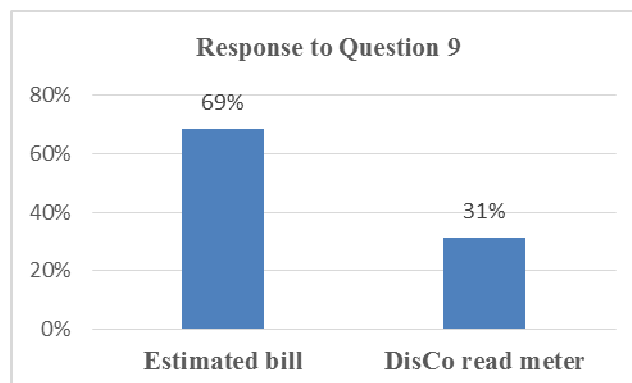
**Figure 7: Response to Q7**

**Response to question 8:** only 19% of those that has meter use prepaid meter that support proper auditing of the power supply from DisCo, and 81% use analog meter that allows easy theft of power supply. See Figure 8.



**Figure 8: Response to Q8**

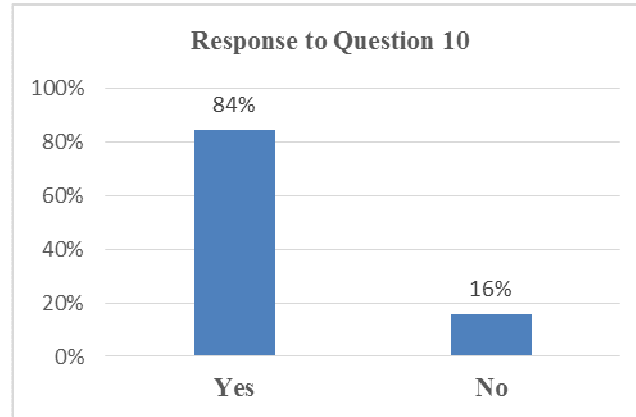
**Response to question 9:** 69% of the respondents are given estimated bill, otherwise known as "crazy bill", while 31% are billed based on their meter reading by the DisCo officials. With this result, it means that auditing of power supply is impossible and that will give room to electricity theft by consumer in connivance with DisCo officials.



**Figure 9: Response to Q9.**

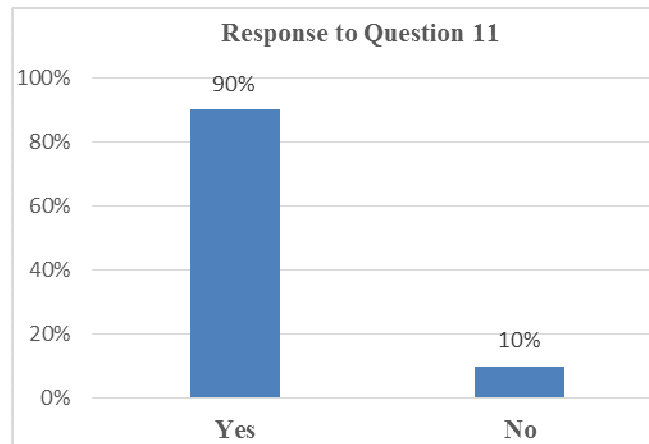


**Response to question 10:** about 84% of those using analog manual meter are currently owing the DisCo, while 16% are not owing; see figure 10. This is due to inefficient billing and revenue collection method being used by the DisCo.



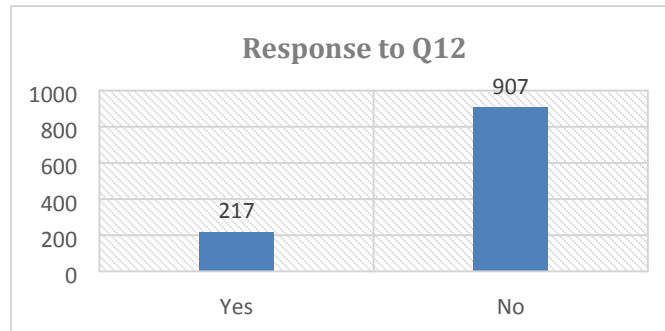
**Figure 10: Response to Q10.**

**Response to question 11:** It is obvious that the respondents with prepaid meter has no link with whether DisCo official come for bill or collection of money for bill given to the consumers. The respondents treated for this part of questionnaire are those with analog meter, and those without meter, which make up about 1,124 (90%) respondents in that category. See figure 11.



