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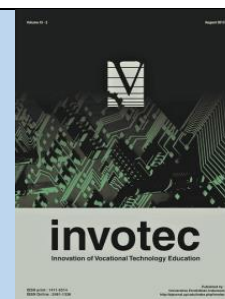
ELECTRICAL DESIGN AND DRAFTING SKILLS NEEDED BY POLYTECHNIC GRADUATES FOR EMPLOYMENT IN THE OIL AND GAS INDUSTRY IN NIGER-DELTA, NIGERIA

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A R T I C L E   I N F O

A B S T R A C T

The study was carried out to assess the skills required by polytechnic graduates for employment in the oil and gas industry in Nigeria's Niger-Delta region. A descriptive survey was used for the study, whose population comprised 1404 oil and gas industry workers in the Niger-Delta, Nigeria. Purposive sampling technique was used to select from the population, 27 electrical supervisors and 62 electrical graduates as the study sample. One research question and one hypothesis guided the study. A 35-item structured questionnaire designed by the researchers and titled "Electrical Design and Drafting Skills needed by Polytechnic Graduates Questionnaire (EDDSPGQ)" was used to collect information from the respondents. The EDDSPGQ was designed based on the 5-Likert Scale. The instrument was face and content-validated by two industry-based electrical supervisors and another expert in measurement and evaluation. The instrument's reliability was established via the Cronbach alpha method, having yielded a coefficient of 0.83.A mean was used to answer the research question; standard deviation was used to ascertain homogeneity in the responses of the respondents; and a t-test was used to test the hypothesis at a 0.05 level of significance. The study reveals that electrical and electronic graduates need to develop skills in drafting point-point diagrams, control circuits of an automatic re-closure scheme, star-delta starters and three-phase line-in diagrams. Consequently, it was recommended, among others, that the Government should provide modern training facilities in polytechnics as well as make SIWES more effective for the quality skills development of engineering students in preparation for employment in the oil and gas industry in Nigeria upon graduation.

1. Introduction

1.1 Significance of the main topics

The petroleum industry in Nigeria came into existence due to the detection of petroleum in 1956 by the Shell Group. Since then, the oil and gas industry has grown rapidly and has a well-defined organisational structure (Nigerian Oil & Gas Industry Brief, 2014).Structurally, the petroleum industry (also known as the oil and gas industry) is categorised into four major divisions, which are the upstream, downstream, midstream, and service sectors, respectively.

The Nigerian Oil & Gas Industry Brief (2014) reports that the upstream sub-division is characterised by exploration and production of petroleum resources. This subdivision was regarded as the most important of all as it serves as the mainstay of the nation's economy, providing over 90% of the country's exports. Furthermore, this all-important sector supplies about 80% of the total revenue accrued to the Nigerian Government. The second division of the petroleum industry, which is known as the downstream segment specializes in filtering raw materials gotten from the upstream in which major activities include filtering of crude oil and purifying of natural gas, whose end products are distributed to the consumers in various forms, among which are diesel oil, gasoline, natural gas, heating oil, lubricants, petrol, kerosene, jet fuels, asphalt, liquefied petroleum gas and other forms of petroleum products. The midstream sector operations cover the treating, loading, publicising and shipping of petroleum resources from one location to another. The oil services sector is vested with the responsibility of providing exploration and backing services, production support services, drilling services, banking services, catering services and communication services for the petroleum business in Nigeria. Therefore, the significance of the service sector in the petroleum business in Nigeria cannot be overemphasized. As a result, the African Export Import Bank estimated that oilfield services generate approximately 90% of the total charge for producing an oil container, translating into a total bulk of approximately thirty billion United States dollars (USD) annually for African countries producing oil (Dagogo, 2014). For Nigeria, the market size ranges approximately between 8 billion USdollars and 10 billion US dollars annually (Kupolokun, 2004). Oilfield services estimated at 800 million USD and 1 billion USD are usually given out as contracts annually to local firms, with the majority of the leftovers being assigned to giant foreign multinational oil service firms operating in the country (UNCTAD, 2006).

