

Effect of Prepaid Metering System on Customer Satisfaction in Niger State, Nigeria

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Abstract—Energy consumers in Nigeria have long complained about Distribution Companies' unfair billing practices, exorbitant monthly electricity bills resulting from meter estimation rather than accurate meter reading. The study's objectives were to establish the relationship between the prepaid metering system and customer satisfaction; and evaluate the level of satisfaction concerning the usage of the prepaid metering system in Niger State, Nigeria. In carrying out the study, the structured questionnaire was administered to 393 randomly chosen respondents drawn from prepaid meter users, out of which 344 responded, generating a response rate of 87.5%. The data derived were subjected to spearman correlation and multiple regression models. The major findings from the study showed a significant, moderate, and positive relationship between the prepaid metering system and customer satisfaction. Additionally, three significant predictors, Affordability, Availability, and Flexibility with $p < .01$ are statistically significant. Further findings from descriptive statistics revealed that users had the highest level of satisfaction with their privacy as a result of no meter readers and no accumulated. The study concluded a positive and beneficial link between the prepaid metering system and customer satisfaction. Therefore, the study recommends good customer care units and a marketing campaign for better knowledge of the prepaid metering system.

Keywords—Prepaid metering system, Postpaid metering system, Customer satisfaction, Spearman correlation, Multiple regression model

1 Introduction

The Postpaid and prepaid systems are the two most prevalent types of electricity billing systems in use around the world [1]. Most households have predominantly been subjected to postpaid billing, and just lately, there has been a significant shift toward

the prepaid metering system [2]. This shift is due to the fact that with a postpaid metering system, users are billed, and monthly payments are based on overall usage, which means that service takes precedence over payment[1],[3],[4]; prepaid metering, on the other hand, requires the user to purchase tokens and units before electricity usage [5]. Electricity was first provided in Nigeria through a postpaid metering system, this requires DISCO staff to manually interpret meter readings and consumers pay for the electricity that has already been used. This is a prevalent method of accounting for substantial non-technical losses resulting from immoral acts like paying bribes to waive bills for consumers who bypass meters. Users who noticed they were overcharged due to incorrect billing estimations typically attempt to recuperate their losses by paying bills late or not at all [6].

According to [1], postpaid billing difficulties include meter reading errors resulting in payment irregularities, inaccessible meter readings causing meter readers to assume and guess. Given the low electricity supply and widespread utility exploitation of customers through irregular billing, accurate consumption metering is crucial in Nigeria. More than eighty percent of the complaints received by the regulator (Nigerian Electricity Regulatory Commission) are about billing irregularities, high tariff rates in the estimated metering approach, and faulty metering infrastructure due to Nigeria's bad billing procedures [7]. The ability of a company to recognize and meet its customers' needs and desires consistently determines its success. Customer happiness is one of the most powerful weapons a business can use to get an edge over its competitors in today's ever-increasing competitive climate. Every organization that wishes to expand its market share must constantly identify and improve aspects that boost customer satisfaction and detect and avoid those that diminish consumer satisfaction [8].

As a result, most countries and cooperatives have shifted to this model (prepaid metering system) in recent years to reap the system's benefits [9]. Prepaid system is a new approach to energy billing that includes a modern electronic customer account management system. Smartcard technology is combined with metering equipment in this system. It not only delivers a service, but it also saves time and money for the company and gives clients more payment choices. It has a paperless payment system and can be used to replace any electromechanical meter on the market, reducing operational costs [10]. As a result of a high customer debt profile and revenue collection difficulties, the Power Holding Company of Nigeria (PHCN) launched the prepaid metering system in 2006 to minimize or avoid complaints of overbilling and other related issues [11]. The prepaid metering system allows DISCOs to collect fees from consumers before using it, reducing revenue lost due to power theft and consumers' unwilling-

ness to pay their utility bills due to incorrect meter reading and payment [12]. The prepaid framework allows for socialization and socioeconomic ordering in a variety of ways, including financial, political, innovative, and technological. Using the prepaid model, consumers can effectively and easily manage their budgets, reducing wasteful and unnecessary electricity use, such as not conserving energy and leaving devices on [13]. The prepaid approach benefits municipalities and utility providers since it boosts income, reduces postpaid outstanding obligations, and improves customer relations [9]. Another overlooked benefit of DISCOs is worker's protection, which exposes staff who are supposed to read meters and visit customers' houses to dangers such as dog bites, harsh weather, and hazards, among other things, as well as the perception of invasion privacy [12]. This paper seeks to study the effects of the prepaid metering system on customer satisfaction, and the specific objectives of the study are to:

- i. establish the relationship between the prepaid metering system and customer satisfaction and;
- ii. evaluate the level of satisfaction concerning the usage of the prepaid metering system in Niger State, Nigeria.

