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STRATEGIES FOR IMPROVING MAINTENANCE OF LABORATORY EQUIPMENT AND TOOLS FOR EFFECTIVE SERVICE DELIVERY IN NNAMDI AZIKIWE UNIVERSITY, AWKA

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ABSTRACT

This study focused on strategies for improving maintenance of laboratory equipment and tools of Science Education and Technology and Vocational Education Departments of Nnamdi Azikiwe University, Awka for effective service delivery. Four research questions guided the study while one null hypothesis was tested at 0.05 level of significance. The study adopted a descriptive survey design using a population of 75 technologists of Science Education and Technology and Vocational Education Departments. There was no sampling for the study because of manageable size of the population. Instrument for data collection was a self-structured questionnaire which was validated by experts. The Pearson Product Moment Correlation Co-efficient was used to determine the reliability of the instrument, which yielded the overall co-efficient of 0.76. Mean and standard deviation were used to answer the research questions while t-test was used to test the hypotheses. The findings revealed that technologists agreed with the following identified effective preventive maintenance strategies, correction maintenance strategies among others. Hypotheses testing showed that there is no significant difference between the mean ratings of Science Education technologists and Technology and Vocational Education technologists on the effective preventive maintenance strategies for improving maintenance of laboratories equipment. The conclusion was that it is important to have preventive maintenance measure adopted and integrated into the laboratory and workshop programmes such that routine tasks like cleaning, servicing, and lubricating of equipment will be a normal part of activity in the workshop. It was recommended among other that all laboratory technologists should be sent for equipment maintenance training through workshops, seminars and conferences periodically.

Keywords: Strategies, Maintenance, Laboratories, Equipment and Service Delivery.

Introduction

Laboratory equipment is portable or heavy mechanical devices for practical oriented course operation in the laboratory, workshop or field laboratory (Umeh-Idika & Okpala, 2022). Olaitan (2015) observed that the use of equipment is mainly on technically specialized skill practices in the instructional and learning situations. It is used for scientific research and takes many forms because of the differing requirements of specialists in the various fields of science and engineering. Scientific laboratories can be found in research rooms in schools and universities, which are used to perform an experiment, take measurements and also

collect data. Thus, ineffective teaching of practical oriented courses in tertiary institutions is to a large extent a result of lack of maintenance culture. Dervistotis (2011) stated that poor maintenance can result in defective output, unsafe working condition and increased production cost due to repairs and excessive downtime. Uzoagulu (2011) noted that functionality of laboratory equipment, tools and facilities and their availability could only be ensured through prompt maintenance. Uzoagulu (2011) stated that laboratory equipment must be utilized to give training and impart requisite practical skills and technical knowledge.

However, to be able to achieve the goal of practical oriented education, there must be adequate facilities such as laboratories and equipment for its teachings and learning skills, knowledge and competencies at the tertiary level. Vocational and technical education include training in engineering such as Electrical, Mechanical, Welding and Fabrication, Agricultural science, computer science, other courses include office technology, food technology, hospitality, business administration, accountancy and so on. These courses are taught at colleges of education, polytechnics and the universities. Olaintan (2015) attributed the inability to maintain machines to the following factors: most establishments have erroneous conception of maintenance as a task for technicians alone, lack of personnel with adequate maintenance principles, utilization of technology which root lies in other culture, absence of record system and inability to support innovations in the departments and lack of funds to procure spare parts. University of Nigeria maintenance committee report (2016) stated that there is an alarming growth of non-functioning laboratory and workshop equipment in the area of science and technology. This has resulted in ineffective teaching of practical course since a large proportion of equipment existing in the workshop do not function as required. Effectiveness is an indication of the impact of group of activities performed on the achievement of the intended learning outcomes. Olaitan (2015) stated that effectiveness of maintenance refers to the extent to which maintenance objectives are met as regards the satisfactions of both internal, external and customer requirements. It is imperative that good operating equipment, tools and facilities will enhance effective maintenance system. Effective maintenance measures would eventually culminate in the retirement and replacement of the equipment and facilities. One basic requirement needed for equipment and facilities maintenance is the provision of direction for effective maintenance programme of instructional equipment in Science Education and Technology and Vocational Education workshops and laboratories. There is need to keep instructional equipment in good working order, until it attains its maximum possible life span. Effective maintenance of workshop equipment that can make science education and Technology and Vocational Education reach the level of high productivity and make the teaching and learning to be more effective is necessary since very few equipment and tools are supplied to the schools.

