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AN ASSESSMENT OF BILLING ELECTRICITY CONSUMERS VIA ANALOGUE METERS IN KANO, NIGERIA, BY KANO ELECTRICITY DISTRIBUTION PLC

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ABSTRACT
This paper assesses the perception of billing consumers via analogue meter in Kano Electricity Distribution Plc, Nigeria. Questionnaire survey was used to collect data from the consumers, frequency counts and percentages were used to analyze the generated data. The result of the study revealed that 38% of the Analogue meters were installed between eleven to twenty one years ago; hence the need for replacement of obsolete meters and periodic inspection of all consumers' meters at least once in three months for proper reading is vital in order to achieve accurate billing. The study also revealed poor and unreliable power supply and most often the bills issued for the electricity consumption are based on estimates, thus contributing to poor consumers' response to payments of electricity bills. Some suggestions that can facilitate the improvements of the operation of the Distribution Company were offered.

Keywords: Electricity Distribution, Consumers, Analogue Meter, Billing, Nigeria

INTRODUCTION

Electricity supply came into Kano in 1930, with the establishment of Challawa power station. The power station had an installed capacity of 60mw. This power station supplied power up to 1968 when Kainji dam was commissioned. The dam was designed to have generating capacity of 960 mw. Kano being an industrial and commercial city, the demand for electricity rose from an average daily requirement of 21mw in 1975 to 66mw in 1985 (Nurudeen, 2004). This demand has steadily increased to 500mw by 2006 (Mukhtar, 2006).

The enactment of Electricity Power Sector Reform Act 2005 (Ken, 2007), transformed the public monopoly of National Electric Power Authority (NEPA) to Power Holding Company of Nigeria (PHCN), eighteen Successor companies emerged from the on-going reform. Kano Electricity Distribution Plc is one of the successor companies of Power Holding Company of Nigeria saddled with the responsibility for delivering energy to homes and businesses in Nigeria. According to Pimentel (1992), power is said to be the engine for growth and development in all economies of the world.

The then NEPA, started its billing manually (Nurudeen, 2004). Consumers' consumption serves as input for the billing. The analogue meter measures the amount of electric energy supplied to consumers. The most common type of analogue meter is more properly known as Kilowatt hour meter. The kilowatt hour is a convenient unit for electricity billing, because the energy usage of a typical electricity consumer in one month is several hundreds Kwh. Megawatt hours and terawatt hours are used for metering large amount of electrical energy (Wikipedia, 2008). .

Application of Information Technology in KED PLC

The advancement in technology coupled with the increase in number of consumers led to computerization of billing operation in Kano Zone. Nassarawa computer center was established in 1991. Computerized billing is preferable to manual billing due to the following reasons

- Very large volume of data;
- Repetitive operations;
- Complicated calculation;
- Consistent accuracy;
- Fast response processing;
- Fraud detection, and
- Minimizing fraud.

The computerized billing started with Mainframe computer, using Cobol Programming Language. The Mainframe computer served the purpose then, for it has an in-built hard disk and tape drives for back-up. The system provides the authority the potentials of analyzing other related reports apart from the consumers bills (Nurudeen, 2004). This particular system has been phased out. The Sun micro system was introduced in 1997. Solaris software was used. The latter has advantage over the former due to its storage capacity. Unlike the Mainframe which used tape drives, the sun used floppy disc and cartridges for back-up. At the moment two applications software are utilized for the purpose of billing, Spectrum and Ad Valorem Records (AVR). Both Applications software use UNIX 5.06 as the operating system.

Spectrum and AVR used graphical interface, while Spectrum is a batch processing system, AVR is an online system and window driven and can be used for the purpose of e- billing (Advalorem, 2009).

Consumers Classification

Consumers are classified based on their mode of consumption and by tariff classification. Tariff measures; defined as electric tariff at which the energy is selling to the consumers. Usually electricity tariff are fixed by Government. Tariff at the moment are categorized into residential, commercial, industrial, street light and special tariff .The special tariff are agro-allied enterprises, Government and teaching hospitals, water boards, secondary and tertiary Institutions. The tariff for each category is fixed by voltage class. Tariff is calculated by kilowatt hour. For industrial and commercial or other consumers, who have receiving transformer with a capacity of 100 KVA or more, who have electrical equipment with an installed receiving capacity of 100 KW or more their tariff comprises two components, these are Kilowatt-hour tariff (calculated on the basis of actual use) and basic electricity tariff (based on the consumption capacity). The Federal Government fixed the tariff and other charges effective from February, 2002 as stated in Table 1.