2. Materials and Methods

The study used a quantitative method approach and a survey questionnaire to determine the level of customer satisfaction from respondents. The study's target population consists of prepaid meter users in Minna, Niger State, Nigeria. This group includes those who use or interact with prepaid electricity meters. Minna was chosen because it is an urban area where most residents in Niger State, Nigeria, use the prepaid metering system and are home to people from various social and economic backgrounds. Respondents for the study were chosen randomly, with each prepaid meter user having an equal chance of being selected. The survey had a sample size of 393 people and was carried out using the Slovin sampling method to determine the sample size.

$$n = \frac{N}{1+N(e^2)} \quad (1)$$

Where n = sample size;
 N = sample frame;
 e = margin of error/confidence level.

$$n = \frac{21734}{1+21734(0.05^2)} = 393$$

A combination of descriptive analysis, rank order, and inferential statistics with the aid of Microsoft Excel and Statistical Package for the Social Sciences (SPSS) was used in the analysis of the data. The questionnaire was divided into three sections. The first section is made up of the background data (gender, age, educational qualification, marital status, household size, primary occupation, household income, years of meter usage, types of apartment, and mode of payment) of the prepaid meter users. The second section includes questions relating to the reliability, affordability, availability, and flexibility of the prepaid metering system. The fifth section is made up of questions on the level of customer satisfaction with respect to the prepaid metering system. Variables were adopted from existing literature [14]; [15] and respondents rated them on a 5-point Likert scale of (Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree) and (Highly Dissatisfied, Dissatisfied, Neutral, Satisfied, Highly Satisfied).

A regression analysis was equally carried out in order to derive a mathematical model of the relationship between the prepaid metering system and customer satisfaction. The study adopted the multiple regression model used [14]. The components of the prepaid metering system include Reliability, Affordability, Availability, and Flexibility, resulting in the given equation:

$$CS = f(\text{REL}, \text{AFF}, \text{AVA}, \text{FLE}) \quad (2)$$

Transforming into a multiple regression model;

$$CS = \beta_0 + \beta_1\text{REL} + \beta_2\text{AFF} + \beta_3\text{AVA} + \beta_4\text{FLE} + \varepsilon \quad (3)$$

Where:

CS = Customer Satisfaction

β_0 = Constant; $\beta_1 - \beta_4$ = Regression Coefficients

REL = Reliability; AFF = Affordability; AVA = Availability; FLE = Flexibility

ε = Stochastic Disturbance Error Term

3 Results and Discussion

3.1 Background data of prepaid meter users

From the results shown in Table 1, out of 393 questionnaires administered, 344 were filled out correctly and collected, yielding a response rate of 87.5%. The high response rate of 87.5% indicates that respondents are willing to take part in the project while the

remaining 49 questionnaires were either incomplete or not returned and as a result was disqualified.

Table 1: Questionnaire Response Rate

Response Rate	Frequency	Percentage (%)
Response	344	87.5
Spoilt/Not returned	49	12.5
Total	393	100

The background data of prepaid meter users are presented in Table 2. The findings show that males account for 77.3% (266) of the 344 prepaid meter users, while females account for the remaining 22.7%. This reveals that more male households use the prepaid metering system than females. Furthermore, most users (59.6%) are between the ages of 31 to 40 years. Users between the ages of 41 and 50 years and those between the ages of 21 and 30 years account for 17.4% and 16.7%, respectively. Users aged 51 years and above and those under the age of 20 years had the lowest representation with 5.2% and 0.9%, respectively. This implies that prepaid meters are more prevalent among youths and adults. According to the findings, 9 users have a Doctor of Philosophy (PhD), 45 have a Master's degree, with a rate of 75.3%, 259 of them have a bachelor's degree and Higher National Diploma (HND), making up the largest group, 28 have a National Diploma (ND)/Nigerian Certificate in Education (NCE), and 3 have completed secondary school. This revealed that many prepaid meter users had a higher level of education than the average secondary school student. The public/civil service employed the majority of users (37.8%), and they were closely followed by those who were self-employed (31.4%), private sector employees (24.4%), and students (6.4%). This trend showed that those employed in the public/civil service preferred prepaid electricity.

