

Original Paper

Assessment of Tools and Equipment Utilization for Effective Electric Power Distribution in Yola Electricity Distribution Company, Adamawa State, Nigeria

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Abstract

The main purpose of this study was to assess the utilization of tools and equipment for effective electric power distribution by Yola Electricity Distribution Company in Adamawa State. Two research questions and two null hypotheses were formulated to guide the study. The study adopted descriptive survey research design. The population of the study was 69 consisting of 46 technicians and 23 supervisors in Yola Electricity Distribution Company. Due to the manageable size of the population, there was no sampling; hence, the whole population was used for the study. A structured questionnaire developed by the researchers titled "Utilization of Tools and Equipment for Effective Distribution of Electricity Questionnaire (UTEDEQ)" was used as the instrument for data collection. The instrument was validated by three experts and a reliability of 0.89 was obtained using Cronbach Alpha reliability method. Mean and standard deviation was used to answer the research questions while t-test was used to test the null hypotheses at 0.05 level of significance. The finding of the study revealed that Yola Electricity Distribution Company utilizes the following tools for effective distribution of electric power distribution: Ladder, Hand Gloves, Safety Belt, Ammeter, Ohmmeter, Voltmeter, Spanners, Screwdrivers, among others; Yola Electricity Distribution Company utilizes the following equipment for effective distribution of electric power distribution: Supply Voltage Detector, Distribution Transformer, Power

Transformer, Battery Rectifier, Supply Voltage, Circuit Breaker, Spring Charger, Trip Circuit, Low Pressure Gas Indicator among other. Based on the findings, the following recommendations were made: YEDC should provide more equipment for effective distribution of electric power especially utility vehicles and other equipment necessary for effective electric power distributions.

Keywords

Tools, Equipment, Utilization, Electric Power, Distribution, Electricity

1. Introduction

The distribution aspect of electric system involves supply of uninterrupted power to consumers at different locations (Brown, Frimpong, & Willis, 2004). The distribution systems are critical for financial success and customer satisfaction. However, distribution systems have received less attention than the generation and transmission parts of the overall electrical Power systems (Awosope, 2014). The main reasons according to Awosope (2014) and (Brown, 2002) why distribution systems may not have been the center of focus is that the distribution system is less capital-intensive and the effect of its failure is more localized compared to generation and transmission systems. Smith (2005) opined that electricity distribution is the final stage in the delivery of electricity to end users. A distribution system's network carries electricity from the transmission station and delivers it to consumers. Typically, electric distribution system components include transformers, voltage regulators, switches, overhead lines, underground cables, circuit breakers among others.

According to Adoghe, Odigwe and Igbinovia (2009), efficient utilization of the distributed power cannot be achieved without a sound maintenance plan and monitoring of the distribution network system. Any organization that expects to utilize and run an efficient day – to – day operation, manage and develop its services effectively must know what assets it has, where they are, their conditions, how they are performing, and how much it costs to provide the services. Knowledge about the physical assets (transformer, circuit breakers, etc.) of the system is necessary to make strategic decisions (Anthony, 2010).

Indeed, equipment utilization as defined in Brown and Humphrey (2005) is the process of maximizing the return on investment of equipment over its entire life cycle by maximizing performance and minimizing costs. Equipment in power systems which have remarkable effects from a reliability perspective are considered with attention to their utilization (Shahidehpour, 2006). Mike (2012) reiterates that electrical utilization equipment are the equipment that utilizes electric energy after the point of outlet for electronic, electromechanical, chemical, heating, lighting, or similar purposes. Examples of such equipment include fixed and variable output power supplies, motors, motor controllers, motor control units mounted in a motor control center, variable frequency drives for motors (VFDs), process control and monitor equipment, battery powered interruptible or uninterruptible power sources, welding machines, and computers. Cords, plugs, and conductors that facilitate connection of utilization equipment to the AC Power Distribution System up to the Point of Outlet are to be

considered as parts of the utilization equipment. The Point of Outlet is the point of connection to the AC Power Distribution System where electrical current is taken to supply utilization equipment. The point of outlet is further defined as the first disconnecting means upstream of the utilization equipment. Such points include standard wall outlets and receptacles, disconnect switches and circuit breakers. Within a MCC, the point of outlet is considered to be the point of connection between the MCC power bus and the removable motor controller assembly (Teemu, Pia, Carl, & Irene, 2004).