Maintenance aims at keeping equipment, tools and other assets in the condition that best facilitates educational goals. It is a way of repairing or servicing used equipment in order to make for enhanced functioning. According to Gelberg (2014), maintenance is a systematic care and attention required to keep equipment in good working order. He also further stressed that in the industry, general system of planned or scheduled preventive maintenance is used not only to keep equipment at its high rates productivity and original accuracy but also to ensure full and uninterrupted service. To ensure maximum availability and reliability of the existing facility, regular maintenance must be carefully planned and religiously carried out to minimize delays and stoppages due to insufficient performance and breakdown of these facilities. To ensure maximum functioning of equipment, designing of effective maintenance measures are required. The effectiveness of any tool or equipment in performing specific function depends on the maintenance measures adopted. According to Ogbuanya (2011), the development of a strategy for maintenance involves a range of structural decision which includes what to be maintained, how maintenance is going to be performed, who performs the maintenance, what range of skills are involved and when should the equipment be maintained? This is one of the ways of planning for maintenance activity in advance by the practical oriented course personnel. Hence the implementation of maintenance measures will require human resources. The measures will be based on definite cooperative focus while the functionality of the element depend on factors like qualification, motivation, interpretation, relationship, training and retraining.

Maintenance strategies involve predictive maintenance, preventive maintenance and corrective maintenance (Adenayi, Hori & Sanni, 2004). Predictive maintenance is a maintenance which takes place when there is a warning signal of danger in the operation of equipment. It is concerned with the application of useful strategies to forestall a breakdown when danger signals are observed. According to Orikpe (2011), predictive maintenance involves watching out for danger signal such as unusual noise, danger light indicators, inefficiency of performance and arresting the situation promptly before there is any major breakdown. The author further pointed out that it may involve minor errors which could be corrected by replacement of parts. Preventive maintenance is a type of maintenance or practice that involves inspection, lubrication, cleaning and testing of an equipment or facility used in factory or laboratory. Wild (2015) stated that preventive maintenance is used to delay the breakdown of equipment, and also reduce the severity of any breakdown that might occur. The author noted that servicing as routine cleaning, lubrication and adjustment may significantly reduce wear and prevent breakdown. Corrective maintenance is a work carried out to restore (including adjustment and repair) an asset that has ceased to meet standards. Corrective maintenance is employed when there is malfunctioning or complete breakdown of the equipment. Similarly, Swoden (2010) stated that corrective maintenance is a work or action needed to restore the integrity of damage or deteriorated structure and it

includes the repair or replacement of defective parts.

An effective education service delivery can only be offered when equipment, tools and facilities are continuously maintained. Each of them needs to be in a good condition at all times to enhance the student's training. Various maintenance measures should be employed to ensure efficient and effective servicing of equipment in order to keep them in operation and to eliminate preventable breakdown. On the other hand, strategies offer a framework within which an organization or individual defines possible means of achieving its goals and objectives. Swanso (2006) described strategy as a well-planned series of action, for achieving an aim especially success against an opponent. In the light of Summers (2009) definition of strategy, specialist in the area automobile technology then needs to package a well-planned action to arouse and improve students' interest to achieve success in the discipline. For effective maintenance services, Ezeji (2016) observed that a good start will be from making judicious use of the available materials and improvising local alternatives to imported materials with a view to ultimately indigenizing the production of the technical equipment. The author indicated that several facilities used for technical training require constant lubricants; they need to be maintained through constant cleaning.

It needs also to be tested to identify the effective parts, care being taken in their use and repairs affected where necessary. Some tools, facilities and equipment in the schools are not properly cared for. Poor co-ordination and many more of the interactive human element leads to failure of many maintenance services and subsequently poor service delivery in the teaching and learning in the tertiary institutions. Hence, the need to identify the strategies for improving maintenance of laboratories equipment and tools in Science Education and Technology and Vocational Education Departments of Nnamdi Azikiwe University, Awka for effective service delivery.

