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An Assessment of the Implications of the Major Socio-economic Characteristics of the Construction Skilled Labor on Effective Delivery of Electricity Power Project in the South Eastern Nigeria

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Provision of adequate power has been a long time problem in Nigeria. It has negatively affected the socio-economic condition of the society. In an effort to address this deplorable situation, the power sector has been transformed by various political administrations from one form to another over time yet, electricity supply and delivery of Electricity Power Project (EPP) have not been effective. The study therefore seeks to improve on power supply services by way of assessing the implications of the major socio-economic characteristics of the construction skilled labor on effective delivery of EPP in the south eastern states of Nigeria. Field survey method of data collection targeted on the skilled labor of the power sector and the active electricity consumers in the study area was adopted, on a mutually exclusive order. An inferential statistical approach of polynomial regression analyses was used to establish model relationships existing between the skilled labor determinants (age of experience, availability, educational qualification, remuneration and training/retraining) as the independent variables and the different functions of effective EPP delivery (steady supply of electricity, fair charges on electricity consumption, and swift response to complaints and faults) as the dependent factors respectively. Findings show that the significant predictive (independent) variables remaining in the three final models tested for adequacy have positive influences on the

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models; with remuneration and training determinants common and strongest in their effects on the models. Age of experience and availability of the labor determinants however are in addition contained only in the model for fair charges on electricity consumption, and model for swift response to complaints and faults respectively. It is therefore recommended to all stakeholders in the power sector to align efforts with the power authority in engaging workers on need based training programmes regularly, as well as review upwards and appropriately the workers remunerations so as to boost generally the human capacity industrial base knowledge, motive and comfort; towards effective delivery of EPP in the study area.

Keywords: Electricity Power Project (EPP); skilled labor; socio-economic characteristics; effective performance; regression model.

1. INTRODUCTION

In Nigeria, electricity was first produced in Lagos in the year 1896, fifteen years after its introduction in England. Both Niger Dams Authority (NDA) and Electricity Corporation of Nigeria (ECN) were merged as National Electric Power Authority (NEPA) on April 1, 1972. In 2005 it was changed to Power Holding Company of Nigeria (PHCN) by an act of legislation. Presently, the generation and supply of electricity in Nigeria is in poor condition, not because of doubts about the resources the PHCN commands, but because of low manpower development [1]. To this effect, waste of resources, poor co-ordination, complacency and indiscipline at work places become the characteristics of the power sector.

Beside other challenges in the power sector, there is shortage of skilled manpower to maintain the power plants [2]. This appalling situation leads to lack of proper maintenance culture in line with global engineering practice. Besides, there is a total absence of effective and efficient maintenance policy in place to guide in the limited attempt in operation and maintenance (O & M) of materials and management, which may equally be attributed to lack or poor working conditions of skilled labor force.

A critical analysis of the operations of PHCN shows that it has not actually addressed manpower problems [1]. The Fourth National Development plan (1981-1985) exposed the very rapid increase in power demand at over 20 percent per annum. This makes it difficult for the installed capacity to cope with the demand by the economy.

Consequently, after a long time struggle over the years without improving significantly in EPP delivery the government through the electricity reform act of 2005 unbundled the then PHCN into eleven distribution companies, one transmission company and six generation companies. Enugu Electricity Distribution Company (EEDC) which is one of distribution companies is located in the South East (SE) geo-political zone of Nigeria covering Abia, Anambra, Ebonyi, Enugu and Imo states with headquarters at Enugu. It has the basic function of distribution, maintaining and marketing of electricity in these five states. The franchise area is subdivided into ten districts as follows: Abia, Abakaliki, Abakpa, Awka, Ogui, Onitsha, Orlu, Owerri, Nnewi and Umuahia with Aba, Onitsha and Nnewi as the major domestic, industrial and commercial centres. In this zone, EEDC installs, meters, bills and co-ordinates consumer credit services and collects revenues. These activities are anchored on effectiveness of the skilled workforces.

The services of these skilled construction labors that constitute the major component of the labor in the EPP are very significant in the effectiveness of EPP delivery. It is therefore concluded that the financial implication or utilization of labor force accounts for a significant proportion of the cost of construction projects [3]. Thus, production costs would always be reduced by either increasing the labor productivity or reducing input resources and waste in order to improve on construction efficiency [4].