The oil and gas industry has gained prominence since the discovery of petroleum in the Niger-Delta, Nigeria. It is an established fact that oil and gas contribute significantly to Nigeria's foreign earnings. According to Chinweze et al. (2012), Nigerian oil and gas industrial operations yields much revenue to the Nigerian government, thereby serving as the prime mover of the nation's economy. Although the industry served as the mainstay of the nation's economy, it was largely dominated by foreigners (Nigerian Oil & Gas Industry Brief, 2014) due to the poor acquisition of relevant industrial skills by local graduates. This situation aggravates graduates' unemployment in Nigeria as there is presently a mismatch between the skills acquired by graduates and those needed by the oil and gas and related industries for productive work.

What electrical design and drafting skills are required of polytechnic electrical and electronic graduates for employment in the Niger-Delta oil and gas industry in Nigeria?

There is no significant difference in the mean responses of electrical supervisors and graduates on electrical design and drafting skills needed by polytechnic electrical/electronic graduates for employment in oil and gas industry in Niger-Delta, Nigeria.

Therefore, the main purpose of the study is to assess the electrical design and drafting skills needed by polytechnic electrical/electronic graduates for employment in the oil and gas industry in Niger-Delta, Nigeria". Thus, the menace of graduates' unemployment due to poor acquisition of relevant industrial skills necessitates this study titled "Electrical Design and Drafting Skills needed by Polytechnic Graduates for Employment in the Oil and Gas Industry in Niger-Delta, Nigeria".

2. Literature Review

Unemployment, which characterises a situation in which people (especially young graduates) who are actively seeking jobs can not secure any, is a prevalent condition in the Niger-Delta and Nigeria as a whole. Unemployment describes a situation where employable individuals are actively seeking opportunities but are unable to find any. The menace of graduates' unemployment is experienced in almost all sectors of the nation's economy (Owo, 2021). Unemployment and its effects on Nigerian graduates have become a great issue of concern to all Nigerians, irrespective of class, as most tertiary institutions keep producing fresh graduates every year, which further increases the number of people seeking employment in Nigeria (Sodipo, 2014).

To further buttress this point, the Industrial Training Fund (ITF) reports that the majority of Nigerian graduates from tertiary institutions are unemployed due to a lack of skills acquisition relevant to industrial work. Thus, skills acquisition by electrical and electronic engineering graduates is crucial if the graduates must secure job placements in the petroleum industry.

Polytechnic graduates in electrical/electronic engineering are Higher National Diploma (HND) graduates who specialised in any aspect of electrical/electronic engineering, such as electrical power, electrical machines, electrical measurement and control, electrical maintenance and repairs, digital electronics, analogue electronics, and so on. The various areas of specialisations in electrical and electronic engineering are taught in theory and practice to foster the acquisition and development of relevant knowledge and skills built on the principles of electricity and electromagnetism (Owo, 2020).

Skills acquisition is crucial for effective performance in the world of work. Skills, as defined by Samuel (2017), are special traits gained through effective training and practise by an individual or group of peoplein a given career. A skill entails any current, visible competence exhibited by someone to achieve a scholarly psychomotor action (Harlin et al., 2007). Consequently, every skillful action requires the quality use of acquired knowledge and competence for the achievement of set objectives. Similarly, Lindner & Dooley (2002) describe skill as the capability to accomplish

proficiently a noticeable action or conduct that produces visible results. Acquiring relevant electrical design and drafting skills by polytechnic graduates can increase their chances of getting employment in the oil and gas industry in Nigeria.

Electrical design and drafting comprise any act of analyzing, forecasting, and upgrading of electrical systems. Electrical design and drafting is one of the courses of instruction designed by the National Board for Technical Education (NBTE) for the HND electrical engineering programme of polytechnics in Nigeria (National Board for Technical Education, 2001). According to The Engineering Design (2016), electrical design and drafting have numerous benefits, including helping electricians to produce an elaborate design that is easy to read and interpret by engineering professionals using architectural drafting prepared in 2D and 3D drawings, showcases all areas of electrical appliances as well as electronics, and using premier drafting services can ensure proper accounting of the entire project phase to avoid the addition of new wiring schemes till the project is completed. Furthermore, the electrical diagram of a building also enables the builders and engineers to make adjustments where necessary as the entire structure is being considered and featured in the electrical drawing (The Engineering Design, 2016). Thus, electrical designs and drafting of a building plan reveal how the entire structure will appear upon completion. Electrical design and drafting is a major area where students are given adequate knowledge in various fieldsin the design and drafting of electrical systems, devices, and distribution panels (National Board for Technical Education, 2001). Consequently, electrical design and drafting engineers need skills in technical and engineering drawing, two dimensions (2D) and three dimensions (3D) drawings, problem solving, mathematical modeling, among others for employment in oil and gas industry.