Statement of the Problem

The problem of the study is that if the maintenance culture is not checked, it will cause the institutions to produce students without practical saleable skills and half-baked graduates. The laboratory equipment, tools and facilities in the Science Education and Technology and Vocational Education workshops and laboratories are meant for the acquisition of practical skills by students. However, proper maintenance of these pieces of equipment is of great importance for achieving its stipulated science-oriented course objectives. Practical skills cannot be effectively impacted theoretically so laboratory equipment and tools are very much required in the training for practical skill acquisition.

However, Ogbuanya (2011) observed that government in realization of the importance of tools, equipment and laboratories in skill training and scientific knowledge has provided funds for tools, equipment and laboratories at the secondary and tertiary institutions in Nigeria. In spite of the huge financial commitment of government in the provision of laboratories, tools and equipment, Anyakoha (2004) stated that these equipment, tools and laboratories lack maintenance. The

unfortunate and regrettable state of equipment tools and laboratories have been attributed to inability of the operators to apply preventive and total maintenance culture as at when due, on the equipment and tools in the laboratories and workshops. Maintaining laboratories equipment and tools in tertiary institutions requires very high capital outlay particularly in form of building, equipment and other infrastructural facilities. Equipping tertiary institutions with workshop laboratories equipment and tools has remained problematic because of its capital-intensive nature.

Despite the fact that tertiary institutions workshop equipment and tools are very expensive and in short supply for effective service delivery, it is wise and necessary that whatever laboratory equipment and tools available should be properly maintained. Based on the above background, evidence still show that there are no proper measures for maintenance of laboratory equipment in this study. Hence this study addressed the problem of poor maintenance culture at Science Education and Technology and Vocational Education laboratories and workshops by identifying strategies for improving maintenance of equipment and tools for effective service delivery in Nnamdi Azikiwe university, Awka.

Purpose of the study

The purpose of this study was to determine the strategies for improving maintenance of laboratories equipment and tools in Science Education and Technology and Vocational Education of Nnamdi Azikwe University, Awka for effective service delivery. Specifically, the study intends to:

1. Identify the effective preventive maintenance strategies for improving maintenance of laboratories equipment and tools.
2. Identify the effective correction maintenance strategies for improving maintenance of laboratories equipment and tools.
3. Identify problems affecting the effective maintenance of laboratories equipment and tools.
4. Find out how the problems affecting the effective maintenance of laboratories equipment and tools could be remedied.

Research questions

The following research questions guided the study:

1. What are the effective preventive maintenance strategies for improving maintenance of laboratory equipment and tools?
2. What are the effective correction maintenance strategies for improving maintenance of laboratory equipment and tools?
3. What are the problems affecting the effective maintenance of laboratory equipment and tools?
4. How can the problems affecting the effective maintenance of laboratory equipment and tools be remedied?

Hypothesis

The hypothesis was tested at 0.5 level of significance using t- test.

1. There is no significant difference in the mean ratings of Science

Education technologists and Technology and Vocational Education technologists on the effective maintenance strategies for improving maintenance of laboratories equipment and tools.

Methods

This study adopted descriptive survey design. The population of the study was 75 technologists of Science Education and Technology and Vocational Education Departments. The entire population was used because the size was manageable. Data were collected using a structured questionnaire tagged Strategies for Improving Maintenance of Laboratory Equipment and Tools for effective Service delivery (SIMLETESD) developed by the researcher with the insight gained from literature review. The instrument was structured on five (5) point rating scale of Strongly Agreed (SA), Agreed (A), Undecided (U), Disagreed (D), and Strongly Disagreed (SD). The instrument was face validated by three experts: two lecturers from Technology and Vocational Education department, one lecturer from Measurement and Evaluation department both in Nnamdi Azikiwe University, Awka. To determine the reliability of the instrument, test re-test method was used on 10 respondents (technologists) from Faculty of Technology and Vocational Education of University of Nigeria, Nsukka. Data collected were analyzed using Pearson Product Moment Correlation reliability co-efficient to obtain aggregate reliability of 0.76. Copies of the questionnaire were personally administered by the researcher with the help of two research assistants to the respondents. The data collected were analyzed using mean, standard deviation and t-test. The mean was used to answer the three research questions while t-test was used to test the null hypotheses at 0.05 level of significance. The null hypothesis was upheld where calculated t value was less than the table value. This indicates that there is no significant difference between the mean ratings of technologists of Science Education and technologists of Technology and Vocational Education on the effective preventive maintenance strategies for improving maintenance of laboratories equipment and tools.