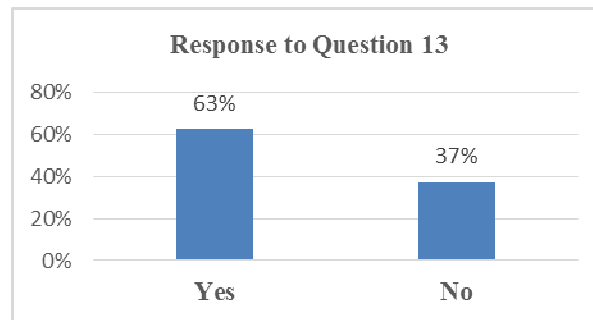
**Figure 11: Response to Q11**

**Response to question 12:** about 19% agreed that their electric power supply has been disconnected in the past due to indebtedness, while 81% disagreed; see Figure 12. This implied that larger percentage of the consumer owing the DisCo are still using electric power supply despite their huge indebtedness. This is to further confirm the prevalence of electricity theft.



**Figure 11: Response to Q12**

**Response to question 13:** This shows that about 63% of total respondents agreed that they used to offer the DisCo officials money during visitation to their buildings, while 37% disagreed; see Figure 13. Careful examination of this result led to observation that consumers in the sampled area connive with DisCo officials to perpetrate criminal act of bribery, tampering and electric theft.



**Figure 13: Response to Q13**

One thousand eight hundred and seventy-five respondents were sampled, out of which only 27% has electric meter; only 9% of the respondents sampled have prepaid meter. About 71% of the population never enjoyed regular electric power supply for 24hrs in a week. The categories of people without meter and those with analog meter do bribe DisCo officials during routine check to avoid disconnection due to their indebtedness.

#### 4. FINDING FROM THE DATA ANALYSIS

The analysis of this study was based on the data gathered from the questionnaire. Our findings are as follows:

- Electric power supply service is ineffective in the area; larger percentage of the residents in the sampled area never enjoy power supply up to 48hrs in a week.
- Majority of the customers in the sampled area are old customers that deserved attention and better services from the DisCo.
- There is no quick response to power failures that result from major faults that the residents in the community cannot easily repair in the area sampled.
- There is no proper auditing of power supply to almost 73% of the sampled population and that may affect the efficiency of the DisCo.

- Auditing of power supply is totally impossible due to ineffective billing, revenue collection, and metering of the buildings sampled, which in turn give room to electricity theft by consumers in connivance with DisCo officials.
- Larger percentage of the consumer owing the DisCo are still using electric power supply despite their huge indebtedness, which means that the DisCo officials are corrupt or inefficient in their duties. This confirms the prevalence of electricity theft.

## 5. RECOMMENDED ICT SOLUTION TO THE PROBLEMS IDENTIFIED

The findings from the study enabled the authors to recommend the following ICT solutions in power sector:

- Computerization of the Prepaid Metering System, introduction of prepayment metering country-wide and periodic training of electricity staff members and officials in the adoption and use of ICT tools.
- Development of real time database driven application program for the following operations:
  - Power flow management
  - Energy Accounting and auditing of distribution
  - Information Retrieval and Analysis
  - load Flow analysis
  - business process automation
  - revenue and commercial management
  - distribution system automation
  - Consumer relationship management etc.

## 6. CONCLUSION

We can conclude that the electricity supply to the sampled area is epileptic; about 71% of the population never enjoy regular stable electric power supply for 48hrs in a week. There is ineffective billing and revenue collection due to the bad metering policy in the area. Many of sampled buildings have no meter; and those with analog meter do bribe Electric Distribution Company officials during routine check to avoid disconnection due to their indebtedness. The activity of consumers in connivance with some Electric Distribution Company officials has resulted to huge electricity theft and is affecting the efficiency of Electric Distribution Company in meeting the user demands due to loss from distribution lapses. Consequently, we hereby propose full application of Information Communication Technology (ICT) for computerization of the Prepaid Metering System; introduction of prepayment metering countrywide; periodic training of electricity staff members and officials in adoption and use of ICT tools; development of real time database driven application program for the operations in the power sector; Power flow management; Energy Accounting and auditing of distribution; Information Retrieval and Analysis; load Flow analysis; business process automation; revenue and commercial management; distribution system automation; consumer relationship management etc.

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