3. Methods

The research design adopted in this study was a descriptive survey design. A descriptive survey study is a type of study in which data from a large sample drawn from a given population are collected and certain features of the sample observed at the time of the study which is of interest to the researchers are described without altering any independent variable of the study (Nwankwo, 2016). Thus, the independent variables of the study are not manipulated in a descriptive survey design (Akaninwor, 2014). In this study, therefore, the independent variables are design and drafting skills expected of polytechnic electricalorelectronic engineering graduates. Although there are other designs that might be considered appropriate for this study such as needs assessment survey or case studies among others, a descriptive survey design was considered most appropriate since the independent variables of the study are not manipulated but reported just as they have been observed in the course of the study. The population in the study comprised 1404 oil and gas industry workers in the Niger-Delta region, Nigeria.

A purposive sampling technique was adopted in this study to select 27 electrical supervisors and 62 electrical graduates as the study sample. Data from the respondents was collected via a structured questionnaire.

Graduates of electrical/electronic engineering technology from polytechnics are those who received standard technical training in the theories and practise of electrical engineering technology and, consequently, specialised in any one of the numerous areas of electricalandelectronic engineering, such as power system engineering, electrical machines, telecommunications, electronics, and computer engineering, instrumentation and control engineering, acoustic engineering, and automation technology. Fresh graduates of electricalandelectronic engineering from Nigerian polytechnics need to develop skills and proficiency in engineering design, technical drawing, mathematical modeling, basic engineering software like MATLAB, tool and machine usage, instrument calibration, coil winding, digital signal processing, electronic components maintenance and repair, electrical maintenance and repairs, electrical design and drafting, computer graphics, data communication and networking, electronic system design, measuring instruments, information and communication technology, logic, innovation, creativity, and among others (National Board for Technical Education, 2001). Owo & Isaac (2020) opined that electrical and electronic engineering graduates from Nigerian polytechnics should have technical skills in telecommunications, instrumentation, data and information technology, digital electronics, power system technology, electrical machines, power electronic devices, automation, control engineering, and other areas.

This becomes crucial as electrical technologists with expertise in these areas are highly needed for the implementation of the local content policy in the oil and gas industry.

As a result, fresh electrical graduates entering the oil and gas industry for a rewarding career require additional training, which is typically organised by the oil and gas industry, to gain exposure to the skills demand and safety rules applicable within the oil and gas industry work environment in order to function effectively in their roles, which include designing complex electrical systems for oil and gas facilities, carrying out electrical maintenance, and performing electrical repairs. Often times, the training and development programmes organised for electricalorelectronic entry- level positions in the oil and gas sector are administered by experienced electrical personnel called electrical supervisors.

Electrical supervisors, on the other hand, are electrical personnel who have received educational training up to the Bachelor's degree or Advanced Diploma in electrical engineering or related fields with proven years of work experience in designing and implementing work schedules for the electrical staff of the oil and gas industry; providing technical assistance to young graduates; reading and interpreting electrical design schematics to ensure proper installation of electrical systems; troubleshooting major system failures and equipment malfunctions; repairing and maintaining electrical equipment; overseeing the purchasing and maintenance of electrical equipment on-site; ensuring that electrical work is completed on schedule with appropriate code, maintaining a safe and clean work area; and consulting with builders, architects, and other professional workers on-site to ensure that quality work is being done through effective teamwork.