In search for adequate and appropriate skilled manpower, Nigeria set up the National Power Training Institute of Nigeria (NAPTIN). It is an organ for the training of skilled manpower for the country's Electricity Power Industry. It therefore reveals that there are 8,440 skilled workers generally running Nigeria Power System [5]. This implies that there is a large gap left. NAPTIN has said that it has a yearly average intake of 250 students and this is not quite enough to move the projected 40,000 MW by 2020. Experts are of the view that the huge challenge threatening the sustainable expansion

plan by Nigeria Electricity Supply Industry (NESI) is not the finance to undertake rehabilitation and expression projects, but the dearth of standard skilled workforce to keep the sector running with minimal hitches. Consequently, In addition to this reason concluded, lack of skilled manpower in the defunct PHCN is one of the major problems that plagued the development of the Nigerian power sector [1].

Just recently, it was reported in the evening broadcast of the Nigeria Television Authority on the 22nd day of May, 2019 that with six Nigeria power plants in idle conditions, the electricity power generation falls to 2.616mw [6]. This regrettable development can be traced down to poor management of the skilled labor among other things in the system; hence the need for effective alignment of efforts from all stakeholders towards reviving the sector sustainably for improved EPP delivery.

2. RESEARCH METHODS

The study as an original work adopted a field survey research design of objective nature in the administration and retrieval of the instrument used for data collection. An inferential statistical method of data analyses was used to process the relationship between the major socio-economic characteristics of the skilled labor forces in the power sector, and the effective delivery of electricity power projects in the Southeast states of Nigeria.

The survey was carried out to find the influence of skilled construction workforce determinants (age, qualification, availability, remuneration, and training programme) on effective delivery of electricity power projects. Given the nature of this study, the population of interest is divided into two namely; the construction skill labor force of the EEDC and the active electricity consumers in the entire South East States, on the basis of mutual exclusive condition of the population.

3. DATA ANALYSIS AND DISCUSSION OF FINDINGS

For the purpose of analysis, data collected from the well designed questionnaires were transformed into multiple regression models. Thus, the multiple regression models as developed are therefore expressed as follows;

$$EDELEPP = f(AGE, QUALF, AVAIL, REM, TRAINP) \quad (1.1)$$

Effective Delivery of Electricity Power Project (EDELEPP) is an objective function (Y) depending on Age of Experience, Educational Qualification, Availability of Labor, Remuneration, and Training programmes as the independent factors. Given the nature of the hypotheses formulated therefore, the multiple regression approach was developed into the following model as;

$$EDELEPP = \beta 0+\beta 1AGE +\beta 2QUALF +\beta 3AVAIL +\beta 4REM +\beta 5TRAINP + e \quad (1.2)$$

Thus, the base model (Equ. 1.2) was therefore estimated with regard to the respective major conditions of effective delivery of EPP in the study. They are presented as follows.

$$STSUP = \beta_0+\beta_1AGE +\beta_2 QUALF +\beta_3AVAIL +\beta_4REM +\beta_5TRAINP + e \quad (2.1)$$

$$FAIRCH = \beta_0+\beta_1AGE +\beta_2 QUALF +\beta_3AVAIL +\beta_4REM +\beta_5TRAINP + e \quad (2.2)$$

$$SWIRES = \beta_0+\beta_1AGE +\beta_2 QUALF +\beta_3AVAIL +\beta_4REM +\beta_5TRAINP + e \quad (2.3)$$

Where:

STSUP = Level of Steady Supply of Electricity;

FAIRCH = Level of Fair Charge in Electricity Supply and;

SWIRES = Level of Swift Response to Complaints and Faults.

The STSUP, FAIRCH and SWIRES are functions of EDELEPP in the study.

The regression analyses generated equations that describe the statistical relationship between one or more predictive variables and the response variables, and to predict new observations. The results indicate the direction, size, and statistical significance of the relationship between the predictors and the response (objective function).

Adequacy (fitness) of the models was checked using the Fisher statistics with the criteria, $F_{cal} \geq F_t$ for fitness. In so far the confirmation of the model for fitness can never be compromised in regression analysis, F test statistic was applied to check for reliability and adequacy of the multiple regression model.

Consequently, coefficients of the independent factors contained in the model that are confirmed adequate were subjected to student 't' test to determine the strength of the individual effects of the predictive variable (determinants) of the skilled labor on the delivery of EPP in the study area.

4. DATA PRESENTATIONS AND ANALYSES

Attention is focused on the Socio-economic Characteristics of the population seeking to test the relationship between skilled construction labor force determinant (i.e. age of experience, educational qualification, availability, remuneration and training/retraining programmes of the skilled labor) and effective delivery of electricity in terms of steady electricity supply, application of a fair charge billing system and swift response to complaints and faults under the electricity power projects, EPP in Nigeria.

