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Original Research Article

An Assessment of Consumers' Experiences and the Desired Improvements on the use of the Existing Prepayment Meters in Parts of Benin City and Warri in Nigeria

***Amhenrior, H.E.**
Department of Electrical/Electronics Engineering, Faculty of Engineering, University of Benin, PMB 1154, Benin City, Nigeria.
*henrino2003@yahoo.com

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ABSTRACT

In this paper, an assessment of prepayment electricity consumers' experiences and the desired improvements on existing meters in parts of Benin City and Warri was carried out. The methodology involved field data collection through the use of questionnaires on electricity consumers especially those using prepayment meters in Benin City, Edo State and Warri, Delta State. The field data were collated and analysed to determine the extent the suggested improvements were actually desired by the users. The results show that no existing prepayment meter in the areas can be recharged through mobile phone and majority (97.09%) of the meters in the areas are keypad operated. Out of the 76.87% of the metered consumers' houses with existing prepayment meters, 66.02% prefer to recharge token using mobile devices and 68.45% want to be able to obtain unit balance, time of power failure and restoration through mobile devices. Some (82.03%) desire at least one of these improvements. Also, from the results, educational level affects the acceptability of improvement in the meter. It is recommended that designers and engineers of prepayment meters should be guided by the outcome of this research on the needed improvement from the consumers' perspective to advance the meters for better performance.

1. INTRODUCTION

According to the Nigeria Electricity Regulatory Commission (NERC), as at the first quarter of 2018, there were 8,135,730 registered electricity users in Nigeria, and only 3,434,003 which is 42% of the total users have been metered. This leaves 58% of the legally connected population unmetered (NERC Quarterly Reports, 2018). Prepayment metering system was introduced about a decade ago in Nigeria by the electricity utility company then known as Power Holding Company of Nigeria (PHCN) and it has since been in use in some urban areas in the country. The most prevalent type of meter especially in the Benin Electricity Distribution Company (BEDC) of the unbundled PHCN is the token recharge prepayment meters

(Amhenrior, 2017; Amhenrior and Edeko, 2018). In this system, the consumer would purchase the recharge token either from the vending station at the utility's offices, banks or any other authorised sales outlet, then, the customer goes to recharge the prepayment meters by keying-in the token physically into the prepayment meter using the keypad. Information sourcing from the meter is also done through physical contact in a similar manner to token recharging.

The prepayment meters are electronic in nature and therefore have some level of smartness. The smartness of the prepayment meter has not been completely leveraged on to the benefit of the consumers and the distribution company (Amhenrior, 2017). In making improvements to the existing meters, it would be proper that the experiences and desires of consumers with the existing meters be taken into consideration by designers and manufacturers. In a study carried out in 2014 in eight different African cities namely Kampala, Lusaka, Maputo, Maseru, Mogale City, Nakuru, Nairobi, and Windhoek by World Bank Group, it was observed that the prepayment system has the potential to give consumers some great advantages, yet major areas of limitations that need improvement were identified namely, improving the technical performance and reliability; convenient vending; and safeguards against inconvenience and hardship. It advocated increasing the use of ICT to help in making prepayment systems more effective and removing burden in token usage especially in the use of mobile phone and its services such as the SMS in the recharge of token (Chris and Kathy, 2014). Many users of prepayment meter have on different occasions advocated individually for an improvement by way of adding features that will enhance the performance of their meters and this paper therefore seeks to find out what kind of improvement that would be required.

