Evaluation of the Performance of Electrical and Electronics Engineering Graduates on the Job Tasks of Maintenance in Industries in North Central Nigeria

Usman, G. A., Ma'aji, A. S., Bukar, B., & Atsumbe, B. N.
Department of Industrial and Technology Education,
Federal University of Technology, Minna
Email: garbausman@futminna.edu.ng, Mobile: 08035989208

Abstract: *The study evaluated the Performance of Electrical and Electronics Engineering graduates in the job task of maintenance of systems in industries in North Central states of Nigeria. One research question was answered and one null hypothesis tested at 0.05 level of significance guided the study. The study adopted Cross Sectional Survey research design. The population of the study consists of 957 Electrical and Electronics Engineering graduates, their supervisors and their peers. A 20 – item questionnaire developed by the researcher, validated by three experts was used for data collection. The reliability coefficient of the instrument was determined through Cronbach's Alpha correlation coefficient and the result of the reliability was 0.88. Mean and standard deviation were used for answering the research question and one-Way Analysis of Variance (ANOVA) was used for testing the hypothesis. The study revealed that the graduates performed good in the job tasks of maintenance of systems. The hypothesis tested was accepted. Thus, there was no significant difference in the mean ratings of the supervisors, the graduates of Electrical and Electronics Engineering and their peers on the performance of the graduates in the job tasks of Maintenance of Systems. The study concluded that the graduates performed well in industries; as such universities could continue to use the present curriculum for now. It was therefore recommended among other things that Management of Universities should consolidate and strengthen further their curriculum implementation strategies.*

Keywords: Performance, Evaluation, Electrical and Electronics, Engineering graduates, Maintenance

Introduction

The prosperity of any nation depends to a large extent on the availability of human and material resources, possession of understanding of the behaviour of the elements of nature and a means for harnessing their perceived advantages for benefit of mankind. This explains why the developed nations of the world achieved their status by the emphasis they gave to engineering which is concerned with resource use and its effective management (Wara, 2011). Engineering, according to Kiddle (1990), is the art or science of utilizing the principles, forces, properties and substances of nature in the production, manufacture, construction, operation and use of the things, means, methods, machines, devices and structure.

Engineering could therefore mean in simple terms the professional art of applying science to the optimum conversion of natural resources to the benefit and welfare of man without causing harm to the environment. The Federal Republic of Nigeria (FRN, 1992) stated that the practice of engineering includes any professional service or creative work requiring the application of special knowledge of mathematics, physics, and engineering in form of consultation, invention, discovery, valuation, research, and teaching in recognized engineering institutions.

Electrical and Electronics Engineering is considered as one of the programmes offered in Nigerian Universities for the purpose of producing graduate engineers with adequate skills to be able to meet up with the demands of the industry. One of the specific objectives of Electrical and Electronics Engineering programme in the universities among others, as stated by National Universities Commission (NUC, 2007) is to enable students to acquire skills in the Installation and maintenance of simple and complex engineering systems so that they can perform optimally in our environment.

For the purpose of realisation of this objective, it becomes imperative to look into the curriculum. Curriculum is defined as all the intended learning goals, experiences, teaching materials and evaluation techniques which evaluators plan and/or use in which students are engaged in, under the direction of the school (Oranu, 1996). A curriculum is structured into four main components: General Education, Professional courses, Professional Related courses and Student Industrial Work Experience Scheme (SIWES) run on a modularized system, (course unit system). All courses are taught and examined within a semester. Credit weights are attached to each course. Courses offered in the first two years of the five-year programme are common to all Engineering students and covered the basic sciences and introductory courses in various branches of engineering.

Courses in the third, fourth years provide an in-depth knowledge and skills in all areas of Electrical and Electronics Engineering. It follows therefore that Electrical and Electronics Engineering curriculum as used in the universities was designed to prepare the graduates for employment in industries. The Association of Graduates Careers Advisory Services, (AGCAS, 2010) stated that the graduates of Electrical and Electronics Engineering are expected to perform well in the job tasks of maintenance amongst others. They could also be self-employed persons or work in government agencies.

Maintenance of engineering systems is actions necessary for retaining or restoring a piece of equipment, machine or system to the specified operating condition to achieve its maximum useful life. Maintenance includes: Breakdown maintenance where the maintenance staff carry out maintenance work only after the machine breaks down; Preventive maintenance which is a daily maintenance routine involving cleaning, inspecting, oiling, retightening and so on. Corrective maintenance improves equipment and its components so that preventive maintenance can be carried out reliably.

