

Evaluation of Maintenance Policy in Telecommunication Industry in Nigeria

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Abstract: *The convergence of telecommunications and computers has expanded the role of telecommunication facilities in all human activities. Constant availability of these facilities is dependent largely on formidable effective maintenance policy in the telecommunication industry with a view to developing a policy that will ensure maximum efficiency of utilization and growth of telecommunication infrastructure in Nigeria. In this paper, the data were collected with the aid of questionnaires and interview guide were analyzed accordingly using descriptive statistics, while three hypotheses were tested using chi-square to determine the relationship between maintenance on both effect of external factor and policy effect. The result revealed that observed value using 0.05 level of significant is 9.488 and chi-square calculated is 197.1 and 105.91 for both external factor effects and effect of policies on maintenance respectively. This actually showed that external factors and effect of policies have significant effect on maintenance. Also, from the table obtained, it was concluded that there was not significant different in faults in the sites. The result indicated that existing telecommunication were poorly maintained and over-stretched. Appropriate strategy that could be incorporated into a comprehensive policy on manpower training, pre-start up and post-start up documentation, funding organization, proper coordination and harmonization of the activities of the government agencies and proper education for technicians/engineers involved in maintenance activities were proffered.*

Keywords: *Maintenance, replacement, telecommunication, equipment, reliability, subscribers, etc.*

1. INTRODUCTION

The world is fast becoming a global village and a necessary tool for this process is communication for which telecommunication is a key player in this process. As a result of advances in technology, rapid changes are taking place in telecommunication. These changes have had a profound effect on telecommunication particularly in the area of computerization, digitalization and regulatory policy (Alabi, 2000). Advances in technology is making computer terminals constitute a significant proportion of the connections to the telecommunications network. max. With the increasing specialization and complexity of equipment and other facilities used in telecommunication industries, the need for effective maintenance strategies has become imperative. Various authors have summarily defined maintenance as the repair and up keep of existing equipment, buildings and facilities to keep them in a safe, effective as designed condition so that they can meet their intended purpose (Prinel, 1977).. The effectiveness of maintenance refers to the extent to which the maintenance objectives are met as regards the satisfaction of both internal and external customer requirements (Oluleye and Olajire, 1999). Implementation of the maintenance strategy requires a human resources organizational framework.

It has been found that a good production system is usually backed up by an effective maintenance system, therefore evaluating maintenance and replacement policy is an important ingredient in the effort to enhance profitability in the manufacturing industries (Kelly *et al*, 1997). The fundamental aim of a radio link, for instance is to deliver sufficient signal power to the receiver at the far end of the link to achieve some performance objectives. The consequence of poor maintenance policy is the disruption of this fundamental aim.

2. RELATED WORKS

Maintainability is the ease and the economy of maintenance (Tomlison, 1993). It is the ability of a system, natural or artificial, to meet operational objective with a minimum expenditure of maintenance efforts under operational environment or condition in which scheduled and unscheduled maintenance is performed. For the purpose of maintenance activity, functions such as test, repair, overhaul, and construction for the specific reason of improving the operational status of a component or equipment be carried out to alleviate unsatisfactory condition found during inspection. It is unscheduled work usually of an emergency nature to correct breakdown.

Maintenance can then be described as work undertaken in order to keep, restore, or improve every facility to an acceptable standard and to sustain the utility and value of the facility (Makoju, 1988). The development in maintenance engineering has resulted in the installation of self-determining processes and equipment that either need little or no maintenance or that tells the operator when they are to get damaged, why they are damaged and what remedy is required. This process is very common in digital system.

Generally, maintenance strategies can be classified into three categories viz, prevention, breakdown/preventive and design out maintenance.

2.1. Preventive Maintenance

The strategy involves routine inspection, servicing, and keeping facility in good condition. It is intended to build a system that will find potential failures and make changes or repair that will prevent failure. Preventive maintenance is more than keeping an equipment running. It involves designing technical and human system that will keep the process running within tolerance and should be applied selectively to production equipment, building and other facilities (Tomlison, 1993).

2.2. Breakdown/Corrective Maintenance

Corrective maintenance will always be required regardless of level of planned maintenance applied but to a lesser extent (Armstrong, 1987). This strategy allows the equipment to function until it develops a fault that will not allow it to function any longer. The equipment is already out of order and it can not perform its function any more. This is the time the maintenance activity is carried out to rectify the fault.