Table 1: Implementation of new Tariff structure

TARIFF CODES	ENERGY CHARGE PER KWH IN (=N=)	FIXED CHARGE PER MONTH IN (=N=)	METER MAINTENANCE CHARGE PER MONTH IN (=N=)	MINIMUM CHARGE PER MONTH IN (=N=)
RESIDENTIAL				
R1	1.20	20.00	100.00	20.00
R2	4.00	30.00	100.00	30.00
R3	6.00	120.00	500.00	120.00
R4	8.50	120.00	1600.00	5,000.00
R5	8.50	0.00	2200.00	31,250.00
COMMERCIAL				
C1	6.50	90.00	100.00	90.00
C2	8.50	120.00	500.00	120.00
C3	8.50	240.00	1600.00	5,000.00
C4	8.50	0.00	2,200.00	31,250.00
INDUSTRIAL				
D1	6.50	90.00	100.00	90.00
D2	8.50	120.00	500.00	120.00
D3	8.50	240.00	1,600.00	5,000.00
D4	8.50	0.00	2,200.00	31,250.00
D5	8.50	0.00	2,200.00	1,500,000.00
STREET LIGHT				
S1	6.50	0.00	500.00	240.00
SPECIAL TARIFF				
A1	5.80	120.00	500.00	120.00
A2	5.80	240.00	1,600.00	5,000.00
A3	5.80	0.00	2,200.00	31,250.00
A4	5.80	0.00	2,200.00	31,250.00

Source: Billing Operation Unit, Customer Services Department KED Plc, (2002)

Kilowatt hour is equal to the amount of energy used by a load of one kilowatt over a period of one hour, or 3,600,000 joules. Demand is normally measured in watts, but averaged over a period, most often a quarter or half hour (Wikipedia, 2008). Analogue electricity meters operate by continuously measuring instantaneous voltage and current and finding the product of these to give instantaneous electric power (watts) which is then integrated against time to give energy used. The aluminum disc is supported by a spindle which drives the register. The register is a series of dials which record the amount of energy consumed. The amount of energy represented by one revolution of the disc denoted by the symbol Kh, given in units of watt-hours per revolution. The value 7.2 is commonly seen, to determine power of consumption at any given time by timing the disc with a stopwatch. If the time in seconds taken by the disc to complete one revolution is t, then the power in watts is $P = 3600. Kh / t$. If $Kh = 7.2$, one revolution took place in 14.4 seconds, the power is 1800 watts (Wikipedia, 2008). Analogue electricity meters must be read manually, whether by the representative of the power company or by the consumers. Where the consumers read the meter, the reading may be supplied to the power company. The electricity company will normally require a visit to the consumers' electricity meters at least annually in order to verify consumers supplied readings and to make basic safety check of the meter. The meters are classified as maximum demand or MD meters and non maximum demand or Non-MD meters. These meters can be single phase or three phases (Mukhtari, 2006). The maximum demand meters are MD whole-current type, CT operated meters and HT Panel meter.

Analogue meter is read only once in a month. To calculate the consumer consumption, previous reading is subtracted from the present reading; the result is multiplied by a multiplier. The reason for the multiplier is to correct the difference in meter and the current transformer ratings. A typical consumer with R2 tariff can have a bill as shown in table 2:

Table 2: A typical consumer with R2 Tariff bill

Descriptions	Tariff	Read date	Previous Reading		Present Reading		Multiplier		Consumption (=N=)
ENERGY CHARGE	ENR2	01/01/2009	**124**	_	**0**	*** 1**	**=**	**124**	496
FIXED CHARGE	FCR2								30
METER MAINTENANCE	MMR2								100
CONSUMER CHARGES									626

Energy charge = tariff equivalent multiply by the consumption. Fixed charge and meter maintenance charge is stated according to tariff class, as in the Table 1. One of the challenges facing the distribution company is poor revenue base and poor consumer response to payments of electricity bills, especially the response by the Non MD consumers. Table 3, Shows the pattern of consumers billed and response from January to June 2008. Evidence from the table indicates that the maximum demand consumers' response to payments of electricity on average of 82.5% compared to Non MD Consumers' response of 20.3%. Factors that contributed to these performances will be revealed in the course of this research.