1.1 Statement of the Problem

Electric power distribution in Adamawa State has become more competitive due to the rapid increase in demand by customers in addition to fierce rivalry between utilities to provide satisfactory level of power continuity (Abu-Elanien & Salama, 2010). Therefore, utilities are required to assure the optimum utilization of the distribution equipment available. Knowledge about the equipment of the Electric Distribution Company is necessary to make strategic distribution decisions to meet consumers' satisfaction in terms of effective electric power distribution. This implies that, to take decisions vital to the operations, growth and maintenance of electric power distribution equipment, information must be collected and analyzed to its full extent. Such information contributes not only to efficient services, but also to the operation of equipment. If the equipment is not adequately utilized, it might lead to total breakdown of the distribution system and the objective of effective electric power distribution will be defeated. It is against this background that this study sought to assess the utilization of tools and equipment for effective electric power distribution by Yola Electricity Distribution Company in Adamawa State

1.2 Purpose of the Study

The main purpose of this study was to assess the utilization of tools and equipment for effective electric power distribution by Yola Electricity Distribution Company in Adamawa State. Specifically, the study sought to determine:

1. The level of tools utilization in the distribution of electric power by Yola Electricity Distribution Company.
2. The level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company.

1.3 Research Questions

The following research question guided the study:

1. What is the level of tools utilization in the distribution of electricity by Yola electric power Distribution Company?
2. What is the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company?

1.4 Hypotheses

H₀₁: There is no significant difference between the mean responses of technicians and supervisors on the level of tools utilization in the distribution of electric power by Yola Electricity Distribution Company.

H₀₂: There is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company.

2. Methodology

The study which was conducted in Adamawa State, Nigeria, and descriptive survey research design adopted for the study. Adamawa State is located in the North-East of Nigeria within latitude 9° 15N and 9° 18N and longitude 12° 25E and 12° 30E. It shares boundary with Borno State to the north-east, Gombe and Bauchi States to the north-west, and Taraba State to the south-west. It shares its border with Cameroon Republic. The population of the study was 69 consisting of 46 technicians and 23 supervisors in Yola Electricity Distribution Company. Due to the manageable size of the population, there was no sampling; hence, the whole population was used for the study. The instrument used for data collection was a structured questionnaire developed by the researchers titled: Utilization of Tools and Equipment for Effective Distribution of Electricity Questionnaire (UTEDEEQ). The responses on the questionnaire were structured on a 5-point Rating scale of Highly Utilized (HU) 5, Utilized (U) = 4, Moderately Utilized (MU) = 3, Slightly Utilized (SU) = 2, Not Utilized (NU) = 1. The questionnaire was validated by three experts, two from the Department of Electrical Technology Education, Modibbo Adama University of Technology Yola, Adamawa State and one from Yola Electricity Distribution Company. A trial test was conducted on 20 technicians and 10 supervisors in Gombe a branch of the Jos Electricity Distribution Company and 0.89 reliability index was obtained for the instrument using Cronbach Alpha reliability method. Data for the study was collected by the researchers with help of two research assistants. Mean statistic was used to answer the two research questions of the study while t-test was used to test the two null hypotheses at 0.05 level of significance.

3. Results

3.1 Research Question One

What is the level of tools utilization in the distribution of electric power by Yola Electricity Distribution Company?

Table 1. Mean and Standard Deviation of Supervisors and Technicians on the Level of tools Utilization in the Distribution of Electricity by Yola Electric Power Distribution Company

S/NO	ITEMS	Respondents						RMK
		N _S = 23		N _T = 46		N _{TT} = 69		
		\bar{x}_S	σ_S	\bar{x}_T	σ_T	\bar{x}_G	σ_G	
1.	Ladder (Various Types)	4.74	0.45	3.98	0.65	4.23	0.69	HU
2.	Hand Gloves	4.57	0.51	4.33	0.82	4.41	0.73	HU