2.3. Design-Out/Improvement Maintenance

It has been established that no matter how much competence and knowledge displayed during design, manufacturing, etc. the possibility is always there to affect some sort of improvements on the reliability and maintainability of equipment based on the experience gained from production operation (Okah-Avae, 1996). This could be the result of environmental conditions not preconceived at the earlier stages or the equipment may be too fragile for the calibre of available personnel.

3. METHODOLOGY

Data collection was through oral interviews. As a research method, the interview is a conversation carried out with definite aim of obtaining certain information.(Osuala, 1990).

Table1. Respondent's profile

Type of Respondents	No
Technical personnel	600
Subscriber	300
Others	100

The interview questions were constructed to gain an appropriate insight to the true situation of the respondents as regards

- (1)their literacy level
- (2)their technical know how

(3) mode of interaction with telecommunication industries

The investigators personally conducted these interviews with the help of research assistants. The responses were recorded as completely as possible in the respondent's own words. The data collected were summarized in the respondent profile as shown in Table 1.

4. THE STUDY AREA AND SAMPLE POPULATION

The research focus is on the telecommunication industry located in the southern part of Nigeria. This was stratified into three strata: south-west, south-east and south-south. In each stratum the respondents were chosen from the three major telecommunication companies that control 60% of infrastructure in Nigeria. The telecommunication industry covers electronic transmission, emission or reception of information by wire, radio and optical or other electromagnetic system between specific places. It excludes postal service and mass media services such as radio and television broadcasting equipment. The information transmitted may be sound, images or bit of data. The industry is made up of different categories of operators, which offers varied services, in addition to the internet and data service providers. There are three broad categories of telecom operators in Nigeria, namely;

1. The fixed wire/wireless service providers such as private owned Nigeria Telecommunication Limited (NITEL), the licensed second national operator (GLOBACOM), a number of fixed wireless operator (otherwise known as Private Telecommunication Operator PTO), and those operating the fixed wireless technology.
2. The cellular operator such as MTN Communications, Etisalat, Zain wireless.
3. The long distance operators such as NEPSCOM COMMUNICATION LTD and Mobile Telecom Service LTD.

The period covered by the study is between 2007 and 2008. About 600 staff of these companies was chosen throughout the southern part of Nigeria. 300 subscribers were also chosen other (neither in staff or subscriber category) were 100 in number. These summed up to a sample size of 100.

5. FINDINGS

The data collected were analyzed using simple percentage and chi-square. The findings from the study are summarized below.

Literacy: Most of the workers involved were technically trained on the job. About 20% of the respondents indicated that they have qualifications ranging from B.Sc to M.Sc, while about 2% have PhD and 75% have qualification between ND and HND or their equivalents. Others, which include craftsman, school certificate and illiterate accounted for 3%. Fig 1 and Fig 2 actually show the pie and bar chart respectively of the qualifications with population of the respondents under investigation.