Table 3: Consumer billed and consumer Payments response from January to June 2008

	Maximum Demand MD			Non Maximum Demand Non MD			TOTAL		
	BILLED	RESP	%RESP	BILLED	RESP	%RESP	BILLED	RESP	% RESP
JAN	1,478	1,305	88.29	331,116	47,885	14.46	332,594	49,190	14.79
FEB	1,474	1,313	89.08	336,010	72,595	21.61	337,484	73,908	21.90
MAR	1,485	1,166	78.52	338,028	78,595	23.25	339,513	79,761	23.49
APR	1,525	1,093	71.70	326,763	69,823	21.40	328,288	70,916	21.60
MAY	1 ,505	1,325	88.04	337,659	78,962	23.37	339,164	80,287	23.67
JUN	1,487	1,178	79.22	316,171	55,512	17.56	317,658	56,690	17.85

Source: Billing Operation Unit, Customer Services Department KED Plc, (2008)

RESEARCH METHODOLOGY

The researcher will discuss: 1). the design of the survey instruments, 2). Survey
Population and sample selection. 3). Data collected from the distribution company

Designing the survey Instrument

To achieve the objective of the study, the survey instrument was design to collect as much information as possible in order to assess the perceptions of billing consumers using input from analogue meters. There are two sections in the questionnaire:
Section one, was used to collect demographic data about gender and installation period of the analogue meters.

In section two, a set of 14 items was used in the questionnaire using the following dimensions:
1- Usefulness of Information Technology (is represented by item 1).
2- Knowledge of Analogue meter and Post payment Bills (is represented by items 2 and 3).
3- Response to supply of readings (is represented by items 4 and 5).
4- Assessment of human and machine error (is represented by items 9, 10 and 11).
5- Assessment of prompt and efficient service (is represented by items 7 and 14).
6- Attitude of consumers to services rendered (is represented by items 8 and 13).
7 Responses to complain made by consumers (is represented by items 6 and 12).
Respondents were asked to rate their opinion about each item using a five point Likert-type rating scale, as conducted by (Idowu et al, 2002). The rating used were strongly agree (SA) = 4, agree = 3 (A), strongly disagree (SD) = 2, disagree (DA) = 1 and neutral (N) = 0. The administered questionnaire can be found in the appendix.

Survey Sample

The study was conducted in Kano Zone Electricity Distribution Plc. The Electricity distribution area of coverage comprises of Kano, Katsina and Jigawa States, in the North West geographical zone of Nigeria. Survey was conducted, through purposive sampling.

Purposive sampling, (Ahmed, 2008) was used to obtain desired information from specific target group. The target group came from the ten business units, namely, Dala, Sharada, Dakata, Kumbotso Nassarawa Sabongari, Katsina, Funtua, Dutse and Hadejia, the researcher administers a total of 180; out of which 92 were returned; a response rate of 51%.

Data collected from the distribution company

Data were collected from the Electricity distribution company as illustrated in Table 1 and 3. Table 4 provides data about gender distribution and duration of installation of analogue meters.

Table 4: Sample Characteristics, N = 92

Male	**71**	**Female**	**21**
Duration of installation of Analogue meter in years			
< 5 yrs	33	11 – 20 yrs	23
6 – 10 yrs	24	> 21 yrs	12

Knowing the period of installation of an analogue meter is vital, as the older the meter, the more malfunction is noticed. Sixty percent of the meters were installed between ten years and 38% were installed between eleven to twenty one years as shown in table 4.

RESULTS AND DISCUSSION

Table 5: Assessment of consumers' view on computerized Billing

Question	**SA**	**A**	**N**	**D**	**SD**	**Mean**
Is computerized Billing better than manual billing?	41.3	34.7	3.3	9.8	10.9	3.11

From Table 5, 76.0% of the respondent agreed that computerized billing is better than manual, while 20.7% disagreed and 3.3% were indifferent. The mean of 3.11 shows that computerized billing is preferable to manual billing; apart from the benefit of computerization stated earlier, computerized billing enables the billing operation to store transaction history of a customer for considerable period of time and print other management reports.

Table 6: Assessment on consumers' knowledge of Analogue meter / Bills

Question	**SA**	**A**	**N**	**D**	**SD**	**Mean**
Can you read your analogue meter?	23.9	32.6	12.0	21.7	9.8	2.67
I understand and can interpret PHCN bills	19.6	31.5	23.9	19.6	5.4	2.67

One of the consumer's right and obligation is to be appropriately metered and to be provided bills based on proper tariff for electricity consumed within the billing month. This can be beneficial to the consumer if only he has the knowledge of reading the meter and interpreting the bills given for his consumption. In Table 6, 56.5% and 51.1% of the respondents respectively agreed to understand reading of meter and interpretation of the bills given for their consumption and 31.5% and 25.0% disagreed. Twelve percent and 23.9% were indifferent, the mean of 2.67 shows that consumers' can interpret the monetary equivalent of their monthly electricity consumption.