Table 2: Background Data of Prepaid Meter Users

Profile	Freq	%	Profile	Freq	%
Gender			Mode of Payment		
Male	266	77.3	Pay Station	132	38.4
Female	78	22.7	Online Payment	120	34.9
			Both	92	26.7

Profile	Freq	%	Profile	Freq	%
Gender			Mode of Payment		
Age			Years of Usage		
21 and below	3	0.9	Under 2	116	33.7
21 – 30	58	16.9	2 – 4	112	32.6
31 – 40	205	59.6	5 – 7	102	29.7
41 – 50	60	17.4	8 – 10	11	3.2
51 – above	18	5.2	11 - above	3	0.9
Edu. Qual.			Income (₹)		
SSCE	3	0.9	Below 30000	9	2.6
ND/NCE	28	8.1	31000 – 60000	36	10.5
HND/BSC	259	75.3	61000 – 90000	105	30.5
MSC/M.Eng	45	13.1	91000 – 120000	69	20.1
PhD	9	2.6	121000 - above	125	36.3
Marital Status			Occupation		
Single	124	36	Student	22	6.4
Married	220	64	Public/Civil Servant	130	37.8
Separated	0	0	Private Employee	84	24.4
Widowed	0	0	Self Employed	108	31.4
Divorced	0	0	Retired	0	0
Household Size					
1 – 3	107	31.1			
4 – 6	203	59			
7 – 9	34	9.9			
10 – 12	0	0			
13 – above	0				

3.2 Relationship between the prepaid metering system and customer satisfaction

The Spearman correlation was used in this section to investigate the relationship between Customer Satisfaction and the Prepaid Metering System. The result of the correlations between the Customer Satisfaction and Prepaid Metering System are presented in Table 3.

Table 3: Correlation between Prepaid Metering System and Customer Satisfaction

Predictor Variables		CS	REL	AFF	AVA	FLE
CS	Corr.	1				
	Sig.					
REL	Corr.	.332**	1			
	Sig.	.000				
AFF	Corr.	.454**	.460**	1		
	Sig.	.000	.000			
AVA	Corr.	.318**	.352**	.265**	1	
	Sig.	.000	.000	.000		
FLE	Corr.	.355**	.302**	.265**	.220**	1
	Sig.	.000	.000	.000	.000	

***. Correlation is significant at the 0.01 level (2-tailed).*

The result shows that reliability and customer satisfaction have a significant, moderate, and positive relationship. ($r = .332$, $p < 0.01$). This indicates that the higher the reliability of the prepaid metering system, the higher the customer satisfaction. There is a significant, moderate and positive relationship between affordability and Customer Satisfaction ($r = .454$, $p < 0.01$). This correlation indicates that the more affordable the prepaid metering system, the more satisfied customers are. There is also a significant, moderate and positive relationship between availability and customer satisfaction ($r = .318$, $p < 0.01$). This correlation indicates that an increase in the availability of the prepaid metering system will lead to a corresponding increase in customer satisfaction. Furthermore, there is a significant, moderate and positive relationship between flexibility and customer satisfaction ($r = .355$, $p < 0.01$). This correlation indicates that the more flexible the prepaid metering system is, the more satisfied customers are.

Additionally, the multiple regression analysis was further used to analyze the relationship between the Prepaid Metering System and Customer Satisfaction to obtain an accurate understanding of the relationship between them. To assure the accuracy of the regression analysis outputs, the multiple regression assumptions were closely followed.