Therefore, for electrical supervisors working in the industry to function exceptionally, the development of technical skills such as electrical systems installation, familiarity with standard

electrical safety codes, advanced troubleshooting skills, and computer skills, among others, is indispensable. Thus, some major responsibilities of electrical supervisors in oil and gas industry are engaging in the training and mentoring of electrical staff, creation work schedules, providing of technical guidance, carrying out troubleshooting operations to fix system issues, and maintenance and repair of electrical equipment used on-site, among others. These advanced technical roles differentiate electrical supervisors from entry -level electrical graduates.

This study was conducted using data from three oil and gas industries operating in the Niger-Delta region of Nigeria. These oil and gas industries are Green Energy International Ltd., AMNI, and Total Exploration and Production. The study used only the electrical supervisors and graduates working in Green Energy International Ltd., AMNI and Total Exploration and Production because the study focused on the design and drafting skills needs of electrical andelectronic technologists for local content policy implementation in the oil and gas industry in Nigeria. Furthermore, the Niger-Delta region was chosen as the study location because it is home to several oil wells in Nigeria.

One research question and one hypothesis guided the study. A 35-item structured questionnaire designed by the researchers and titled "Electrical Design and Drafting Skills needed by Polytechnic Graduates Questionnaire (EDDSPGQ)" was used to collect data from the respondents. The EDDSPGQ was designed based on a 5-point Likert scale designated as: Strongly Agree, Agree, Undecided, Disagree, and Strongly disagree, having numerical values of 5, 4, 3, 2, and 1 respectively.

The instrument was face and content-validated by two industry-based electrical supervisors and another expert in measurement and evaluation. The instrument's reliability was established via the Cronbach alpha method, which yielded a coefficient of 0.83. The instrument was distributed to the respondents by the researchers. Out of the 89 questionnaires distributed to the respondents, only 82 were retrieved and used for data analysis. A mean was used to answer the research question; standard deviation was used to ascertain homogeneity in the responses of the respondents; and the hypothesis was tested at a 0.05 level of significance using a t-test.

In order to consider any item in the questionnaire, a decision rule established on the real limits of numbers was applied. For research questions, the decision stated that any item with a calculated mean value equal or greater than 3.50 (3.50-5.00) was agreed upon as electrical design and drafting skills needed by polytechnic electrical/electronic graduates. Furthermore, any item whose mean is greater than or equal to 2.50 but less than 3.49 (2.50-3.49) was considered undecided. For any item whose mean was less than or equal to 2.49 (0.50-2.49), such an item is rejected as a design and drafting skill needed by graduates. Standard deviation values close or wide apart indicate whether or not there is similarity in the opinion of the respondents. The hypothesis was tested at . a level of significance 0.05 using a t-test. The criteria for accepting or rejecting the hypothesis were as follows:. The hypothesis will be accepted if the calculated value of t (t_{cal}) is equal or less than the critical value of t (tcrit). Otherwise, it will be rejected.

4. Results

The findings of the study were presented based on the research question and hypothesis as follows:

4.1 Research question

What electrical design and drafting skills are required of polytechnic electrical and electronic graduates for employment in the Niger-Delta oil and gas industry in Nigeria?

Table 1. Mean responses on electrical design and drafting skills needed by Polytechnic Electrical/Electronic Graduates for Employment in Oil and Gas Industry in the Niger-Delta Nigeria