Result

Research Question 1: What are the effective preventive maintenance strategies for improving maintenance of laboratories equipment and tools?

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Table 1: Mean ratings of the respondents on the effective preventive maintenance strategies for improving maintenance of laboratory equipment and tools **N=75**

S/N	Items		$\bar{X}$	SD	Remarks
1.	Routine checks for laboratories equipment and tools should be carried out on daily basis		3.80	1.028	A
2.	Technologists should teach students on how to differentiate between functional and faulty equipment and tools	4.00	0.915	A	
3.	Students assist in cleaning of laboratories equipment and tools		3.60	1.026	A
4.	Technologists carry out periodic inspection on each equipment and tools to observe if any has damaged		3.60	1.050	A
5.	Seminars, workshop and conferences are organized periodically on maintenance	4.20	0.819	A	
6.	Teachers and students refer to servicing manual when maintaining laboratory equipment.	4.00	0.863	A	
7.	Adjustment and replacement of disposable parts are carried out on regular basis	3.80	0.969	A	
Cluster Mean			**3.86**	**0.953**	**A**

Data in Table 1 show that out of the seven items listed on preventive maintenance strategies for improving maintenance of laboratory equipment and tools, all the items were rated agreed with the mean score of 3.60 to 4.20 The cluster means score of 3.44 shows that the respondents agreed on the identified effective preventive maintenance strategies for improving maintenance of laboratory equipment and tools.

Research Question 2: What are the effective correction maintenance strategies for improving maintenance of laboratory equipment and tools?

Table 2: Mean ratings of the respondents on the effective correction maintenance strategies for improving maintenance of laboratory equipment and tools **N=75**

S/N	Items		$\bar{X}$	SD	Remarks
1.	Technologists acquire adequate training before using laboratories equipment and tools	4.00	0.781	A	
2.	Arrangement are made for servicing equipment and tools after use		3.60	1.291	A
3.	Routine maintenance exercise on the equipment and tools are carried out by students under close supervision	3.50	1.444	A	
4.	Schedule of duty are used to enable all technologists to actively participate in maintenance of laboratories equipment and tools for future work	3.80	1.176		A
5.	Ensure that moving parts of equipment and tools are always well lubricated after work	4.20	0.898	A	
6.	Technologists and students should report to the higher				

	authorities on any faulty equipment and tools for proper replacement	3.50	1.372	A	
7.	Adjustment and replacement of worn out parts are carried out on regular basis	3.60	1.291	A	
Cluster Mean		**3.74**	**1.179**		**A**

Data in Table 2 show that out of the seven items listed on correction maintenance strategies for improving maintenance of laboratory equipment and tools, all the items were rated agreed with the mean score of 3.50 to 4.20 The cluster means score of 3.44 shows that the respondents agreed on the identified effective correction maintenance strategies for improving maintenance of laboratory equipment and tools.

Research Question 3: What are the problems affecting the effective maintenance of laboratory equipment and tools?

Table 3: Mean ratings of the respondents on problems affecting the effective maintenance of laboratory equipment and tools **N=75**

S/N	Items		$\overline{X}$	SD	Remarks
1.	Some technologists do not possess the manipulative skills required to operate and do minor repairs	4.40	0.643	A	
2.	There is insufficient fund provide for maintenance of laboratories equipment and tools	4.00	0.915	A	
3.	The available laboratory equipment and tools are not functioning properly		3.60	1.026	A
4.	There is incessant power failure at the laboratories and workshops		4.00	0.863	A
5.	Obsolete laboratory equipment and tools are procured	4.20	0.898	A	
6.	Inferior quality of laboratory equipment and tools are supplied	4.00	0.939	A	
7.	Orientation courses on maintenance practices are not organized for newly employed technologists	3.80	0.969	A	
Cluster Mean			**4.00**	**0.893**	**A**

Data in Table 3 show that out of the seven items listed on problems affecting the effective maintenance of laboratory equipment and tools, all the items were rated agreed with the mean score of 3.60 to 4.40 The cluster means score of 3.44 shows that the respondents agreed on the identified problems affecting the effective maintenance of laboratory equipment and tools.

Research Question 4: How can the problems affecting the effective maintenance of laboratory equipment and tools be remedied?