Zahoor *et al.* (2017) noted in their paper that the disadvantages of prepayment smart meters include difficulty in understanding the new technology, scratch card availability, technical problems and card reader issues. In a survey in South Africa, a researcher assessed the water prepayment meter in some parts of the country and determine the level of satisfaction with prepayment meter technology. The study result shows that 54% of the respondents were in support of the technology; 15% were against it while 31% were indifferent. As expected in any new technology, there are shortcomings associated with prepayment meters. The most noticeable among them is the technical reliability on which general satisfaction with the technology is strongly dependent on. From a report submitted to Water Research Commission (WRC) in South Africa on institutional and socio-economic review of the use/application of electronic prepayment meter technology in the provision of water supply services to urban and peri-urban areas, 89% of the respondents were dissatisfied on the technical reliability of the meters (Marah *et al.,* 2004). Similarly, in a study conducted in three different cities of different economic levels in Zambia, an average of 6% across the three areas stated that they were experiencing problems with the prepayment meters and an average of 68% across the three areas stated that they were satisfied with the availability of electricity credit and 92% were okay with the displayed information on their prepayment meters. However, the study also revealed that some of the respondents want the prepayment meter to have a buzzer and be able to indicate the consumption of each appliance (Albert *et al.,* 2014). From the foregoing, every consumer may have a specific feature that may be very important to them when incorporated in the metering technology to give them a high degree of satisfaction. These therefore form the expectation and perception about the meter they have used.

Also, in 2012 a study was carried out to determine customers' perception and acceptability on the use of Prepayment Meters in Accra West Region of Electricity Company of Ghana (ECG). According to the study, prepayment meter user friendliness, durability, access to vending points, user's educational level and the rate of response to technical issues in the meter are among the major factors determining the acceptability in that region (John, 2012). In a study on project management and performance of prepaid electricity metering project of Kenya power using Nairobi City as a case study, the researcher recorded the highest customer satisfaction of 74.2% in Kitengela; the highest prepayment service complaints of 61% in Tala and Gatundu branches and the highest prepaid meter replacement of 46% in Tala branch (Kebeya, 2015). This shows that the way consumers perceive this technology and the required improvement also vary from place to place. Consequent upon this, most manufacturers usually evaluate their market to determine if their products are

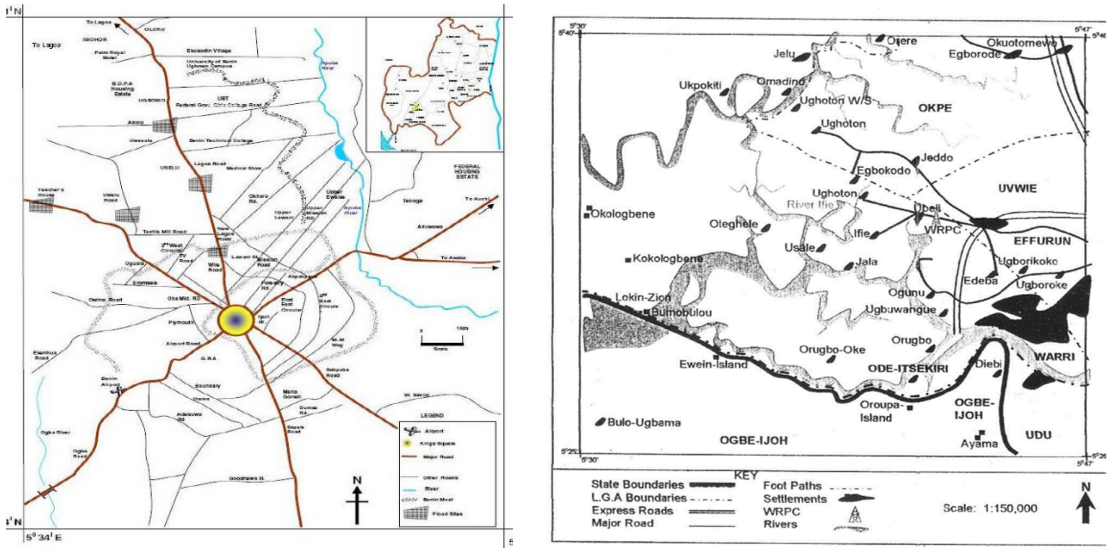
performing up to expectation. In line with this, a study was carried out in the KwaZulu-Natal area of South Africa to determine if Conlog (prepaid meter manufacturer) services and products meet the expectations of the people. It was concluded that customer satisfaction in electricity prepayment metering industry in the area was as a result of the quality offered, as Conlog strives to understand and meet customer needs (Mondli, 2016).

2. MATERIALS AND METHODS

This study was carried out in two cities namely Benin in Edo State and Warri in Delta State. Both cities are metropolitan cities that are within the coverage of the Benin Electricity Distribution Company (BEDC). These cities were chosen because they have a high population of prepayment meter users, with people of different educational level and social strata.