Table 7: Assessment on consumers' response to supply of reading to PHCN

Question	**SA**	**A**	**N**	**D**	**SD**	**Mean**
I do supply my reading (consumption) to PHCN	16.3	18.5	20.7	29.3	15.2	2.27
PHCN Staff read my meter	19.6	29.3	20.7	21.7	8.7	2.59

In order to achieve accurate billing in any utility company, a regular reading based on consumer consumption must be provided the reading can also be supplied by the consumer. From table 7, 48.9% of the respondent are of the opinion that phcn staff read their meters while 30.4% disagreed, 20.7% were indifferent. The mean of 2.59 confirmed the reading of analogue meter by distribution company personnel. On the supply of reading to PHCN by the consumers, 34.8% agreed to that, 51.0% disagreed and 20.7% were neutral. The mean of 2.27 is computed.

Table 8: Assessment on human and machine error

Question	**SA**	**A**	**N**	**D**	**SD**	**Mean**
I was once given a crazy bill	29.3	17.4	14.2	25.0	14.1	2.59
PHCN staff once gave me other consumer bills	12.0	12.0	9.8	42.4	23.8	1.93
My meter was once stolen and replaced	5.4	7.6	13.0	47.9	26.1	1.66

A cardinal obligation of a utility company to its customers is to deliver credible bills within the billing month. From Table 8, 46.7% of the respondent agreed to be once given a crazy bill, 39.1% disagreed 14.2% were indifferent. The mean of 2.59 confirmed that most of the time the bills given to customers are outrageous. On proper presentation of bills to the customers by the marketers, 24.0% agreed to have experienced that while 66.2% disagreed 9.8% were indifferent. The mean of 1.93 is evaluated. The prevalence of meter theft is also an issue in the distribution company. Out of the 92 respondent, 13.0% agreed to have lost their meter, 74.0% disagreed and 13.0% were indifferent .The mean of 1.66 shows the prevalence of meter theft is minimal.

Table 9: **Assessment on prompt and efficient service**

Question	SA	A	N	D	SD	Mean
I get my PHCN bills on time	18.5	27.2	18.5	27.2	8.6	2.45
Do you enjoy power supply regularly?	3.2	9.8	13.0	20.7	53.3	1.95

A consumer is expected to pay for services rendered only when given a bill showing his consumption as early presentation of bills often contributed to cash drive. In Table 9, 45.7% of respondent agreed to be getting bills on time and 35.8% disagreed while 18.5% were indifferent. The mean of 2.45 shows that bills are distributed on time. On the issue of regular power supply 74% of the respondent disagreed with the provision of electricity of adequate quality only 13% agreed to enjoy regular power supply while 13% were indifferent. The mean of 1.95 confirmed that customers did not enjoy prompt and efficient service delivery due to inefficient and epileptic power supply by the PHCN.

Table 10: **Assessment on attitude of consumers' to service rendered**

Question	SA	A	N	D	SD	Mean
How regular do you settle your PHCN bills?	18.4	26.1	45.7	7.6	2.2	3.02
I feel I pay much with PHCN computer billing	29.3	23.9	21.7	21.8	3.3	2.78
My bills are always on estimate	22.8	32.6	19.6	10.9	14.1	2.84

Table 9 shows that 44.5% agreed with response of regular payments of electricity bills while 9.8% disagreed and 45.7% were indifferent. The mean of 3.02 is computed. Fifty three percent of the respondent felt that, they are over charged while 25.1% disagreed to that notion. Twenty two percent were indifferent. The mean of 2.78 is computed. On the issue of estimate billing 55.4% of the respondent agreed to be issued an estimated bills and 25.0% disagreed 19.6% are indifferent with the mean of 2.84. Questions 6 and 8 (see Appendix A) are similar but reaction of the respondent confirmed the conclusion of poor consumers' response to payments of electricity bills as stated in Table 2**, c**ouple with the inefficient power supply.

Table10: Assessment of PHCN customer services response to complain by consumers'

Question	SA	A	N	D	SD	Mean
My complain always receive prompt attention	10.9	18.5	20.7	23.8	26.1	2.21

One of the customers' rights is to be treated courteously and not keep waiting longer than necessary. Table 10 shows 49.9% of respondents disagreed on receiving prompt attention to their complained while 29.3% agreed and 20.7% were neutral. The mean of 2.21 confirmed that most of the time customers complain of poor response to their complaints.