However, in recent times, factors such as technological advancement in Electrical and Electronics Engineering field in the area of equipment, tools and work processes are raising concerns about the relevance of the training received by the graduates in the universities. Some of these developments include the inventions of modern training and equipment, like the use of multifunction electrical and electronic test and measuring instruments. (Electronic Devices Corporation (EDC, 2012).

Even though these advancements are not reflected in the Electrical and Electronics Engineering Curriculum, the researcher assumed that the SIWES will take care of the skill gaps. However recent observations by experts, such as, Ndukwe (2010) revealed that most of the Electrical and Electronics Engineering graduates produced have not been able to perform the tasks for which they were assigned. Industrialists, scholars, researchers and the society continue to wonder what was responsible for the inadequacies observed on engineers produced. The researcher raises the question of whether it is a faulty curriculum, or lack of adequate facilities or improper orientation by the lecturers while in the university. It therefore becomes absolutely necessary that once a developed curriculum is implemented in schools, appropriate evaluation should be carried out from time to time to examine its relevance to the needs of the employer. Okoro (2000) indicated the reasons for conducting evaluation to include: Needs of the individual, society or government for change from time to time thereby necessitating changes in the curriculum, New technologies and processes are discovered, necessitating the need for schools to teach new knowledge and skill for the new challenge, and when graduates of a programme or school are not getting employment. The evaluation in this regard is to ensure that funds are not wasted in the provision of education.

Stufflebeam (2000) defined evaluation as a study designed and conducted to assist in passing judgement of merit or worth. Evaluation is an elastic word that stretches to cover judgment of any kind. Therefore, evaluation for the purpose of this study is passing judgement of worth on the impact of the curriculum through performance evaluation at work settings or industries. Mertens (1998) defined performance evaluation as the systematic investigation of the merit or worth of the performance of individual for the purpose of ascertaining the effectiveness of an educational curriculum. Sarah (2010) identifies purposes of performance evaluation to include: course improvement, decision about individuals and administrative regulations. Other purposes are to secure the basis for making judgments at the end of a period of operation. Therefore, the purpose of performance evaluation in the context of this study is to find out the performance of the Electrical and Electronics Engineering graduates in the task of maintenance of systems in the industries.

There are many different types of performance evaluation depending on the aspect or area and the purpose of the evaluation. The most important basic types are formative, summative and ultimate. In other words, ultimate evaluations are conducted when graduates of a programme are working to determine the extent to which the objectives of the programme have been satisfactorily achieved. It is concerned with the impact of the programme on the graduates by following them up to their places of employment.

This study focused on the ultimate type of evaluation, because it is aimed at evaluation of the performance of Electrical and Electronics Engineering graduates in the task of maintenance of systems in industries. This is done through ultimate or follow-up study. Peter, Howard and Mark (1999) stated that ultimate or follow-up studies are undertaken to find out whether interventions actually produce the intended effects. It is therefore the most appropriate to be used.

Performance evaluation can be done by anyone familiar with a person's performance in the workplace such as mangers; this is done on the assumption that the manager is the most qualified person to evaluate the employee's performance fairly. Supervisors; can assess the staff under their supervision. Subordinates; this is done where subordinates rate the supervisors in order to make their organizations less hierarchical and to develop better managers. Peers; peer evaluation is done where the other work group members do by assessing their colleagues. Customers; Evaluation by customers and clients may give a clear view of certain behaviours. Self-evaluation is giving the employee a chance to evaluate himself; this study used the supervisors, the graduates themselves and peers of the graduates to evaluate the performance level of Electrical and Electronics Engineering graduates.

Experts such as Olaitan and Ali(2006),Olaitan (2003),Mama(2002) and Nwachukwu (1998)observed that in performance evaluation, the use of appropriate models have been emphasized by experts because it provides a general guide that can be adapted or modified to suit specific programmes being evaluated. There are several models of curriculum evaluation. This study adopted the Tyler's Objective-centred model of curriculum evaluation as most relevant. The key emphases of the Tyler's model are: Specifying objectives of the programme, collecting performance data and comparing performance data with the grading systems of the universities specified. In the context of this study, it means translating the objectives of Electrical and Electronics Engineering into job tasks using supervisors, graduates of Electrical and Electronics Engineering and their peers to collect performance data, analyse the data collected by comparing with NUC grading systems for the purpose of making judgements. Tyler's model of evaluation has several advantages. It is relatively easy to understand and apply. It is rationale, systematic and focuses attention on curricular strengths and weaknesses.