2.1. Description of Study Area

Benin City is located on the coordinate 6° 20' 0" N and 5° 38' 0" E. It is both the administrative and commercial capital of Edo State in the South-South region of Nigeria. It is an ancient city with a 2008 to 2010 population projection estimate of 1,383,900 people (NBS, Annual Abstract of Statistics 2011). As common in most Nigerian cities, it is made up of planned and unplanned settlements. Benin City is a built - up area with both ancient and modern houses mostly connected to the electricity distribution network for power supply. Warri is both the commercial and industrial hub of Delta State in the South-South region of Nigeria. It is a modern city covering three Local Government Areas with a 2008 to 2010 population projection estimate of 641,763 people (NBS, Annual Abstract of Statistics 2011). It is located at about 80km from Benin City. It is situated on the Niger Delta estuary of the Atlantic Ocean. Like Benin City, it is a built-up area made up of planned and unplanned settlements with both ancient and modern houses connected to the electricity distribution network for power supply. Figure 1 shows the map of the study areas.



(a) Benin City, Edo State (b) Warri, Delta State

Figure 1: Map of Benin City and Warri in Nigeria

The implementation of this study was done in two stages. These include field data collection by the administration of questionnaires to people and the analysis of the field data. The survey was carried out by administering questionnaires to the public. The survey was carried out in Benin and Warri metropolis and it covered four Business Units of BEDC. Benin area constituted the highest numbers of respondents namely Ugbowo District with the highest number of 167 respondents, Sokponba District with 29 respondents, Ikpoba Hill District with 84 respondents, and Warri District had 30 respondents. The questions where structured in a way that leads from general to specific to determine the respondent's experiences with the existing prepayment meters in a manner that helped to identify the existing areas the respondent wanted improvements. The analysis of the responses obtained from the survey was carried out and the results of the analysis are presented in the results section.

A number of statistical tools such as charts and test of hypothesis were used. The Chi Square test was particularly used to test the authenticity and the claims of the respondents especially in the specific areas of improvement of the existing prepayment meters. The chi Square test is defined as follows:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \quad (1)$$

Where:

χ^2 = Chi square
O_i = Observed number of cases in category *i*
E_i = Expected number of cases in category *i*
$\sum$ = Summation from *i* to *n*

The null and alternative hypotheses for each Chi square test can be stated as:

H_0: $O_i = E_i$
H_1: $O_i \neq E_i$

3. RESULTS AND DISCUSSION

3.1. Basic Data Results and Social Demographic Analysis

The basic information of the data collected are the numbers of respondents used in the survey and their social demographic classifications such as the age distribution of the respondents, house or apartment ownership classification, type of house they live in whether these houses are metered with energy meter or unmetered and the type of energy meter those that are metered are using. These analyses are presented below.

Total number of respondents	=	310
Metered houses	=	86.45%
Unmetered houses	=	13.55%
Respondents on PPM	=	66.45%

Metered Houses Analysis (86.45%)

a) Analog or postpaid meters = 23.13%
b) Prepayment peters (PPMs) = 76.87%

The age distribution of the respondents shows that 30 to 45 years constituted 53%, the largest proportion of the respondents and this was followed by 46 to 60 years of the respondents which constituted 20%. This analysis shows that the captured data (group of people by age) were reasonable as those captured were

responsible enough to be able to respond to the research questions with the required knowledge and experience. The age distribution of the survey is as shown in Figure 2.

The house ownership classification shows that 54% of the respondents lived in a rented house/apartment while 46% were house owners. Figure 3 shows the house ownership classification. The proportion of the respondents that have energy meter in their houses/apartments was 86% of which 77% were prepayment meters. The percentage of the metered respondents and those using prepayment meters among them were high enough for the realization of the research objective. Figures 4 and 5 show house metering status and the meter type respectively.