CONCLUSION

The study has dealt with an assessment of computerize billing via analogue meter as perceived by customers in Kano Zone Electricity Distribution Plc, Nigeria. The study revealed that computerized billing is preferable to manual billing because it enables the billing operation to store transaction history of a customer for considerable period of time and print other management reports using information and technology tools. From the study it was established that 38% of the analogue meters were installed between eleven to twenty one years, hence there is need for replacement of obsolete meters and periodic inspection of all consumers meters at least once in three months for proper reading in order to achieve accurate billing.

The study also revealed poor customers' response to payments of electricity bills and this is attributed to outrageous bills and most often the bills issued for the electricity consumption are based on estimates.

Poor and unreliable power supply is one of the major obstacles to economic growth of business enterprises in Nigeria. As a national priority the Nigerian Government must fund generation expanded projects, invest in transmission capacity building and improve on distribution network. In addition it should explore the usage of renewable energy with a view to closing the gap between electricity demand and supply in shortest possible time.

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Annex 1

Dear Respondent

This questionnaire is purely designed for research work on customers' assessment of PHCN Billing using reading from Analog meter. Please, fill in the correct information. All the information will be treated confidentially and the information will be used for the purpose of research work only.

Please tick [√] or fill where appropriate.

Section A

1. Gender: A. MALE [ ] B. FEMALE [ ]
2. AGE: A. 15 – 30 [ ] B. 31– 45 [ ] C. 46 – 55 [ ] D. 56 – 65 [ ] E. 66 &above. [ ]
3. QUALIFICATION A.TCII/ WASC [ ] B.OND/NCE [ ] C.B Sc /HND [ ] D.M Sc/ PhD [ ] E. Others [ ]
4. What type of meter do you have? A. Single face [ ] B. Three face [ ] C. Direct [ ]
5. The service I enjoy is only for A. Domestic [ ] B. commercial C. Industrial [ ]
6. For how long is your Analog (post payment) meter installed?

A. 0 – 5 yrs [ ] B. 6– 10yrs [ ] C. 11 –20yrs [ ] D. 21yrs & above [ ]

Section B: Survey Instrument questionnaire

S/NO	STATEMENT	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1.	IS COMPUTERIZED BILLING BETTER THAN MANUAL BILLING?					
2.	CAN YOU READ YOUR ANALOQUE METER(BASED ON CONSUMPTION)					
3.	I UNDERSTAND AND CAN INTERPRET PHCN BILLS					
4.	I DO SUPPLY MY READING (CONSUMPTION) TO PHCN					
5.	PHCN STAFF READ MY METER					
6.	MY BILLS ARE ALWAYS ON ESTIMATE					
7.	I GET MY PHCN BILLS ON TIME					
8.	I FEEL I PAY MUCH WITH PHCN COMPUTER BILLING					
9.	MY METER WAS ONCE STOLEN AND REPLACED					
10.	PHCN STAFF ONCE GIVE ME OTHER CUSTOMER BILLS					
11.	I WAS ONCE GIVEN A CRAZY BILL					
12.	MY COMPLAINS ALWAYS RECEIVE PROMPT ATTENTION					
13.	HOW REGULAR DO YOU SETTLE YOUR PHCN BILLS?					
14.	DO YOU ENJOY POWER SUPPLY REGULARLY?					

Annex 2:
Analysis of mean base on questionnaire submitted using five point Likert rating scale

SA	A	N	D	SD	f	SAX4	AX3	NX0	DX1	SDX2	SUM	Mean
38	32	3	9	10	89	152	96	0	9	20	277	3.11
22	30	11	20	9	81	88	90	0	20	18	216	2.67
18	29	22	18	5	70	72	87	0	18	10	187	2.67
15	17	19	27	14	73	60	51	0	27	28	166	2.27
18	27	19	20	8	73	72	81	0	20	16	189	2.59
21	30	18	10	13	74	84	90	0	10	26	210	2.84
17	25	17	25	8	75	68	75	0	25	16	184	2.45
27	22	20	20	3	72	108	66	0	20	6	200	2.78
5	7	12	44	24	80	20	21	0	44	48	133	1.66
11	11	9	39	22	83	44	33	0	39	44	160	1.93
27	16	13	23	13	79	108	48	0	23	26	205	2.59
10	17	19	22	24	73	40	51	0	22	48	161	2.21
17	24	42	7	2	50	68	72	0	7	4	151	3.02
3	9	12	19	49	80	12	27	0	19	98	156	1.95

Where mean = sum/f