3.	Safety Belt	4.35	0.49	4.43	0.78	4.41	0.69	HU
4.	Safety Boot	4.22	0.80	4.63	0.49	4.49	0.63	HU
5.	Pliers (Various Types and Shapes)	3.74	0.45	4.39	0.65	4.17	0.66	HU
6.	Voltmeter	4.65	0.49	3.87	0.34	4.13	0.54	HU
7.	Ammeter	5.00	0.00	4.37	0.64	4.58	0.60	VHU
8.	Ohmmeter	4.83	0.39	4.37	0.83	4.52	0.74	VHU
9.	Helmet	4.65	0.49	4.11	0.64	4.29	0.64	HU
10.	Screwdrivers (Various Types)	4.00	0.67	4.57	0.58	4.38	0.67	HU
11.	Spanners (Various Types)	4.09	0.42	4.59	0.65	4.42	0.63	HU
12.	Utility Knife	3.39	0.50	4.48	0.55	4.12	0.74	HU
13.	Measuring Tape (Various Sizes)	3.96	0.21	4.07	0.71	4.03	0.59	HU
14.	Allen Wrench Set (Hex Set)	3.48	0.51	3.93	0.80	3.78	0.74	HU
15.	Tongue and groove Plier	3.30	0.56	3.30	0.55	3.30	0.55	MU
16.	Wire Stripper	3.35	0.49	4.02	0.77	3.80	0.76	HU
17.	Wattmeter	3.87	0.34	3.91	0.59	3.90	0.52	HU
18.	Cutters (Various Sizes)	3.43	0.51	3.54	0.55	3.51	0.53	HU
19.	Multi-meter	3.22	0.52	3.74	0.53	3.57	0.58	HU
20.	Level	3.87	0.34	3.41	0.72	3.57	0.65	HU
21.	Flashlight	3.43	0.51	4.24	0.52	3.97	0.64	HU
22.	Wire Crimper	3.22	0.52	3.59	0.58	3.46	0.58	MU
23.	Saw	3.87	0.63	3.43	0.62	3.58	0.65	HU
		3.97		4.06		4.03		HU

\bar{x}_S = Mean of Supervisors, \bar{x}_T = Mean of Technicians, σ_S = Standard deviation of Supervisors, σ_T = Standard deviation of Technicians, \bar{x}_G = Grand Mean, σ_G = Grand Standard deviation VHU = Very Highly Utilized, MU = Moderately Utilized, HU = Highly Utilized, N_S = Number of Supervisors, N_T = Number of Technicians, N_{TT} = Total Number of Respondents, RMK = Remark

From Table 1 above, the respondents indicated that items 1-6, 9-14, 16-21 and 23 with mean responses which ranges between 3.51 and 4.49 and standard deviation range between 0.52 and 0.76 respectively are highly utilized. Items 7 and 8 with a mean response of 4.58 and 4.52 having a standard deviation of 0.60 and 0.74 are very highly utilized. The respondents indicated that item 15 and 22 with mean response of 3.30 and 3.46, having a standard deviation of 0.55 and 0.58 are moderately utilized. Therefore, the results in Table 1 revealed that out of 23 items listed, two (2) of the items, are highly utilized, 19 of the items are utilized and two(2) of the items are moderately utilized.

3.2 Research Question Two

What is the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company?

Table 2. Mean and Standard Deviation of Supervisors and Technicians on the Level of Equipment Utilization in the Distribution of Electricity by Yola Electric Power Distribution Company