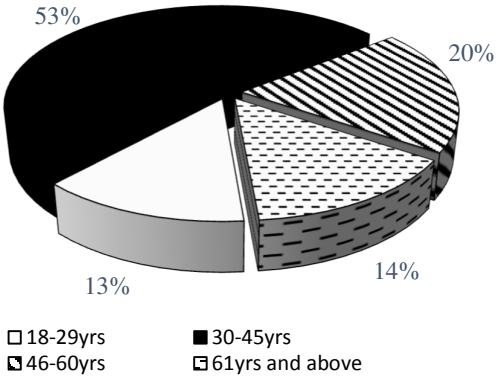


Figure 2: Age distribution of respondents

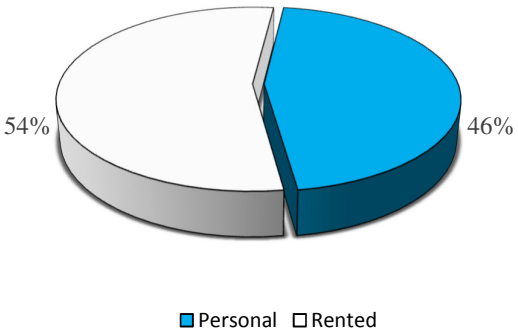


Figure 3: House ownership classification

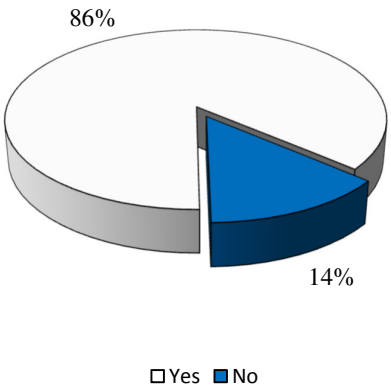


Figure 4: House metering status

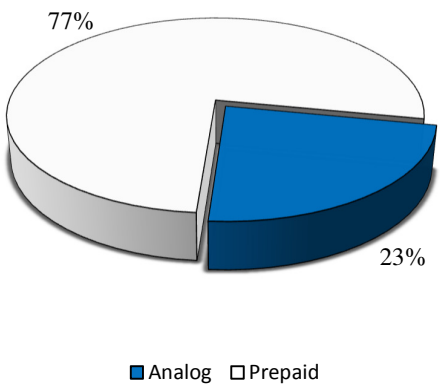


Figure 5: Meter type

3.2. Years of Prepayment Meter Usage

As stated in the introduction, the prepayment meter was introduced about a decade ago in BEDC and therefore the maximum number of years of usage could not be more than 11years. This is why relatively few respondents have used prepayment meters 9 years in the sample studied. The highest numbers of respondents were recorded for 1-3 years with 68 respondents and this was closely followed by 3-5years with 65 respondents and then 5-9 years with 60 respondents in the studied sample space. The bar chart in Figure 6 presents the numbers of years of usage of prepayment meters by respondents. Meters that are one year to

nine years old represents 93.68% of the total prepayment meters under study and were still in their active service region of their reliability as their life span have not been exceeded. With a usage period of 3 and above, the captured respondents represent 67.47%, and this has given enough years of experiences for the respondents to understand the behavior of the meters and as such, their responses can be taken as correct and genuine.

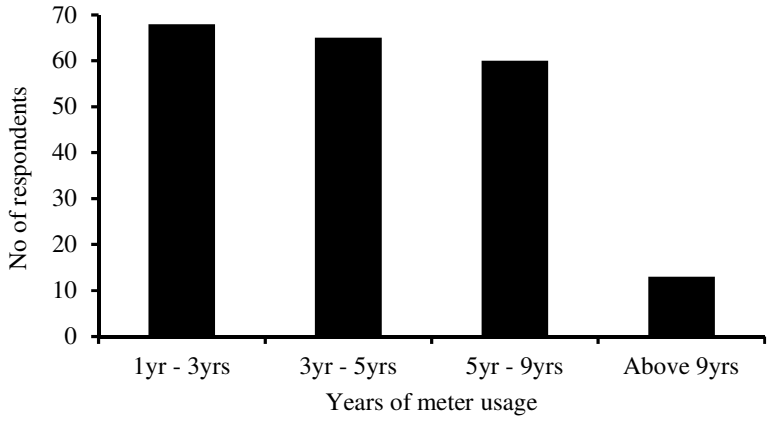


Figure 6: Years of meter usage

3.3. Prepayment Capability Experience

Here the respondents who are strictly on prepayment meter were analysed on a number of criteria namely, token recharging methods, the numbers of years of prepayment meter usage, wireless communication of meter with mobile phones and the desired improvements needed in the prepayment meters.