4.1 The Influence of Skilled Construction Labor Force Determinants on Steady Electricity Supply

In determining the relationship between the EPP labor determinants and effective delivery of the electricity power projects in terms of steady electricity supply, the following hypothesis was therefore tested.

$H0_1$: There is no significant relationship between the skilled construction labor force determinants and effective delivery of EPP in terms of steady electricity supply in Nigeria;

The result of this hypothesis is presented in Table 1. The first test carried out was the analysis of variance (ANOVA), to arrive at the F - test seeking to confirm the adequacy of the model as a whole.

Test of Adequacy for Model 1: As a decision rule if the calculated F - ratio is greater than the tabulated F - ratio or critical F - ratio, we reject Ho and accept Ha. Here, the F - ratio calculated (16.897) > F - ratio theoretical (3.02, 2.21), at 1% and 5% levels of significance respectively. Hence, we reject Ho and accept Ha, to conclude that there is a significant relationship between skilled construction labor force determinants and effective delivery of electricity power projects (EPP) under the steady supply of electricity in Nigeria.

The resulting estimated model is given as;

$$Y_{STSUPt} = 1.885 + 0.081AGE_t + 0.010QUALF_t + 0.067AVAIL_t + 0.209REM_t + 0.520TRAINP_t \quad (3.1)$$

Test of Significance of the Coefficients of the Predictive Variables:

As a decision rule**,** If the calculated t is greater than the tabulated t (DF = 214), we eliminate the variables of insignificant coefficients to conclude that the other variables belong significantly; which implies that a particular explanatory variable makes a significant contribution to the dependent variable (Y_{STSUPt}) in the south east. Here, only two (REM, and TRAINP) out of the five explanatory variables proved to be significant contributors to effective delivery of EPP under steady electricity supply in the study (i.e. 2.05, 8.56 respectively) > t - tabulated (1.96), at least at 5% level of significance. We therefore, eliminate the variables of insignificant coefficients

Table 1. Results/output of the hypothesis

Variables	Coefficients	Std error		t(df=214)	Significance
Intercept	β_0 = 1.885	0.759			
$X_1 = AGE_t$	β_1 =0.081	0.056		1.452	0.148
$X_2 = QUALF_t$	β_2 = 0.010	0.078		0.131	0.896
$X_3 = AVAIL_t$	B_3 = 0.067	0.043		1.530	0.128
$X_4 = REM_t$	B_4 = 0.209	0.102		2.050	0.042
$X_5 = TRAINP_t$	B_5 =0.520	0.061		8.560	0.000
Source	SS	Df	MS	F=16.897	0.000***
Regression	25.185	5	5.037		
Residual	63.796	214	0.298		
Total	88.982	219			

*NB: *** = significant at 1%; ** = significant at 5%; NS = Not significant. F-ratio tabulated DF (5, 214) 1% = 3.02, 5% = 2.21, t-ratio 1% = 2.58; 5% = 1.960*

Thus, R = 0.953, R^2 = 0.928, Adjusted R^2 = 0.906, Observations = 220, Predictor Variable = 5, Dependent Variable = Steady Electricity Supply

in the final model and conclude that the two explanatory variables namely remuneration and training programme proved to exert significant effects on the level of effective delivery of EPP under steady electricity supply in Nigeria.

Results from the statistical analyses carried out on adequacy of model no.1, and significance of coefficients of the predictive variables were therefore used to derive finally an appropriate model in the following expression:

$$Y_{STSUPt} = 1.885 + 0.209REM_t + 0.520TRAINP_t \quad (2.2)$$

4.2 The Influence of Skilled Construction Labor Force Determinants on Fair Charge to Electricity Consumption

In order to determine the relationship between EPP labor determinants and effective delivery of the electricity power projects in terms of fair charge in billing system. The following hypothesis was therefore tested:

$H0_5$: There is no significant relationship between the skilled construction labor force determinants and effective delivery EPP in terms of fair charge in billing system in Nigeria. The result of this hypothesis is presented in Table 2.