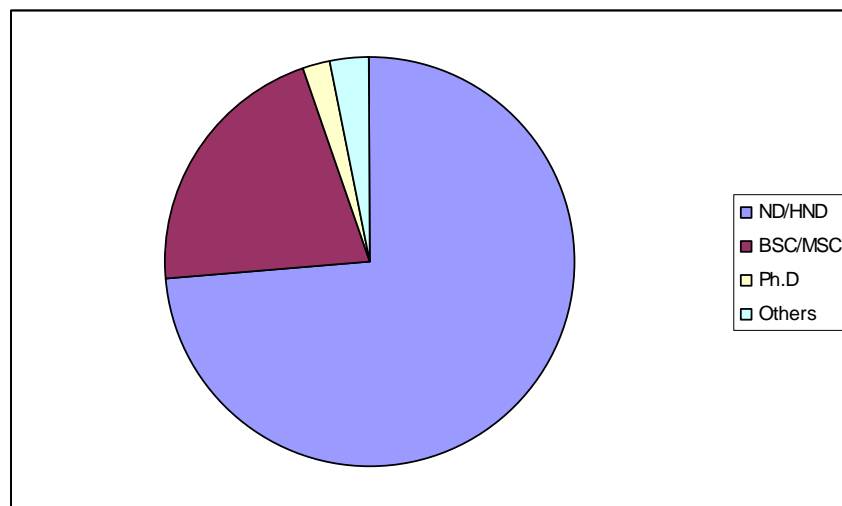


Fig1. Pie chart showing qualification of respondent

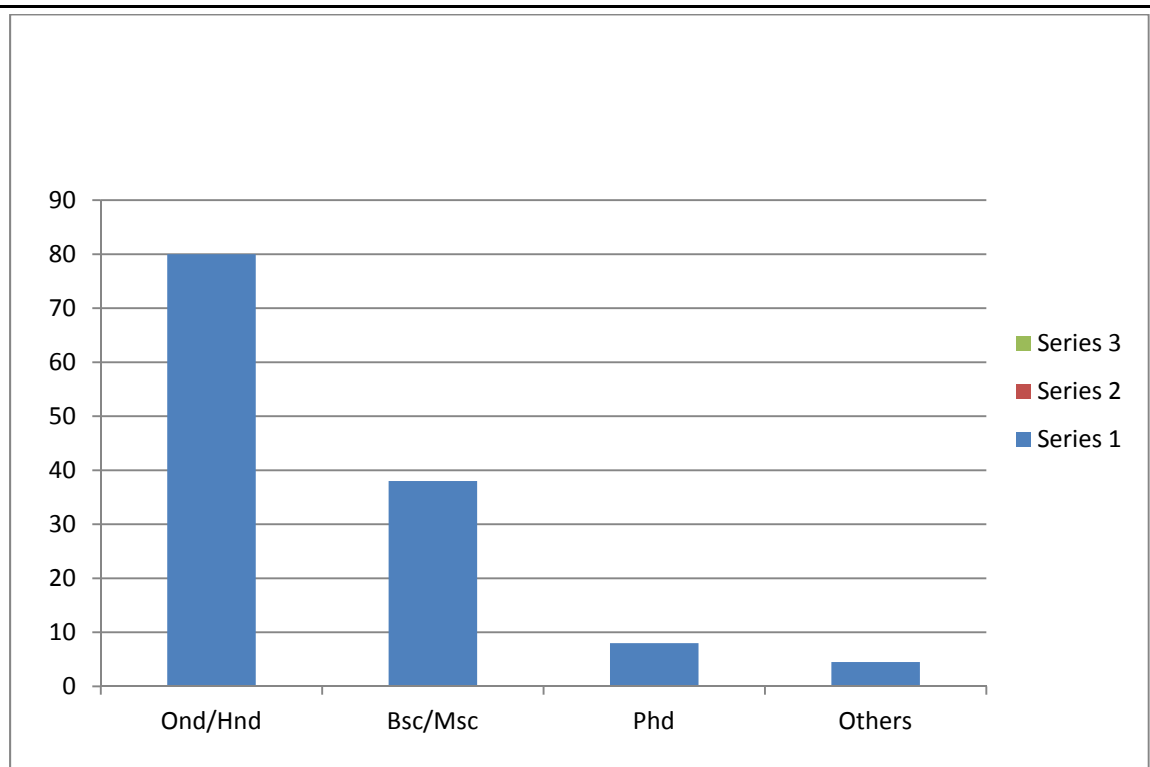


Fig2. Showing population of technical respondent

6. EXTERNAL FACTOR EFFECTS ON MAINTENANCE

Table 2 shows the effect of external factors such as subscriber, contractor and government agencies on the maintenance activities. The following research questions were posted to guide the study.

Research Questions

1. How often do your maintenance screw requires subscriber assistance like reporting issues of vandalization of their facilities, illegal access to theft and unauthorized person to BTS station?.
2. How often do contractor affects the performance of maintenance activities?
3. How often do government agencies like water corporation, Power Holding Company of Nigeria (PHCN) influence operational efficiency?

In assessing the maintenance activities using external factors, 3-item inventory was used. The scale has three response categories. The scale value is as follows: (1) Often; (2) Seldom; (3) Rarely as shown in Table 2. Statistical analysis was used to test the external factor effects on maintenance using chi-square defined

$$\phi^2 = \sum \frac{(O - E)^2}{E} \dots\dots\dots(1)$$

Where

O = Observed Value

Σ = Expected Value

$$\Sigma = \frac{R_T X C_T}{G_T} \dots\dots\dots(2)$$

Where G_T = 300

Substitute for R_T and C_T for each opinion score in Table 2 using equations 1 and 2 so that the result is presented as shown in Table 3.