S/NO	ITEMS	Respondents						RMK
		Ns = 23		N _T = 46		N _{TT} = 69		
		\bar{x}_S	σ_S	\bar{x}_T	σ_T	\bar{x}_G	σ_G	
1.	Supply Voltage Detector	4.78	0.42	3.89	0.82	4.19	0.83	HU
2.	Distribution Transformer	4.57	0.51	4.33	0.82	4.41	0.73	HU
3.	Power Transformer (7.5 MVA)	4.35	0.49	4.43	0.78	4.41	0.69	HU
4.	Battery Rectifier	4.22	0.80	4.63	0.49	4.49	0.63	HU
5.	Supply Voltage Circuit Breaker	3.74	0.45	4.39	0.65	4.17	0.66	HU
6.	Spring Charger (33KV)	4.65	0.49	3.87	0.34	4.13	0.54	HU
7.	Trip Circuit	4.60	0.21	4.77	0.64	4.48	0.60	HU
8.	Low Pressure Gas Indicator	4.63	0.39	4.37	0.83	4.42	0.74	HU
9.	Electronic Hooter Alarm	4.65	0.49	4.11	0.64	4.29	0.64	HU
10.	Alarm Annunciator	4.00	0.67	4.57	0.58	4.38	0.67	HU
11.	System Protector Indicator	4.09	0.42	4.59	0.65	4.42	0.63	HU
12.	Transformer Protector (trip)	3.39	0.50	4.48	0.55	4.12	0.74	HU
13.	Voltage Selector	3.96	0.21	4.07	0.71	4.03	0.59	HU
14.	A.C mains Fail Indicator	3.48	0.51	3.93	0.80	3.78	0.76	HU
15.	Mode Selector	3.70	0.56	3.60	0.55	3.60	0.55	HU
16.	Metering Box	3.35	0.49	4.02	0.77	3.80	0.76	HU
17.	Spring Charger (11KV)	3.87	0.34	3.91	0.59	3.90	0.52	HU
18.	High Speed Relay	3.43	0.51	3.54	0.55	3.51	0.53	HU
19.	Gang Isolator	3.22	0.52	3.74	0.53	3.57	0.58	HU
20.	Energy Meter	3.35	0.49	3.74	0.68	3.61	0.65	HU
21.	Local remote Switch	3.87	0.34	3.41	0.72	3.57	0.65	HU
22.	Transformer Meter	3.43	0.51	4.24	0.52	3.97	0.64	HU
23.	Control Unit (CTU)	3.72	0.52	3.89	0.58	3.76	0.58	HU
24.	Feeder Pillar Plinth	3.87	0.63	3.43	0.62	3.58	0.65	HU
		3.96		4.08		4.02		HU

\bar{x}_S = Mean of Supervisors, \bar{x}_T = Mean of Technicians, σ_S = Standard deviation of Supervisors, σ_T = Standard deviation of Technicians, \bar{x}_G = Grand Mean, σ_G = Grand Standard deviation HU = Highly Utilized, MU = Moderately Utilized, U = Utilized, N_S = Number of Supervisors, N_T = Number of Technicians, N_{TT} = Total Number of Respondents, RMK = Remark

Table 2 above the equipment utilized for the distribution of electric power by Yola Electricity Distribution Company in Adamawa State. The respondents indicated that item 1-24 with mean responses which ranges from 3.51 and 4.49 and having a standard deviation range from between 0.52 and 0.76 respectively are highly utilized. Therefore, the results in Table 2 revealed that all of the 24 items listed are highly utilized for effective power distribution in Adamawa State.

3.3 Hypothesis One

There is no significant difference between the mean responses of technicians and supervisors on the level of tools utilization in the distribution of electric power by Yola Electricity Distribution Company.

Table 3. t–test Statistical Analysis of Difference between the Mean Responses of Technicians and Supervisors on the Level of Tools Utilization in the Distribution of Electric Power by Yola Electricity Distribution Company

Respondents	N	Mean	S.D	df	t	p – value	Remark
Supervisors	23	3.97	0.47	67	2.41	0.091	Not Significant
Technicians	46	4.06	0.63				

$P > 0.05$ N= Number of respondents, S.D = Standard Deviation

The result of analysis in Table 3 revealed that there is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company. With mean response of 3.97 and standard deviation of 0.47 for supervisors and a mean response of 4.06 and standard deviation of 0.11 for technicians at 67 degree of freedom, implies that Yola Electricity Distribution Company utilized the equipment used in distribution of electric power in Adamawa State since $P < (0.05, t = 2.41, df = 67, p = 0.091)$.

3.4 Hypothesis Two

There is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company.

Table 4. t–test Statistical Analysis of Difference between the Mean Responses of Technicians and Supervisors on the Level of Equipment Utilization in the Distribution of Electric Power by Yola Electricity Distribution Company

Respondents	N	Mean	S.D	df	t	p – value	Remark
Supervisors	23	3.96	0.12	67	1.26	0.531	Not Significant
Technicians	46	4.08	0.11				

$P > 0.05$ N= Number of respondents, S.D = Standard Deviation, df = Degree of Freedom

The result of analysis in Table 4 revealed that there is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company. With mean response of 3.96 and standard deviation of 0.12 for supervisors and 4.02 and 0.11 for mean response and standard deviation for technicians at 67 degree of freedom, implies that Yola Electricity Distribution Company utilized the equipment used in distribution of electric power in Adamawa State since $P < (0.05, t = 1.26, df = 67, p = 0.531)$.