In the context of this study an industry could mean any organisation where Electrical and Electronics Engineering graduates find employment to carry out job tasks of some or all the contents of the objectives as specified in the NUC benchmark. Industrial performance means the act of carrying out or accomplishing the job tasks assigned to the graduate in the workplace. It is also the way and manner in which the graduate does a job, judged by its effectiveness. It is against this backdrop and considering the fact that the Electrical and Electronics Engineering curriculum as has been used in the universities to ascertain its appropriateness to the needs of the industries, that this study on the evaluation of the performance of Electrical and Electronics Engineering graduates of universities in the industries was carried out.

Statement of the Problem

Electrical and Electronics Engineering programme in Nigerian universities was designed to produce competent graduates who possess skills and perform very well on the job tasks on Maintenance of electrical systems among others, (NUC, 2007). In addition, they should have good professional judgement and also be able to take responsibility for the direction of important tasks, manage people, funds, materials and equipment, (Adedokun, 2011). In order to achieve these objectives, the graduates were exposed to the rigours of the training in the institutions to meet the demand of employers. They undertook Students Work Experience Practice (SWEP) at the end of their second year and 24 weeks of Students Work Experience Scheme (SIWES) training in industries during the second semester of their fourth year.

Every society needs efficient and well-trained workforce to move the economy forward. Okorie (2001) observed that Government had invested much funds in the area of facilities and infrastructure, yet there is no significant impact on the side of the graduates. He further stated that there are inadequacies in the area of employer rating and proper supervision, which might subsequently prevent the trainers from putting in their best and improve their skills.

These researches were carried out in other Engineering disciplines there is no available evidence of any study that was carried out to evaluate the performance of Electrical and Electronics Engineering graduates in industries in North Central States of Nigeria.Ogwo and Oranu (2006) suggested that ultimate evaluation of the performance of graduates was necessary in order to identify grey areas of the programme that require improvement or otherwise. Therefore, the paucity of research data on the relevance of the curriculum in Electrical and Electronics Engineering in producing graduates who are skilled in carrying out the job tasks of maintenance in the industry raises the need for this study which is posed as a question. What is the performance of Electrical and Electronics Engineering graduates on the job tasks of maintenance in industries in North Central States of Nigeria?

Research Question

The research question answered in the study was; What is the performance level of Electrical and Electronics engineering graduates on the job task of maintenance of engineering systems in industries?

Hypothesis

This null hypothesis guided the study and was tested at 0.05 level of significance;

HO_1: There is no significant difference in the mean ratings of the supervisors, graduates of Electrical and Electronics Engineering and their peers on the graduates' level of performance on the job task of maintenance of engineering systems in industries.

Methods

The study adopted the use of Cross-sectional survey research design. According to Fredrick and Larry (1985), Cross sectional research survey design involves using different groups of people who differ in the variable of interest but share other factors and characteristics, such as socioeconomic status, educational background and qualification.

The study was conducted in all the six states in North Central geo-political zone of Nigeria comprising of Benue, Kogi, Kwara, Nassarawa, Niger and Plateau States as well as the Federal Capital Territory (FCT). North Central states are bordered in the North by Kaduna state, in the south by Edo State, in the west by Republic of Benin and in the East by Taraba state. North Central states lies between latitude 7^0 North and longitude 8^0 east. North Central states of Nigeria are within the Sub region of the Savannah. The choice of North Central states of Nigeria was necessitated by the fact that there exist relevant industries that employed Electrical and Electronics Engineering graduates. Furthermore, there are universities in the area that also train Electrical and Electronics Engineering graduates.

The population for this study was 957 respondents, comprising of 351 supervisors, 351 graduates and 251 peers of Electrical and Electronics Engineering. The whole population was used; thus, no sampling was done.

The instrument used for data collection was a structured questionnaire titled: "Evaluation of the Performance of Electrical and Electronics Engineering Graduates on the Job Tasks of Maintenance in Industries Questionnaire." (EPEEGJTMIQ). The instrument was developed by the researcher using data obtained from the objectives of the study. The objectives of the programme were translated into job tasks of maintenance in industries.

The draft instrument was subjected to face and content validation by experts. Copies of the draft rating instrument with the purpose of the study, research questions and hypothesis were given to three validates in the Department of Industrial and Technology Education, Federal University of Technology, Minna and one each to engineers in Scientific Equipment Development Institute-Minna and Rural Ceramics Industries, Suleja in Niger state.

In order to determine the reliability of the instrument a pilot test was carried out on 43 respondents in 10 industries in Kaduna and Kano States. The instrument was administered to a sample of 16 supervisors, 27 graduates. These states did not form part of area of the study. The correlation coefficient of the instrument using Cronbach's Alpha (α) Reliability Coefficient was found to be 0.88.