3.3.1. Token recharge methods

The token recharge method from the surveyed sampled population of meter users is as shown in Table 1. A total of 200 respondents representing 97.08% of the total metered respondents were recharging their meters through keypad while there was no respondent that was able to recharge with mobile phone. Table 2 shows that 66.02% of the total respondents were willing to recharge their prepayment meter with mobile phone.

Table 1: Token recharge method for prepayment meters

SN	Mode of recharging token into	Number	Percentage
1	Through keypad	200	97.09
2	Through BEDC computer	6	2.91
3	Through mobile phone	0	0.00

Table 2: Respondents' willingness to recharge with mobile phone

SN		Number	Percentage
5	Willing to recharge through	136	66.02
6	Not willing to recharge through	56	27.18
7	Undecided	14	6.80

3.3.2. Meter communication capabilities with mobile phones

Here, the ability of the meters to communicate with mobile phones for information sourcing by the respondents were analysed in numbers and percentages as shown in Tables 3. The willingness of respondents to be able to use mobile phones with their meter was also analysed as shown in Table 4. From Table 3, it is evident that wireless communication capabilities of the existing prepayment meters are limited as 80.09% of the respondents' meters cannot communicate the unit balance of the meter to mobile phones while 85.92% of the respondents' meters cannot communicate the time of power failure and restoration to customers' mobile phones. The results from Table 4 show that 82.03% of the respondents are willing to communicate more with their meters using mobile phones in at least one area of communication capabilities improvement. Figure 7 shows a combined bar chart of the meter communication capabilities and the areas of desired improvements.

Table 3: Meter communication capabilities with mobile phones

SN	Meter communication capability with Phone	Numbers	Percentage
1	Receiving unit balance on phone	2	0.97
2	Not receiving unit balance on phone	165	80.09
3	Not sure	39	18.94
4	Receiving time of power failure and restore on	2	0.97
5	Not receiving time of power failure and	177	85.92
6	Not sure	27	13.11

Table 4: Analysis of the desire for more communication capabilities with mobile phones

SN	Meter communication capability with Phone Desired	Numbers	Percentage
1	Willingness to receive unit balance only on phone	21	13.11
2	Willingness to receive time of power failure and	7	10.19
3	Willingness to receive both (1 and 2) on phone	141	68.45
4	Willingness for at least one	169	82.03
5	Undecided	37	10.28

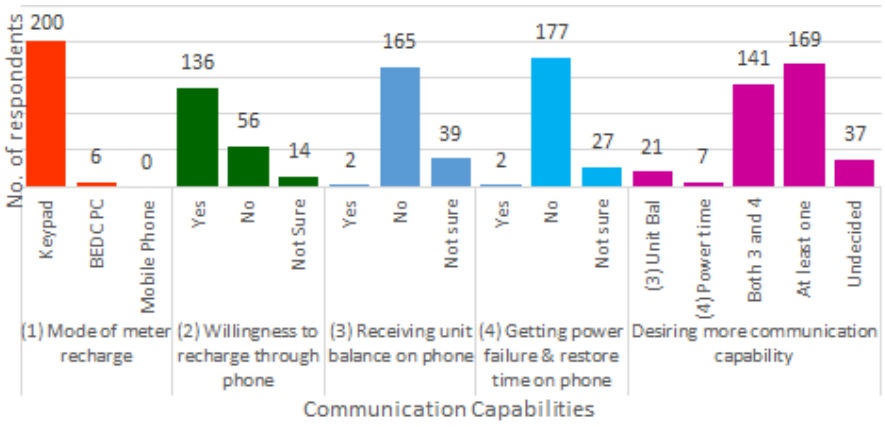


Figure 7: Combined analysis chart

3.4. Chi-Square Data Presentation

This section presents the Chi-Square analysis results for five critical question that bother on the mode of token recharge into the existing prepayment meters, their wireless communication capabilities and the desired improvement of the respondents in the meter. This is presented in Table 5 with the accepted hypothesis in each specific question. The results show that the null hypothesis (H_0) is rejected in favour of the alternative hypothesis (H_1) in the five cases. This test is used to validate the results of the claims of respondents in the previous sections where charts were used in the analysis of these critical questions.