Table 4: Collinearity Statistics

Model	Collinearity Statistics	
	Tolerance	VIF
Reliability	0.709	1.411
Affordability	0.762	1.313
Availability	0.852	1.174
Flexibility	0.878	1.139
Dependent Variable: Customer Satisfaction		

The collinearity statistics presented in Table 4 shows that all four predictors have tolerance values greater than .10 and variance inflection factor (VIF) values less than 10 in the collinearity statistic tests; this demonstrates that there is no multicollinearity between the variables.

Table 5: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.544	.596	.588	.36494

The model summary presented in Table 5 shows that there is a multiple correlations ($R = .544$) of the four significant variables with the criterion. The R Square of this model is .596, which means that this model explains 59.6% of the variance in customers using prepaid meter. Additionally, the adjusted R Square shows that the four variables account for 58.8% of the variance, contributing to higher customer satisfaction.

Table 6: ANOVA (Model Validity)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.975	4	4.744	35.620	.000
	Residual	45.148	339	.133		
	Total	64.124	343			

The analysis of variance (ANOVA) presented in Table 6 shows that the regression is significant ($F_{4, 339} = 35.620$, $P < 0.01$). This result implies that all four predictor variables (Reliability, Affordability, Availability, and Flexibility) effectively explain customer satisfaction variation. The multiple regression variable coefficients is further presented in Table 7

Table 7: Multiple Regression Variable Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	1.919	.187		10.240	.000
Reliability	.053	.048	.060	1.112	.267
Affordability	.263	.042	.326	6.244	.000
Availability	.127	.038	.163	3.305	.001
Flexibility	.189	.043	.214	4.408	.000

The results show that affordability has a statistically significant value of $p < .01$; hence it has a statistically significant influence on the dependent variable. Unstandardized coefficient value of .263 shows that a unit rise in affordability will cause a rise of .263 in customer satisfaction. Therefore, a rise in the affordability of the prepaid metering system will strengthen the satisfaction of customers. In explaining the standardized coefficients, the dependent variable rises by .326 standard deviations for each standard deviation of movement in affordability. Furthermore, availability has a statistically significant value of .01 ($p < .05$); hence it has a statistically significant influence on customer satisfaction. Unstandardized coefficient value of .127 shows that a unit increase in availability will cause an increase of .127 in customer satisfaction. Hence, an increase in the availability of the prepaid metering services will increase customers' satisfaction.

Regarding the standardized coefficients, for every one standard deviation of movement in availability, customer satisfaction increases by .163 standard deviations. Additionally, flexibility has a statistically significant value of $p < .01$; hence this has a statistically significant influence on customer satisfaction. Unstandardized coefficient

value of .189 for this shows that a unit rise in flexibility will cause an increase of .189 in customer satisfaction. Hence, an increase in the flexibility of the prepaid metering system and services will strengthen the satisfaction of customers. In terms of the standardized coefficients, for every one standard deviation of movement in flexibility, customer satisfaction increases by .214 standard deviations while reliability has a non-statistically significant value of .267 ($p > .05$), this shows that it has no statistically significant meaningful effect on the customer satisfaction. Additionally, the value of .053 unstandardized coefficients implies that each measurement in reliability will produce a .053 change in customer satisfaction. Hence, a rise in the reliability of the prepaid metering system will strengthen the satisfaction of customers. In explaining the standardized coefficients, customer satisfaction increases by .060 standard deviations for each standard deviation of movement in reliability.

The three significant predictors (affordability, availability, and flexibility) are positively related to the criterion in the regression. Affordability has the highest standardized coefficient at 0.326, followed by flexibility with a coefficient of 0.214, and availability with a standardized coefficient of 0.163. This indicates that affordability has a stronger unique contribution in explaining customer satisfaction than flexibility and availability. However, one of the variables (reliability) has a significant value greater than 0.05, indicating that it does not contribute significantly to the model. Therefore, reliability will be excluded to improve the desirability of the regression model. Thus, based on findings presented in Table 3.6, the regression equation is as follows:

$$CS = 1.919 + 0.263AFF + 0.127AVA + 0.189FLE \quad (4)$$

Where:

CS = Customer Satisfaction; AFF = Affordability; AVA = Availability; FLE = Flexibility

These findings are in agreement with earlier studies that supported that the major factors that influence prepaid metering systems and customer satisfaction were: costing; reliability; availability and flexibility. Customers also consider several factors before accepting the prepaid meter for use, including the prepaid meter's user-friendliness, durability, and access to prepaid meter vending points while also establishing a weak positive correlation between the adoption Prepaid Metering System and Customer Satisfaction [14]; [15].