The researcher administered the instrument through personal contacts with the respondents and with the help of 14 research assistants in all the states under study. The research assistants from all the states under study were given copies of the instruments containing the instructions on how to fill the instrument. 957 instruments were distributed by the researcher and the research assistants. A total of 813 correctly filled instruments were collected back, which comprised of the supervisors and Electrical and Electronics Engineering graduates thereby giving 84.95% returned.

The data collected from the respondents were analysed using mean, standard deviation and One-Way Analysis of Variance (ANOVA) statistics. Mean and standard deviation were used in answering the research question and the ANOVA was employed in testing the hypothesis. The responses on the instrument items was analysed using 5-point rating scale by assigning values as in the limit of numbers given below. A probability of 0.05 level of significance was adopted for testing the hypotheses. Results from the data of this study was analysed using the Computer Statistical Package for Social Sciences (SPSS).

To interpret and make decision on the findings of the study, the following guidelines were adopted. The mean of each item was interpreted in relation to the real limits of numbers on the scaling points in Table1 as presented by Spiegel, (1972).

Table 1
Real Limits of Numbers

	Nominal Scale	Scale Real Limit of Numbers
5	Excellent	4.50 5.00
4	Very Good	3.50 – 4.49
3	Good	2.50 – 3.49
2	Poor	1.50 – 2.49
1	Very poor	1.00 – 1.49

(Source: Spiegel, 1972)

The standard deviation was calculated to find the closeness or otherwise of the items in relation to the respondents. The hypothesis for the study was tested using One-Way Analysis of Variance (ANOVA) considered the most appropriate method of analysis for comparing means of more than two variables. When the null hypothesis was calculated, where the P value was compared with alpha at 0.05. Such that where the P value (F-critical) is greater than alpha at 0.05, the null hypothesis was accepted, whereas when the P value (F-critical) is less than alpha at 0.05 the null hypothesis was rejected.

Results

Research Question
What is the performance level of Electrical and Electronics Engineering graduates on the maintenance of engineering systems in the industries?

Table 2
Mean Ratings of Respondents on the performance level of Electrical and Electronics Engineering Graduates in the job tasks of maintenance of engineering systems in the industries.

S/N	Job Tasks	X_A	SD_A	Remarks
	Ability to:			
1	Carry out troubleshooting operations effectively	3.34	1.35	Good
2	Plan a routine maintenance schedule.	3.30	1.38	Good
3	Observe routine maintenance schedule	3.78	1.33	V.Good
4	Inspect completed installations and observe operational and safety standards	3.34	1.30	Good
5	Identify the type of maintenance required and carry it out	3.46	1.28	Good
6	Inspect facilities and equipment for regulatory compliance	3.71	1.34	V.Good
7	Dismantle, repair and assemble equipment.	2.80	1.38	Good
8	Determine causes of operating errors and decides what to do about it.	3.73	1.30	V.Good
9	Adhere to safety requirements.	3.75	1.34	V.Good
10	Conduct performance testing on equipment and systems	3.38	1.34	Good
11	Compile data and write reports regarding maintenance problems	3.71	1.38	V.Good
12	Inspect completed installations and observe operational and safety standards.	3.28	1.29	Good
13	Perform safety inspections in industrial or repair setting	3.41	1.33	Good
14	Identify indicators of systems performance and the actions needed to improve or correct performance.	3.57	1.34	V.Good
15	Inspect transformers and generators for efficiency in their operations.	3.71	1.26	V.Good
16	Test equipment and keep records of the information the test reveals.	3.74	1.27	V.Good
17	Offer recommendations when equipment is determined to be less efficient than desired.	3.58	1.34	V.Good
18	Make sure that completed works meet specification and safety standards	2.91	1.33	Good
19	Perform routine maintenance on equipment and installations to determine when and what kind of maintenance is needed	3.64	1.39	V.Good
20	Test equipment appropriately	3.73	1.34	V.Good
	GRAND MEAN	3.47	1.33	Good

KEY: X_A = Mean of Respondents, SD_A = Standard Deviation of Respondents,   GM = Grand Mean

Table 2 shows the performance level of Electrical and Electronics Engineering graduates in the job task of maintenance of engineering systems in the industries. This revealed that the mean for items 3,6,8,9,11,14,15,16,17,19, and 20 are rated as very

good while items 1,2,4,5,7,10,12,13 and 18 are rated as good. This showed that the performance level of the graduates in those job tasks is good. Generally, the grand mean of the responses is 3.47 which showed that the graduates performed good in those job tasks. The Standard Deviation of the items ranges from 1.26-1.39 indicating that the respondents of the research question were also not far from one another in their responses.