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Table2. Effect of External Factor on Maintenance Activities

External factor	Opinion Score			Total (R _T)	%
	Often %	Seldom %	Rarely %		
1. Subscriber	7	13	80	100	
2. Contractor	89	8	3	100	
3. Government agencies e.g. PHCN, Police, etc	84	9	7	100	
C _T	180	30	90	300	

Table3. Estimated Value and Chi-square Calculation Obtained

Observed value O	Expected value E	$\frac{(O - E)^2}{E}$
7	60	46.82
13	10	0.9
80	30	83.33
89	60	14.02
8	10	0.4
3	30	24.30
84	60	9.60
9	10	0.10
7	30	17.63
		197.1

Source: Derived from Table 2

From Table 3

$$\varphi^2 \text{ Cal} = 197.1 \quad \dots\dots\dots(3)$$

but

$$\varphi^2 (5\%) = 9.488$$

7. POLICY EFFECT ON MAINTENANCE

Table 4 shows the summary of the respondent's awareness on maintenance policy, their participation in its formulation and effectiveness of the policy instrument in the telecommunication industry in the area. The following questions were posited to give the policy effect on maintenance

1. Are you aware of any maintenance and replacement in your telecommunication industry?
2. Have you ever contributed to policy formulation on maintenance in this establishment?
3. Is the policy in question effective enough?
4. Do you think that Board of directors or Top Management is responsible for policy formulation?

In this case, the scale also has three response categories. The scale value is as follows: (1) Yes; (2) No; (3) Neutral. Statistical analysis was also used to test for the effect of policy on maintenance activities.

Substitute for R_T and C_T for each opinion score in Table 4 using equations 1 and 2 so that the result is presented as shown in Table 5.

Table4. Effect of Policies on Maintenance Activities

Factors	Yes (%)	No (%)	Neutral (%)	Row Total (R _T)
1. Staff awareness of maintenance	80	8	12	100
Staff participation in policy formulation	15	75	10	100
Effectiveness of policy instruments	35	60	5	100
olumn Total (C _T)	130	143	27	300

Table5. Estimated Values and Chi-square Calculation on policies Effect on Maintenance

Observed value O	Expected value E	$\frac{(O - E)^2}{E}$
80	43.33	31.03
8	47.67	33.01
12	9.00	1
15	43.33	18.52
75	47.67	15.67
10	9	0.11
35	43.33	1.60
60	47.67	3.19
5	9	1.78
		105.91

Source. Derived from Table 4

From table 5

$$\phi^2 \text{ Cal} = 105.91 \dots\dots\dots (4)$$

Faults on Sites: Table 6 reveals that many telecommunication problems are caused by transmission faults such as lockout, Calls drop, crosstalk, etc. These are regarded as equipment fault. In determining the percentage of fault on site the following questions were posited.

1. What are the major faults on site?
2. Which of these faults are more frequent?
3. How long does it take to rectify the fault?
4. What do you think is commonly responsible for the faults?

To show whether or not there is a significant difference in the faults on sites, hypothesis testing was employed.

$$G_T = 100 \text{ and } N = 12$$

$$C_T = \frac{G_T^2}{N} = 833.33 \dots\dots\dots(5)$$

Where G_T = Grand Total

$$SS_{sites} = \frac{R_{T1}^2 + R_{T2}^2 + R_{T3}^2}{T_P} - C_F \dots\dots\dots(6)$$

$$SS_{Total} = a_{11}^2 + a_{12}^2 + a_{13}^2 + a_{14}^2 + a_{21}^2 + a_{22}^2 + a_{23}^2 + a_{24}^2 + a_{31}^2 + a_{32}^2 + a_{33}^2 + a_{34}^2 \quad (7)$$

$$SS_E = SS_{Total} - SS_{sites} \quad (8)$$

Where

SS_{sites} = Sum of square in site

SS_{Total} = Sum of square total

T_P = Total number of type of faults

By substituting in equations 6, 7 and 8 using Table 6, we shall have

$$SS_{sites} = 23.17$$

$$SS_{total} = 388.67$$

$$SS_E = 365.5$$

From these calculations, we can therefore generate ANOVA table as shown in Fig.7

Table6. Major Causes of Faults on Line

Respondent's location	Power fault (%)	Willful damage (%)	Diesel theft (%)	Transmission fault (%)	Total R _T (%)
Site 1	12	1	13	2	28
Site 2	15	3	10	3	31
Site 3	10	6	20	5	41
Total	37	10	43	10	100

Table7. ANOVA Table

Source of statistics variation	Degree of freedom	Sum of square (SS)	Mean of square	F-value
Sites	2	23.17	11.585	0.29
Error	9	365.5	40.611	–
Total	11	388.67	–	–

8. DISCUSSION

As shown in Table 3, three hypotheses were tested using chi-square on external factor on maintenance activities. The result revealed that observed value using 0.05 level of significant is 9.488 and chi-square calculated is 197.1. Also, policy effect on maintenance was also tested using four research questions with the use of chi-square. The result showed that 0.05 level of significant is 9.488 and chi-square calculated is 105.91 as depicted in Table 5. The two results actually indicated that external factor and policy effect have significant effect on maintenance.