Table 4: Mean ratings of the respondents on how the problems affecting the effective maintenance of laboratory equipment and tools be remedied **N=75**

S/N	Items	$\bar{X}$	SD	Remarks
1.	There should be adequate supply of laboratory equipment and tools	3.40	1.028	A
2.	Minor fault should be repaired as soon as possible to avoid total breakdown	3.60	1.036	A
3.	Fund for maintenance of laboratories equipment and tools should be under the control of Chief Technologists	3.60	1.026	A
4.	There should be prompt supervision of purchases and installation of news laboratories equipment and tools	3.60	1.024	A
5.	Seminars, workshop and conferences on the importance of maintenance should be organized for technologists and students	4.20	0.892	A
6.	Rules and regulation to guide the use of laboratories equipment and tools be established	4.00	0.863	A
7.	Relevant training on the use of laboratories equipment and tools should be carried out on regular basis	3.80	0.926	A
Cluster Mean		**3.74**	**0.971**	**A**

Data in Table 4 show that out of the seven items listed on problems affecting the effective maintenance of laboratory equipment and tools be remedied, all the items were rated agreed with the mean score of 3.40 to 4.20 The cluster means score of 3.44 shows that the respondents agreed on the identified problems affecting the effective maintenance of laboratory equipment and tools be remedied.

Hypothesis 1: There is no significant difference in the mean ratings of Science Education technologists and Technology and Vocational Education technologists on the effective maintenance strategies for improving maintenance of laboratory equipment and tools.

Table 5: Summary of T-test for the mean responses of Science Education technologists and Technology and Vocational Education technologists on the effective preventive maintenance strategies for improving maintenance of laboratory equipment and tools

Department	N	df	t	Sig (2 tailed)	Mean Difference	Std. Difference	Error	Decision
Science Education	49	73	0.523	0.601	0.33308	0.63626		NS
Technology and Vocational Education	26							

Table 4 shows the t-value at 0.05 level of significant and 73 degree of freedom is 0.523 with a significant value of 0.601. Since the significant value of 0.601 is more than the 0.05 level of significant, the null hypothesis is not significant. This indicates that there is no significant difference between the mean ratings of Science Education technologists and Technology and Vocational Education technologists on the effective preventive maintenance strategies for improving maintenance of laboratory equipment and tools, thus the null hypothesis was accepted.

Discussions

The result in Table 1shows that the cluster mean rating of technologists in the items is above the mean benchmark of 2.50. These indicate that the technologists agreed. Therefore, the cluster mean of 3.86 shows that the technologists have a positive agreement on the identified effective preventive maintenance strategies for improving maintenance of laboratory equipment and tools. This agrees with the view of Ezeji (2016) which stated that it would be a wise use of time for institutional maintenance workers to perform routine task such as cleaning, lubricating or adjusting tools. Most importantly, the students should be learning how to perform many of these tasks, since they will be part of their job responsibilities once they become employed on their own. Lubricating of equipment should be carried out on a daily basis. This will help to reduce friction, wear and corrosion of equipment.

Table 2 shows that the cluster mean rating of technologists of Science Education and Technology and Vocational Education in the items is above the mean benchmark of 2.50. This however indicates agreed. Therefore, the cluster mean of 3.74 shows that the technologists have a positive agreement on the identified effective correction maintenance strategies for improving maintenance of laboratory equipment and tools. The findings support the view of Uzoagulu (2011) that the functionality of equipment and their availability can only ensure prompt maintenance.

The outcome in Table 3 shows that the cluster mean rating of technologists in the items is above the mean benchmark of 2.50. This however indicates agreed. Therefore, the cluster mean of 4.00 shows that the technologists have a positive agreement on the identified problems affecting the effective maintenance of laboratory equipment and tools. This finding is in line with Olorunselu (2016) that there is need for electricity supply. Most of the equipment imported for laboratory use can only be powered by electricity. The schools in rural areas without sufficient electricity supply will not benefit from such equipment and tools. The problem of adequate power supply to operate that equipment in the workshops is not peculiar with rural areas, but Nigeria in general.