Table 5: Chi-Square data

SN	Specific question	Observed (O_i)	Expected (E_i)	$(O_i - E_i)$	$(O_i - E_i)^2$	$\frac{(O_i - E_i)^2}{E_i}$	Degree of freedom	Tab val (α = 0.05)	Accepted hypothesis
1	How Do you recharge token into your meter	200 6 0 ∑ = 206	68.66 68.66 68.66 ∑ = 206	131.34 -62.66 -68.66 ∑ = 0.02	17250.19 3926.27 4714.19	251.24 57.18 68.65 ∑ =377.07	2	5.99	H_1: $O_i \neq E_i$ Since 377.07>5.99
2	Would you like to recharge meter with phone	136 56 14 ∑ = 206	68.66 68.66 68.66 ∑ = 206	67.34 -12.66 -54.66 ∑ = 0.02	4534.67 160.27 2987.71	66.04 2.33 43.51 ∑ = 111.88	2	5.99	H_1: $O_i \neq E_i$ Since 111.88>5.99
3	Are you able to obtain credit usage and balance from your meter?	2 165 39 ∑ = 206	68.66 68.66 68.66 ∑ = 206	-66.66 96.34 -29.66 ∑ = 0.02	4443.55 9281.39 879.71	64.71 135.17 12.81 ∑ = 212.69	2	5.99	H_1: $O_i \neq E_i$ Since 212.69>5.99
4	Are your able to obtain time of power failure and restore wirelessly	2 177 27 ∑ = 206	68.66 68.66 68.66 ∑ = 206	-66.66 108.34 -41.66 ∑ = 0.02	4443.55 11737.55 1735.55	64.71 170.95 25.27 ∑ = 260.93	2	5.99	H_1: $O_i \neq E_i$ 260.93>5.99
5	Which of the features in 3 and 4 would you like in your meter?	21 7 141 27 ∑ = 206	51.5 51.5 51.5 51.5 ∑ = 206	-30.5 -44.5 89.5 -14.5 ∑ = 0.0	930.25 1980.25 8010.25 210.25	18.06 38.45 155.53 4.08 ∑ = 216.12	3	7.81	H_1: $O_i \neq E_i$ 216.12>7.81

3.5. Educational Level Analysis

In this section, the respondents were analysed according to their educational level and then with special regard to their willingness to communicate with their prepayment meters through mobile phones. This analysis was to determine the effect of educational level in their decisions regarding the use of prepayment meters. Table 6 shows the educational level of the respondents, while Tables 7 and 8 presents the educational analysis of respondents willing to recharge prepayment meters through mobile phone and those unwilling to recharge their meters through mobile phones respectively.

Table 6: Educational analysis of respondents

SN	Description	Numbers	Percentage	$(Y - \bar{Y})^2$
1	FSLC	29	9.35	233.47
2	WASC/SSCE/NABTEB	73	23.55	824.83
3	OND and NCE	45	14.52	0.52
4	First Degree	108	34.84	4060.23
5	Master Degree	41	13.22	10.75
6	PhD	10	3.23	1175.11
7	Others	4	1.29	1622.47
	Total	310	100	7927.38

Mean = 44.28 and Standard Deviation =33.65

Table 6 shows the numbers of respondents in each educational level and their corresponding percentage of the studied sampled population. The highest numbers of respondents were first degree holders, constituting 34.84%. This was followed by Ordinary National Diploma (OND), Nigeria Certificate in Education (NCE) with 14.52% and master degree holder with 13.22%. Table 7 analysed each educational level on the number of respondents that have prepayment meters, those among the numbers that were willing to recharge their meters with mobile phone, the percentage of the numbers willing to recharge with mobile phone at the educational level as compared to the total numbers willing at all educational level, and the percentage of those willing to recharge with mobile phones as compared to the numbers of prepayment meter user in each educational level. Table 8 shows the same analysis of Table 7, but in this case the analysis was for those who were unwilling to recharge their prepayment meters with mobile phones.