4. Findings of the Study

Based on the results presented, the following findings were made:

1. Yola Electricity Distribution Company highly utilizes the following tools for effective distribution of electric power distribution: Ladder, Hand Gloves, Safety Belt, Ammeter, Ohmmeter, Voltmeter, Spanners, Screwdrivers, Utility Knife, Measuring Tape, among others
2. Yola Electricity Distribution Company utilizes the following equipment for effective distribution of electric power distribution: Supply Voltage Detector, Distribution Transformer, Power Transformer, Battery Rectifier, Supply Voltage, Circuit Breaker, Spring Charger, Trip Circuit, Low Pressure Gas Indicator, Electronic Hooter Alarm System, Protector Indicator, Transformer Protector, Voltage Selector among other
3. There is no significant difference between the mean responses of technicians and supervisors on the level of tools utilization in the distribution of electric power by Yola Electricity Distribution Company
4. There is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company.

5. Discussion of Findings

The finding of the study revealed that Yola Electricity Distribution Company highly utilizes the following tools for effective distribution of electric power distribution: Ladder, Hand Gloves, Safety Belt, Ammeter, Ohmmeter, Voltmeter, Spanners, Screwdrivers, Utility Knife, Measuring Tape, among others. The finding is in agreement with Madueme (2002) who reported that for an effective utilization of a service, all the necessary tools must be available and utilized. To further support the findings, Gabriel and Isaiah (2012) reported that electrical power tools are at their best if effectively utilized. Gabriel and Isaiah further asserted that the electricity distribution companies frequently utilize ladder, utility vehicles, safety belt, pliers, voltmeter and utility knife hand gloves, safety boot, in ensuring effective distribution of electric power and fault diagnosis.

The finding of the study revealed that Yola Electricity Distribution Company highly utilizes the following equipment for effective distribution of electric power distribution: Supply Voltage Detector, Distribution Transformer, Power Transformer, Battery Rectifier, Supply Voltage, Circuit Breaker,

Spring Charger, Trip Circuit, Low Pressure Gas Indicator, Electronic Hooter Alarm System, Protector Indicator, Transformer Protector, Voltage Selector among other. The finding is in agreement with Chatta (2015) examined the spatial distribution and utilization of electricity transformer in Sabon Gari local government area in Zaria, Kaduna state. Chatta opined that for effective utilization of electric power, transformers, cables of require standard and gauge, fault detecting instrument must be frequently utilized and provided by the electric power distribution company. Furthermore, Dikio, Biobele and Victor (2018) reported that in an area where there is a large number of consumers, state of the art electrical equipment will best serve them as the equipment will meet the high demands of the electrical consumers.

The finding of the study revealed that there is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company. This finding is in agreement with Azodo (2014) who reported that the respondent at Obantoko residents were unanimous in their decision on the effectiveness of the tools utilized for electric power distribution. The finding is further supported by Zhuang et al. (2015) whom in their submission reported that the responses of the respondents were not significantly different. The finding of the study revealed that there is no significant difference between the mean responses of technicians and supervisors on the level of equipment utilization in the distribution of electric power by Yola Electricity Distribution Company. This finding is in agreement with Sunday and Fagbenle (2011) who reported that the level of equipment utilization was high as there was no significant difference between the engineers and lines men on the equipment utilization in Egbin 1320 MW thermal power plant. The finding is further supported by Chatta (2015) who reported that there was no statistical difference between the opinion of the supervisors and lines-men on the utilization of distribution transformer in Sabon Gari local government area in Zaria, Kaduna State.

6. Conclusion

Based on the findings made, the study concluded that Yola Electricity Distribution Company utilizes both tools and equipment for the sole purpose of electric power distribution to consumers and ensuring that the distribution is effective.

7. Recommendation

Based on the findings of this study, the following recommendations are made:

1. YEDC should provide more equipment for effective distribution of electric power especially utility vehicles and other equipment necessary for effective electric power distribution
2. YEDC should partner with other private organizations and community to provide other tools and equipment needed for effective electric power distribution within their operational jurisdiction.

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