Hypothesis
There is no significant difference in the mean performance ratings of the supervisors, the graduates of Electrical and Electronics Engineering and their peers on the graduates' performance on the job tasks of maintenance of engineering system in the industries.

Table 3
One - Way Analysis of Variance Of (ANOVA) Of Mean Performance Ratings of Respondents on the Electrical and Electronics Engineering Graduates' performance level on The job Tasks Of Maintenance of Engineering System In the Industries.

Source	SS	Df	MS	F	P	Decision
Between Groups	2.375	2	1.188	0.666	0.514	Accept
Within Groups	1444.865	810	1.784			
Total	1,447.24	812				

Table 3 indicates that the p value of 0.514 is greater than alpha= 0.05, there is therefore a good reason to accept the null hypothesis. This mean that there is no significant difference in the mean performance rating of the supervisors, the graduates of Electrical and Electronics Engineering and their peers on the Graduates' performance on the job tasks of maintenance of engineering systems in the industries.

Findings of the Study
The findings of the study are as follows:

1. The level of performance of graduates of Electrical and Electronics Engineering in carrying out job task of maintenance of engineering systems in the industries is good.

2. There was no significant difference in the mean performance ratings of the supervisors, the graduates of Electrical and Electronics Engineering and their peers on the graduates' performance on the job task of maintenance of engineering systems in the industries.

Discussion of Findings

Findings of the study as it relates to the level of performance of graduates of Electrical and Electronics Engineering, in the job task of Maintenance of Engineering systems in the industry as shown in Table 2 indicated that graduates performed well with a grand mean of 3.47. Since electrical and electronic equipment is the life wire of any industry or an organisation for its day to day running, it required a regular routine and adequate maintenance of the machines and equipment used. This study agrees with the words of Falana (2002), that "for graduates of Electrical and Electronics Engineering to perform effectively in maintenance task, there is the need for them to specialize which would help them to advance in training and knowledge in a chosen specialization". This means that the high mean rating response for the maintenance skill is an indication that it plays a very important role in any industry.

This is because no proper maintenance will take place if the staff of any firm were not knowledgeable. In a related study, Mafe (2002) identified the maintenance of electrical and electronic equipment and machines as a responsibility and requirements of engineering programme. The high response rate is an indication that the graduates have knowledge of maintenance practice right from their university training. The study agreed also with the assertion of Umele Saba, and Tsado (2011) who maintained that skills acquisition of graduates in the maintenance of electrical components, equipment and devices that were using electrical power was very necessary. They further stressed the need for the undergraduates to be more serious and work harder in the area of maintenance practice which must be demanded of anywhere they want to work.

The National Policy on Education (NPE Revised 2013) states that engineering education should prepare graduates for employment opportunities by providing them with experience in planning, repairing, supervising and controlling others in their places of work. Ability to make sure that completed works meet specification and safety standards, to dismantle, repair and assemble equipment. It could be suggested here that any maintenance work to be carried out by manufacturers, the engineers using the equipment should be fully involved in the work. The analysis as revealed by the null hypothesis three showed that there was no statistically significant difference in the mean performance rating of the supervisors, the graduates of Electrical and Electronics Engineering and their peers on the maintenance tasks carried out by the graduates in industries as indicated in Table 3. Olabanjo (1997) asserted that the greatest treasure that Nigeria needs to hold properly was the skills acquisition of her citizenry which will subsequently help Nigerians in the area of Maintenance, therefore, this finding has validated the relevance of the curriculum contents and training to the needs of the study.

Conclusion

It was concluded that the performance of Electrical and Electronics Engineering graduates in industries as it relates to the job tasks of maintenance of engineering systems are appropriate and satisfactory. It was discovered that the performance level of the graduates based on the responses of the supervisors, the graduates themselves and their peers showed that there was no statistically significant difference in the mean performance ratings of the graduates in all the identified skills. It therefore showed that the curricula of Electrical and Electronics Engineering programme are effective in providing employability skills needed by industries.

Recommendations

The following recommendations were proffered in order to sustain and strengthen the implementation of the Electrical and Electronics Engineering programme on maintenance of systems in the Universities.

1. Management of Universities should consolidate and strengthen further their curriculum implementation strategies on maintenance of systems in the provision of employability skills to Electrical and Electronics Engineering students.

2. National Universities Commission should review the curriculum of Electrical and Electronics Engineering every five years to strengthen the maintenance contents in line with technological development.

3. Collaborations between universities and industries should be enhanced in the area of SIWES training on modern practical training facilities.

4. Staff internship programme should also be enhanced to the industries in order to update their maintenance knowledge and skill on technological breakthrough.

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