The result in Table 4shows that the cluster mean rating of technologists in the items is above the mean benchmark of 2.50. This however indicates agreed. Therefore, the cluster mean of 3.74 shows that the technologists have a positive agreement on the solutions to the problems affecting the effective maintenance of laboratory equipment. This agrees with the view of Lawal (2010) that special attention must be

given to regular training and retraining on the skill of maintenance personnel. Seminars, workshops and conferences on the importance of maintenance should be organized for the technologists. With the changing of technology, it is imperative that all technologists involved in workshops and laboratories keep up to the latest workshop practices.

Conclusion

The study concluded that there is need to adopt proper maintenance culture in laboratories and workshops of tertiary institutions. Relevant training and retraining on equipment and tools maintenance should be encouraged and not neglected by the university authorities. This will enable the technologists to improve on their knowledge and maintenance skills. Students should equally be taught on the proper maintenance culture. If these measures are adopted and implemented it will improve the maintenance of laboratory equipment and tools in tertiary institutions.

Recommendations

The following recommendations were made:

1. All laboratory attendants should be sent for equipment maintenance training through seminars, workshops, conferences for effective preventive strategies.
2. Funds should be made available by the government to the university's management for effective maintenance of the equipment and tools.
3. Maintenance should be done on these equipment and tools constantly to prevent both damage and complete breakdown.
4. Maintenance should be carried out as soon as minor faults are detected.
5. Workshops and laboratories should be supplied with constant electricity for effective use of laboratory equipment and tools. Big electric generators should also be made available.
6. Sufficient number of competent laboratory technologists should be employed.
7. University management should train and retrain technologists to acquire relevant maintenance skills.

REFERENCES

Adenayi A.A & Sanni S.A (2004). Indigenous Technological Capability (TIC) Building and Improving Maintenance effectiveness: a case study of the manufacturing industry in Nigeria. *International Journal of Technological Innovation, Entrepreneurship and Technological Management,* 8(3), 6-9.

Anyakoha. E.U. (2004). *"Towards effectiveness management and utilization of food and nutrition laboratory for effective skill development in Nigeria secondary schools in Austere times".* A Paper Presented at the 13th Annual National Convention of the University of Nigeria, Nsukka.

Dervistotis, K.N. (2011). *Maintenance System Reliability Operations and*

Operation Management. London: Rinehart and Winston

Ezeji, S.C.O.A (2016). *"Management of Material Resources through the Maintenance". A Challenge for Indigenization of technical Equipment.* A Paper Presented at the National Conference on management of Technical Education in Nigeria. Strategies for the Implementation of the relevant Provision of National Policy on Education Held at the Anambra State Polytechnic Oko.

Gelberg, J.C. (2014) How to Set up a Sound Shop Maintenance. *Journal of Vocational Education,* 2(3), 1-12.

Lawal, G.O. (2010). Maintenance Cultural: The Nigeria Situation. *Nigerian Journal of Engineering Management,* 1(4), 1-12.

National Center for Research in 'Vocational Education (2007). *Manage Vocational laboratory.* Columbus; Ohio State university.

Ogbuanya. E.C (2011). *"Development of a System for the Maintenance of Technical College Equipment".* Unpublished Ph.D Thesis, Department of Vocational Teacher Education, University of Nigeria Nsukka.

Olaitan, S.O. (2003). *"The Role Maintenance Culture in the Economic Development in Nigeria".* A Paper Presented at the Convocation Ceremony. Federal Polytechnic. Idah, Benue State.

Orikpe, L.A (2011). Maintenance Culture and Instructional Materials, Nigeria Vocational Association.

Summer, K. (2009), "Strategic Management GM105" https://www.csus.ed

Swoden, A.M. (2000). *"The Approach to Maintenance". In Swoden, A.M. (ed), the Maintenance of Brick and Stone Masonry structure.* London: E& F-N Spon.

Umeh-Idika, A & Okpala, J. Strategies for improving maintenance of laboratories equipment for effective service delivery in Universities in Abia State. *Nigeria Journal of Home Economics,* 10(7), 324-332

Uvia, S.A (2016). *"Problems of Maintenance in Secondary School".* Unpublished Thesis, Department of Vocational Teacher Education, University of Nigeria Nsukka.

Uzoagulu, A. E (2011). *"The Role of Maintenance Culture in the Economic Development of Nigeria".* A Paper Presented at the 8th Convocation Ceremony of the Federal Polytechnic Idah.

Wild. R. (2015). *Maintenance and Replacement: Essentials of Production Theory and Problems.* New York: McGraw-Hill Book Co.