Test of Adequacy for Model 2: Decision Rule - If the calculated F - ratio is greater than the tabulated F - ratio or critical F - ratio, we reject Ho and accept Ha. Here, the F - ratio calculated (9.053) > F - ratio theoretical (3.02, 2.21), at 1% and 5% levels of significance respectively. Hence, we reject Ho and accept Ha, to conclude that there is a significant relationship between skilled construction labor force determinants and effective delivery EPP in terms of fair charge in billing system in Nigeria. The resulting estimated model is given as;

$$Y_{FAIRCHt} = 3.237 + 0.097AGE_t + 0.104QUALF_t + 0.030AVAIL_t + 0.423REM_t + 0.104TRAINP_t \quad (4.1)$$

Test of Significance of the Coefficients of the Predictive Variables:

The decision rule as usual explains that a particular explanatory variable or more make significant contributions to the dependent variable, ($\mathbf{Y_{FAIRCHt}}$) in Nigeria. Here, three (AGE, REM, and TRAINP) out of the five explanatory variables proved to be significant contributors to the objective function, ($\mathbf{Y_{FAIRCHt}}$) in the study. (i.e. 2.173, 5.191, and 2.13) > t - tabulated (3.02, and 1.96 respectively), both at 1% and at 5% levels of significance.

We therefore, eliminate the variables of insignificant coefficients in the final model and conclude that the other three explanatory variables namely; age, remuneration and training programme exerts significant effects on the level of the objective function, ($Y_{FAIRCHt}$) in Nigeria.

Results from the statistical analyses carried out on the adequacy of no. 2 model, and significance of coefficients of the predictive variables were therefore used to finally derive the appropriate model stated as follows:

$$Y_{FAIRCHt} = 3.237 + 0.097AGE_t + 0.423REM_t + 0.104TRAINP_t \quad (4.2)$$

Table 2. Results/output of the hypothesis

Variables	Coefficients	Std error		t(df=214)	Significance
Intercept	β_0 = 3.237	0.607			
$X_1 = AGE_t$	β_1 =0.097	0.045		2.173	.031
$X_2 = QUALF_t$	β_2 = 0.104	0.063		1.666	0.097
$X_3 = AVAIL_t$	B_3 = 0.030	0.035		0.852	0.395
$X_4 = REM_t$	B_4 = 0.423	0.082		5.191	0.000
$X_5 = TRAINP_t$	B_5 =0.104	0.049		2.130	0.034
Source	SS	Df	MS	F=9.053	0.000***
Regression	8.630	5	1.728		
Residual	40.802	214	0.191		
Total	49.432	219			

*NB: *** = significant at 1%; ** = significant at 5%; NS = Not significant. F-ratio tabulated DF (5, 214) 1% = 3.02, 5% = 2.21, t-ratio 1% = 2.58; 5% = 1.960*

Thus, R = 0.748, R^2 = 0.715, Adjusted R^2 = 0.695, Observations = 220, Predictor Variables = 5, Dependent Variable = Fair Charge Billing System

4.3 The Influence of Skilled Construction Labor Force Determinants on Swift Response to Complaints and Faults

In determining the relationship between the labor determinants and effective delivery of the electricity power projects in terms of swift response to complaints and faults, the following hypothesis was therefore tested:

$H0_6$: There is no significant relationship between the skilled construction labor force determinants and effective delivery of swift response to complaints and faults under the electricity power projects (EPP) in Nigeria. The result of this hypothesis is presented in Table 3.

Test of Adequacy for Model 3: In adopting the decision rule as usual, the F - ratio calculated (14.302) > F - ratio theoretical (3.02, 2.21), at 1% and 5% levels of significance respectively. Hence, we reject Ho and accept Ha, to conclude that there is a significant relationship between skilled construction labor force determinants and effective delivery of swift response to complaints and faults under the electricity power projects (EPP) in Nigeria. The resulting estimated model is given as;

$$Y_{SWIRESt} = 2.583 + 0.010AGE_t + 0.138QUALF_t + 0.147AVAIL_t + 0.201REM_t + 0.144TRAINP_t \quad (5.1)$$

Test of Significance of the Coefficients of the Predictive Variables:

The decision rule In this case confirms that three (AVAIL, REM, and TRAINP) out of the five explanatory variables prove to be significant contributors to the objective function ($Y_{SWIRESt}$) in the study (i.e. 2.619, 5.518, and 7.823) > t - tabulated (3.02, 1.96), both at 1% and at 5% levels of significance.

We therefore, eliminate the variables of insignificant coefficients in the final model to conclude that the other three explanatory variables namely availability, remuneration and training programme prove to exert significant effects on the level of effective delivery of EPP in terms of swift response to complaints and faults in Nigeria.