S/N	Item Statement	Supervisors (N1 = 24)			Graduates (N2 = 58)		
		$\overline{X}_1$	SD_1	RMK	$\overline{X}_2$	SD_2	RMK
1	Skills in drawing main switchgear permissible combinations.	4.41	0.51	Agreed	4.86	0.35	Agreed
2	Skills in drawing three phase line in diagram.	4.23	0.97	Agreed	4.47	0.65	Agreed
3	Skills in drafting internal distribution schemes for block of three flats.	4.81	0.40	Agreed	3.88	0.99	Agreed
4	Skills in drafting multi-storey building.	4.29	0.85	Agreed	4.53	0.51	Agreed
5	Skills in drafting layout of switchgear for office building.	4.35	0.49	Agreed	4.61	0.49	Agreed
6	Skills in drafting layout diagram for factory distribution system.	4.59	0.51	Agreed	4.31	0.67	Agreed
7	Skills in drafting an industrial cubicle switch board.	4.24	0.44	Agreed	4.50	0.65	Agreed
8	Skills in designing electrical services for bungalows.	4.41	0.71	Agreed	4.56	0.56	Agreed
9	Skills in designing electrical services for flats.	4.29	0.58	Agreed	4.72	0.45	Agreed
10	Skills in designing electrical services for estates.	4.47	0.51	Agreed	4.58	0.50	Agreed
11	Skills in drafting electrical services plan for bungalows.	4.35	0.61	Agreed	4.72	0.45	Agreed
12	Skills in drafting electrical services plan for flats.	4.12	0.70	Agreed	4.44	0.56	Agreed
13	Skills in drafting electrical services plan for estates.	4.29	0.69	Agreed	4.44	0.56	Agreed
14	Skills in drafting point-to-point diagrams.	4.06	0.75	Agreed	4.64	.54	Agreed
15	Skills in drafting baseline diagrams.	3.77	1.15	Agreed	4.25	.77	Agreed
16	Skills in drafting highway diagrams.	3.47	1.01	Undecided	4.31	0.62	Agreed
17	Skills in drafting lineless diagrams.	3.47	1.01	Undecided	4.44	0.80	Agreed
18	Skills in drafting various designs using wiring diagrams.	4.41	0.62	Agreed	4.47	0.77	Agreed
19	Skills in drawing direct fitting.	4.24	0.44	Agreed	4.69	0.46	Agreed
20	Skills in drawing semi-direct fitting.	4.00	1.00	Agreed	4.08	0.84	Agreed
21	Skills in drawing ladder diagrams.	3.71	0.92	Agreed	4.14	1.01	Agreed
22	Skills in drafting standard symbols used in ladder diagrams.	3.82	0.73	Agreed	4.08	0.97	Agreed
23	Skills in drafting the control circuit of an automatic re-closure scheme.	4.29	0.77	Agreed	4.08	0.91	Agreed
24	Skills in drafting the control circuit of an automatic safe remote system.	4.29	0.59	Agreed	4.22	0.54	Agreed

S/N	Item Statement	Supervisors (N1 = 24)			Graduates (N2 = 58)		
		$\overline{X}_1$	SD$_1$	RMK	$\overline{X}_2$	SD$_2$	RMK
25	Skills in drafting the control circuit diagram for direct-on-line starter.	4.41	0.51	Agreed	4.56	0.73	Agreed
26	Skills in drafting star-delta starter.	4.41	0.62	Agreed	4.44	0.50	Agreed
27	Skills in drafting the layout of power substation up to 11kv	4.41	0.61	Agreed	4.50	0.65	Agreed
28	Skills in drafting the layout diagram for transformer.	3.47	1.06	Undecided	4.72	0.45	Agreed
29	Skills in drafting the layout diagram for generators.	4.41	0.62	Agreed	4.58	0.60	Agreed
30	Skills in drafting the layout diagram for switchgears.	4.12	0.99	Agreed	4.69	0.52	Agreed
31	Skills in preparing bills of engineering management and materials.	4.39	0.87	Agreed	4.36	0.76	Agreed
32	Skills in preparing post contract document.	4.25	0.68	Agreed	4.36	0.76	Agreed
33	Skills in drawing bar chart for building construction.	4.06	0.43	Agreed	4.39	0.87	Agreed
34	Skills in drawing electrical contractor's chart from the main contractor's bar chart.	4.47	0.51	Agreed	4.25	0.84	Agreed
35	Skills in drafting main bus-bar system diagram serving high rise flat.	4.65	0.49	Agreed	4.36	0.64	Agreed
	Average Mean/SD	4.21	0.70		4.44	0.66	

Source: Researchers' Field Result; 2021

The result in Table 1 shows the response of electrical supervisors and graduates on electrical design and drafting skills needed by polytechnic electrical/electronic graduates for employment in oil and gas industry in Niger-Delta, Nigeria as well as their level of decision on a particular item. The result as shown in Table 1 reveals that electrical supervisors and graduates' responses show that all the 35 items are electrical design and drafting skills needed by polytechnic electricalandelectronic graduates for employment in the oil and gas industry in Niger-Delta, Nigeria with a mean value of 3.50 and above. The standard deviation values from 0.00 to 0.99 indicate that the respondents were close in their responses while standard deviation values of 1.00 and above suggest that the respondents (electrical supervisors and graduates) were far apart in their responses.