3.3 Customer satisfaction level with respect to prepaid meter usage

The prepaid meter user is satisfied when the product quality meets their expectations, and they assume the item to be of high quality; on the other hand, if it does not meet their parameters of perceived quality, they assume the product to be of low quality. Users who are satisfied complain less, speak more positively about the products they like and are more likely to remain loyal customers. The tendency of prepaid meters to provide value to customers and thus meet their needs is vital. The customer satisfaction level with respect to prepaid meter usage is presented in Table 8.

Table 8: Customer Satisfaction with Prepaid Meter Usage

Factors	Mean	%	S.D	Remark
I am satisfied because it is efficient and not easily damaged	4.38	87.56	0.645	High Satisfaction
It is easy to buy prepaid credit (tokens/units)	4.33	86.69	0.667	High Satisfaction
I am satisfied with the tariff system	2.55	51.05	1.225	Low Satisfaction
I am satisfied with the mode of payment	4.31	86.28	0.712	High Satisfaction
I am satisfied because there is no accumulated debt	4.42	88.43	0.700	High Satisfaction
I am satisfied because I can monitor my consumption	4.39	87.85	0.724	High Satisfaction
I am satisfied because I am not charged when there is power outage	4.40	87.97	0.725	High Satisfaction
I am satisfied with paying upfront before use	3.99	79.59	0.924	High Satisfaction
I am satisfied with the response anytime I encounter challenge	2.68	53.60	1.102	Low Satisfaction
I am satisfied with the privacy I enjoyed as a result of no meter readers	4.42	88.43	0.643	High Satisfaction

The results indicate that there exists a low satisfaction level with the tariff system and the response users receive whenever they encounter a problem. This is because prepaid meter users (particularly low-income earners who find it difficult to pay the

previous tariff) are dissatisfied with the increase in electricity tariff. Users are also dissatisfied with the fact that when a problem is reported to the customer care unit, they tend to drag their feet and act slowly. The available customer service units are unable to effectively address customer complaints to ensure customer complaints satisfaction. There is also the issue of lateness and laziness among sales representatives and other workers who are responsible for the welfare of customers. Prepaid meter users had the highest level of satisfaction with their privacy as a result of no meter readers and no accumulated debt, with a mean score of 4.42. This is because they no longer have to rely on others to read their meters for them, and they are satisfied because they no longer have to worry about inaccurate readings or strangers posing as meter readers. On “no accumulated debts,” users are highly satisfied because they pay before consumption, and there are no bills delivered to their homes. Users also had a high level of satisfaction because they are not been charged during power outages or when the meter is not in use, they can now monitor their consumption, the meters are efficient and not easily damaged, tokens are easy to buy, and they are satisfied paying upfront. These findings are in agreement with [16], who opined that a major prominent level of satisfaction that customers enjoy from the adoption of prepaid metering system is the payment before usage, and it largely assists the user feel comfortable and get maximum satisfaction.

4. Conclusion and Recommendation

Conclusions were drawn based on the findings of the research. The findings successfully demonstrated that the prepaid metering system and customer satisfaction have a relationship and are linked. Reliability, Affordability, Availability, and Flexibility were the variables identified by the study as influencing the usage of prepaid electricity metering systems on customer satisfaction. However, Affordability has a stronger unique contribution in explaining customer satisfaction as compared to Flexibility and Availability. Residents in Minna have enthusiastically welcomed the implementation of the prepaid electric meter in the city, and they believe that the ability of the distribution company to understand customer needs is an important factor in creating customer satisfaction as well as the company’s readiness to effectively address any operational challenges or other challenges that may arise. Based on the findings and conclusion of this study, the following is recommended;

- i. Good customer care service (units)
- ii. Communication with meters wirelessly through mobile phones
- iii. Receiving and installation of meters on time

- iv. A marketing campaign for better knowledge of the prepaid meter
- v. Future research work can look into the impact of utility sales on the installation of prepaid meters and increased/reduced meter tampering etc.

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