Table 7: Respondents willing to recharge meters with mobile phones

		A	B	C	D
SN	Description	Nos among on PPM	Nos willing	$\%_1$ = (B/ΣB) x 100	$\%_2$ = (B/A) x 100
1	FSLC	14	8	5.88	57.14
2	SSCE	48	30	22.06	62.50
3	OND &	37	22	16.18	59.46
4	First	66	42	30.88	63.64
5	Master	32	27	19.85	84.38
6	PhD	7	4	2.94	57.14
7	Others	3	3	2.21	100.00
	Total (Σ)		136	100	

Table 8: Respondents unwilling to recharge meters with mobile phones

		A	B	C	D
SN	Description	Numbers on PPM	Nos not willing	$\%_1$ = (B/ΣB) x 100	$\%_2$ = (B/A) x 100
1	FSLC	14	3	5.36	21.43
2	SSCE	48	15	26.79	31.25
3	OND &	37	13	23.21	35.14
5	First Degree	66	19	33.93	28.79
6	Masters	32	5	8.93	15.62
7	PhD	7	1	1.78	14.28
8	Others	3	0	0	0.00
	Total (Σ)		56	100	

The age distribution of the respondents shows a predominance of the age group of 30 to 45 years and 46 to 60 years which constitutes 53% and 20% respectively of the total respondents. These two groups of respondents are within the active working age of the country and have the economic power to own a house or an apartment with the attendant responsibilities that come with it, such as the ownership of energy meter and its usage. These two groups constitute 73% of the total respondents. This was followed by the retired and elderly (14%) and lastly those within the age bracket of 18 to 29 years. The implication of this is that meter ownership and usage are mainly in the hands of the adults who perhaps have the means in the studied area. On the years of usage of prepayment meters, it was observed that 67.47% of the users have owned prepayment meters for more than three and above and this has made them to discover the deficiencies in the meters. This has also enabled them to compare the technologies with other fast changing technology

especially the mobile communication and the possibility of its application to achieve an improvement in the device.

In Tables 1 to 4, some of the deficiencies and expectations where presented. One of the deficiencies observed was that 97.09% of prepayment meter can only be recharged with token through the keypads among others. From these results, it can be said that the available prepayments meters are limited in wireless communication capabilities and therefore the existing meters were being operated manually. The results also show that consumers are already dissatisfied with the technology in place and they would want to enjoy the benefits brought about by mobile phone revolution in the metering technology by way of the value-added-services (VAS). The deficiencies are probably due to the fact that the designers did not take the need of the use of mobile phone technology with the meter into consideration. Again, the consumers may not have hitherto demanded for such improvements from the utility company who would in turn task the manufacturer on it. Therefore, there is the need for an improvement in the functionalities of the prepayment meter especially in the area of communications with mobile phones for the consumers of electricity.

From column C of Table 7, first degree holders constituted the highest percentage (30.88%) of prepayment meter users willing to recharge their prepayment meters through mobile phone, as they also constituted the highest percentage (34.84%) of the total users of prepayment meters. Also, as shown in column D of Table 7, every educational cadre substantially desired to be able to recharge token into their meters through mobile phones with the least percentage of 57.14% in FSLC and PhD. Users with other certificates had 100% acceptance followed by master degree holders with 84.38%. The reverse was the case from Table 8 as no categories of educational level had more than 35.14% of its respondents who were unwilling to recharge prepayment meters through mobile phones. The unwillingness was least in the higher cadres of educational level with PhD (14.28%) and followed by master (15.62%). From column D of Table 8, the percentage within each educational cadre who were unwilling to recharge token into their meters through the mobile phone were higher in the lower educational cadres with FLSC, SSCE and OND/NCE having 21.43%, 31.25% and 35.14% respectively. It can then be said with some level of certainty that educational level affected the understanding and willingness to recharge meter token through mobile phone. Therefore, the low level of education may have caused the 27.18% respondents to be unwilling to be able to recharge meter token through mobile.