4.2   Hypothesis

There is no significant difference in the mean responses of electrical supervisors and graduates in terms of the electrical design and drafting skills needed by polytechnic electricalandelectronic graduates for employment in the oil and gas industry in Niger-Delta, Nigeria.

Table 2. t-Test analysis on electrical design and drafting skills required by Polytechnic Electrical and Electronic Graduates for employment in Oil and Gas Industry in Niger-Delta, Nigeria

S/N	$\bar{X}$	SD	N	df	α	tcal	tcrit	Remark
Supervisors	4.21	0.70	24					
				80	0.05	-1.01	1.67	Accepted
Graduates	4.44	0.66	58					

Source: *Researchers' Field Result; 2021.* Accept Ho if $t_{cal} \leq t_{crit}$, Otherwise Reject Ho.

Table 2 reveals that the calculated mean was less than the value obtained from the table. As a result, the null hypothesis was confirmed.This implies that there is no significant difference in the mean responses of electrical supervisors and graduates on the electrical design and drafting skills required by polytechnic electrical and electronic graduates for employment in the Niger-Delta oil and gas industry in Nigeria.

5. Discussion

The finding of the study, as seen in Table1, reveals that electrical design and drafting skills are needed by polytechnic electricalandelectronic graduates for employment in oil and gas industry in Niger-Delta, Nigeria, as indicated by supervisors and graduates in view of the fact that poor skills acquisition hinders graduates' employment in the oil and gas industry. This finding was supported by the Engineering Design (2016) which stipulates that electrical design and drafting are very important in the world of work as it enables students to acquire adequate knowledge and competence in the designing and drafting of electrical systems, devices, and distribution panels in the oil and gas industry. This finding further corroborates the views of Sodipo (2014), who posits that lack of skills syndrome created a gap in the graduates' knowledge which ordinarily would have been settled by the programme curriculum. This finding equally agrees with Ejiofor (2016), who submits that most Nigerian graduates from polytechnics are found to be lacking in skills, hence the need to acquire and develop relevant technical skills. Likewise, this finding shares a page with Ismail & Mohammed (2015) and Adeniyi (2015), who state that Nigerian graduates of electricalandelectronic technology do not have the relevant employability skills for employment in oil and gas industries, thereby making it difficult for indigenous polytechnic engineering graduates to be employed in the oil and industry. This finding conversely disagrees with the views of Dagogo (2014), who shows that technical college graduates already possess the technical skills needed for employment in the oil and gas industry in Nigeria.

6. Conclusion

Electrical design and drafting is one technical area in which polytechnic electrical/electronic engineering graduates need to develop skills for oil and gas industry jobs. Skills in electrical design and drafting are needed by polytechnic electrical and electronic graduates in order to contribute

effectively to the world of work. Design and drafting skills therefore enable electrical engineering graduates to take on various, technical roles in the oil and gas sector, such as the designing of industrial power systems, drafting of electrical systems, designing of electrical devices and distribution panels in oil and gas industry in Niger-Delta, Nigeria. The acquisition of these skills properly positions polytechnic graduates ahead of their university counterparts in any design and drafting roles in the petroleum industry in Nigeria, as poor skills acquisition in this area could hinder quality employment in the oil and gas industry.

7.   Recommendations

From the findings of the study, these few recommendations were suggested by the researchers:

1. The government should provide modern engineering training facilities in all public polytechnics in Nigeria for hands-on experience in electrical design and drafting.
2. The government should adequately fund TVET programmes in Nigerian polytechnics for effective manpower development.
3. The government should make the Students Industrial Work Experience Scheme (SIWES) more effective for the quality skill development of technology students.
4. The government should encourage institution-industry collaboration in the training of technology students with a view to meeting the local industry's demand for skilled technologists in Nigeria.

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