Results from the statistical analyses carried out on adequacy of no.3 model, and significance of coefficients of the predictive variables were therefore used to derive the final model in the following expression:

$$Y_{SWIRESt} = 2.583 + 0.147AVAIL_t + 0.201REM_t + 0.144TRAINP_t \quad (5.2)$$

5. DISCUSSION OF FINDINGS

All the models of the three major functions of effective electricity power project delivery are adequate in the study. Some of the determinant factors however are proven not to contribute significantly in all the models except levels of remuneration and training/retraining of the skilled workers in the power sector. Nevertheless, the contributive effects of age and availability factors of skilled labor towards effective electricity power project delivery are significant only in the models of fair charge to electricity consumption and swift response to complaints and faults functions respectively.

Table 3. Results/output of the hypothesis

Variables	Coefficients	Std error		t(df=214)	Significance
Intercept	β_0 = 2.583	0.983			
$X_1 = AGE_t$	β_1 =0.010	0.072		0.136	0.892
$X_2 = QUALF_t$	β_2 = 0.138	0.101		1.465	0.144
$X_3 = AVAIL_t$	B_3 = 0.147	0.056		2.619	0.009
$X_4 = REM_t$	B_4 = 0.201	0.132		5.518	0.000
$X_5 = TRAINP_t$	B_5 =0.144	0.079		7.823	0.000
Source	SS	Df	MS	F=14.302	0.000***
Regression	10.762	5	2.152		
Residual	107.074	214	0.500		
Total	117.836	219			

*NB: *** = significant at 1%; ** = significant at 5%; NS = Not significant. F-ratio tabulated DF (5, 214) 1% = 3.02, 5% = 2.21, t-ratio 1% = 2.58; 5% = 1.960*

Thus, R = 0.832, R^2 = 0.801, Adjusted R^2 = 0.770, Observations = 220, Predictor Variables = 5, Dependent Variable = Swift Response to Complaints and Faults

The appropriate models as derived in Eqs 3.2, 4.2 and 5.2 are therefore expressed as follows, respectively.

i. $y_{stsupt} = 1.885 + 0.209REM_t + 0.520TRAINP_T$

ii. $Y_{FAIRCHt} = 3.237 + 0.097AGE_t + 0.423REM_t + 0.104TRAINP_t$

iii. $Y_{SWIRESt} = 2.583 + 0.147AVAIL_t + 0.201REM_t + 0.144TRAINP_t$

All the contributory determinants have positive influence on all the models for efficient performance of EPP. Training/retraining determinant factor has the strongest effect on steady electricity supply of electricity than remuneration determinant factor while; remuneration factor exert the strongest effect on fair charge to electricity consumption**,** and swift response to complaints and faults than training/retraining, age and availability determinants as the case may be.

6. CONCLUSION

In respect of the subject matter, human resource today has a strategic role for increase in productivity of any organization; and this makes it superior in industrial competition [7]. With the effective and optimum use of skilled labor, all the benefits arising from increased productivity can be obtained; and it is made possible by establishing clear and understandable criteria for managing the factors affecting performance of labor in general.

In the study therefore, some socio-economic factors like Training and Remuneration especially, as well as Age of experience and Availability of the skilled labor can be used to regulate and improve the delivery of EPP. The motivation of the labor force is a necessity, because the quality of human performance depends largely on it. Thus, it is ethical that higher motivation brings higher productivity; even the smallest action that is positive or negative can have a noticeable effect on workers attitude.

Findings also show that remuneration maintains the most influential motivational factor for improved labor performances toward effective delivery of EPP in the study. In the light of this, motivation - especially monetary rather than moral - has proven its influence on the productivity of workers [8]. On the same note, it was claimed that money is the only motivator for construction workers [9]. Similarly, another study asserted that earnings related factors are predominant for motivating construction workers and operatives in a developing countries like Nigeria [10]. Besides, Money related issues as observed are most important to the Iranian workers towards improving productivity at work places [11]. The findings of all these studies therefore are in the same direction with the findings in this study for improved condition of project delivery in general.

On the other hand, training/retraining as a systematic acquisition of skills, concept or attitudes is marked as another vital motivational factor for the effective performance of the skilled labor. It served as strategy for sustaining the effective performances of workers. Most people employed in the construction industry are not already versed or skilled in all the tasks required to perform effectively. Evidence shows that training factor is next to remuneration factor in an effort to improve delivery of EPP; hence no amount of resources spent on training is a waste. Training therefore is beneficial to all stakeholders involved in the construction project for increased value and competence in the industry. EPP can use training and retraining programme that is need based to attract, develop and sustain their employees (skilled manpower) for improved delivery of electricity power project.

Without shredding words, findings and reports have therefore proven that, remuneration and training/retraining should be seen as critical among other measures, as a necessary tool for closing the gap in skilled manpower performance requirements for effective delivery of EPP in the south eastern states of Nigeria.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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