The chi-square hypothesis test of some specific questions of this study validated the deficiency claims in the available meters in the studied area of BEDC coverage area. It also validated the facts that had been established in Tables 1 to 4, that users of prepayment meters were desirous of communicating more with their meters through mobile phones and improvement in the wireless communication capability of prepayment meters.

4. CONCLUSION

This research work has taken an in-depth assessment of the experiences on prepayment meters by the users in Benin and Warri and their expected improvements on the device in the areas of their observed shortcoming. The results of this study have shown that the users of prepayment meters desire to have their meters do more for them especially in being able to recharge and communicate with their meters wirelessly through mobile phones as opposed to the existing manual means of recharging and obtaining information from the meters. Particularly, the respondents want to be able to have value-added-service such as wireless recharge of token into meter through mobile phones; wireless information sourcing from the meter like unit balance, the time of power failure and restore etc. The research results also showed that the level of education of the prepayment meter users were major determinants of acceptability of suggested improvements to the device. It is therefore important that a deliberate education on the value and advantages of having the meter improved to perform more efficiently especially in the area of communication should be embarked on for the users of the prepayment meters and those who intend to migrate to the prepayment metering system. This

will help in the usage of the meter too. By the results of this study, prepayment meter designers and engineers now have a guide on the areas of needed improvement especially from the consumers' perspective to advance the measuring device for better performance.

5. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

REFERENCES

Accenture (2013). Realizing the Full Potential of Smart Metering. *Accenture's Digitally Enabled Grid program,* pp. 1-24.

Albert, M., Priscilla, M., Austine, N., Lilias, M. and Henry, A. (2014). The Effects of the Introduction of Prepayment Meters on the Energy Usage Behaviour of Different Housing Consumer Groups in Kitwe, Zambia. *AIMS Energy,* 2(3), pp. 237-259.

Amhenrior, H. E. (2018). Development of an SMS-Based Prepayment Energy Meter Monitoring System for Consumers and Utility Companies. *American Journal of Embedded Systems and Applications*, 6(1), pp. 37-45.

Amhenrior, H. E. (2017). Analysis and Development of a GSM Based Recharging and Monitoring of Energy Metering System. PhD Thesis, *University of Benin, Benin City, Edo State, Nigeria.* pp. 1-2.

Amhenrior, H. E. and Edeko, F. (2018). Design and Implementation of a GSM-Based Single Phase Prepayment Energy Meter with Hybrid Recharge Mode. *American Journal of Embedded Systems and Applications*, 6(1), pp. 46-55.

Chris, H., Kathy, E. and Richard, F. (2014). The Limits and Possibilities of Prepaid Water in Urban Africa: Lessons from the Field. *Water and Sanitation Program, World Bank Group, 90159 vl.*

John, Q. (2012). Customer Perception and Acceptability on the Use of Prepaid Metering System in Accra West Region of Electricity Company of Ghana. *Master Thesis, Institute of Distance Learning, Kwame Nkrumah University of Science and Technology.* pp. 52-59.

Kebeya, A. S. (2015). Project Management and Performance of Prepaid Electricity Metering Project of Kenya Power: The Case of Nairobi City County and its Environs. *Master Thesis, University of Nairobi.* pp. 27.

Marah, L., O'Donovan, M., Finlayson, K. and Boberg, D. (2004). Institutional and Socio-Economic Review of the Use/Application of Electronic Prepayment Meter Technology in the Provision of Water Supply Services to Urban and Peri-Urban Areas. *Water Research Commission*, pp. 39-41.

Mondli, G. (2016). Customer satisfaction analysis of Conlog Electricity prepayment meters in KwaZulu-Natal: A customer perspective. *Master Thesis, Durban University of Technology. European Smart Metering Alliance.* Version 1.1. pp. 104-108.

National Bureau of Statistics (NBS) (2011). Federal Republic of Nigeria, Annual Abstract of Statistics.

NERC Quarterly Reports, (2018). First Quarter Reports. *Nigerian Electricity Regulatory Commission.* pp. 1-64.

Zahoor, H., Shahzad, M., Lachhman, D., Muhammad, H. S. and Jawad, H. A. (2017). Issues and Challenges of Existing Electricity Pre-Paid Smart Metering Systems: A Review. *Science, Technology and Development,* 36(1), pp. 44-52.