Also, looking at the faults on sites, hypotheses testing was also employed as shown in Table 6 to determine if there is a significant difference in the faults on sites. By constructing the ANOVA table as shown in Table 7, there was no significant difference in faults on the sites. This actually shows that existing telecommunication equipment were poorly maintained and over-stretched.

9. CONCLUSION

Since Nigeria is homogeneous society in that there are common features and problem characterizing telecommunication industries in Nigeria, the findings discussed in this research can be generalized to the larger society. Proper maintenance and replacement policy of equipment in telecommunication industries is a must and when achieved the issue of telecommunication breakdown will be reduced.

Conclusion can then be drawn as follows

- (1)The level of network infrastructural development in Nigeria is encouraging but the maintenance strategy to cater for the increasing demand for telecommunication facility is poor.
- (2)The process of policy formulation always excludes the participation of maintenance staff. Any policy statement is interpreted as management ploy to exploit the system.

10. RECOMMENDATIONS

Since external factor has significant effect on maintenance, it is evident from the research that the subscribers do not report about the issue like vandalization of facilities, etc. The effect of this is that many faulty lines and BTS stations would be left unclear for a long time. For effectiveness and efficiency of maintenance activities, information about downtime should be reported for immediate and necessary actions. This will ensure that minimum down time is recorded for telecommunication facilities, thereby increasing efficiency of machine utilization.

Again the research finding revealed that majority of telecommunication projects are executed by contractors. The competence of these contractors is reflected in the performance of the facilities they installed. Many faults due to poor layout, bad jointing, sub-standard materials, poor constructions, and inappropriate location of plants may not manifest during acceptance and commissioning stages. When a bad job is executed and commissioned, it would require greater maintenance effort during its life span than one that is executed to specifications and standards. A standard maintenance policy that will ensure that competent contractors are patronized would be beneficial to maintenance activities of the telecommunication industry. On the effect of government agencies appropriate legislature be put in place to enforce metropolitan planning authorities in the country to live up to expectation. Moreover, since it was revealed from our

research that policy has significant effect on maintenance activities as seen in Table 5, the findings showed that the majority of respondents are not part of policy formulation and therefore there is no proper implementation of the policy formulated.

Also, many fault on sites are due to diesel theft, therefore security guard should be allocated to all the sites. Many of the power faults are due to cable fault and therefore proper underground cable should be buried according to ITU (International Telecommunication Union).

To enhance the effective maintenance in telecommunication industry, the following are therefore recommended.

- Effort must be geared towards adequate network maintenance that will be compatible with numerous telecommunication providers that are springing up daily. The use of job order should be minimized in places where the core network operations are involved because there are delays in replacements of bad equipment which will result to poor or no signal during the down time. This result to loss of revenue and dissatisfaction from subscribers involved.
- Research efforts should be intensified in the Universities, Polytechnics and other research centers with a view to ensuring that inputs to the telecommunications infrastructure maintenance are sourced locally, and that facilities are available to test the imported equipments for compatibility with systems to avoid costly damage to the equipment and national psyche.
- Maintenance tools, test equipment, materials and spare parts should be provided as a matter of policy. Their availability must be monitored and enforced by powerful unit that should discipline anybody that may be responsible for any lapse or inadequacy in their provision.
- Maintenance staff should be updated on the latest techniques of maintenance technology no matter their designation. They must also be developed psychologically to see themselves as true professional who must guide the ethics and norms of their profession. This is necessary to be able to withstand societal pressure that encourages illegal activities in all ramifications. These are possible through regular seminars, workshops, trainings and symposia packaged for the need of the industry and the society at large.
- The use of cameras and intruder alerts security systems should be put in place, as this will alert the security personnel and the Field Support Engineer of an illegal intrusion. The cameras will record traffic and all daily activities as it keeps track of events as they unfold.
- Intelligent equipment like switches and routers should be used. Latest technology should replace the old ones.
- The use of community leader to assist on site protection from theft and damage should be put in place.

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