Developing Sets of Labour and Wage Rates for Appropriate Remuneration Review toward Improving 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.

Original Research Article

ABSTRACT

In an effort to address the problem of ineffective power project delivery and poor electricity supply in the south eastern part of Nigeria especially, studies on implications of socio-economic characteristics of the construction skilled labour on effective delivery of electricity in the power sector have reported that remuneration factor among others is very critical for improved electricity power project (EPP) delivery. To confirm the finding, this study therefore investigates the salary and wage rates of the construction professionals and the skilled labour in the government establishments and private firms respectively. Using activity sampling technique, the masonry (block laying) and carpentry trades in the power sector of the south east were investigated. Findings have shown that the average non productive and active times of the trades respectively are at an average ranges of 25% - 37.20% and 62.5% - 75% for the masonry trade; and average of 18.80% - 31.20% and 68.80% - 81.20% for carpentry trade respectively. The study also proves that standard times and standard outputs of the trades respectively stand at 1.37 hr/m^2 and 0.75 m^2/hr for the masonry trade; and 0.85 hr/m^2 and 1.19 m^2/hr for carpentry trade respectively. Consequently, the labour rates of the masonry and carpentry trades are estimated at 6 m^2 and 9.52 m^2 respectively. In an effort to

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compare the labour rate of the skilled workers in the EPP with those in some major private construction firms and civil service, it was discovered that labour rates of workers in EPP are lesser than the others; likewise the wage rates respectively. Although the labour rate of the skilled labour in EPP are lesser than those in the other places of work, the wage rates of the work trades in EPP are far lesser than the wage rates in the other areas of employment; hence the ratio of the wage rate to labor rates in EPP are significantly lesser than the ratios in the other areas especially, the construction firms in the study area. This study recommends therefore an establishment of a data base framework in the power sector for improved remuneration of the skilled labour that incorporates need based and certified training programme, towards effective delivery of EPP in the south east and Nigeria in general.

1. INTRODUCTION

Electricity power project delivery has remained a major problem in the South-East States (S.E.S.) of Nigeria, and Nigeria as a country. It is therefore confirmed that the size of skilled workforce needed to keep Nigeria's electric power system running is huge; and that about 17,441 skilled workers are needed to work in the power sector as the electricity market is expected to expand to about 40,000 megawatts (MW) capacity by Okafor [1]. It is however, difficult to have electricity supply at near peak presently. Beside other challenges in the power sector, there is shortage of skilled manpower to maintain the power generating plants [2]. Since shortage and low productivity of skilled manpower has been noted as a major problem in the delivery of the electricity power project and services/maintenance of the generating plants in Nigeria, effort are made to determine the socio-economic characteristics of the skilled labour affecting the power project and the plants [3]. He therefore concluded that remuneration and training determinants among other socio-economic characteristics of the skilled labour are very prominent in their contribution to effective delivery of EPP in the south eastern Nigeria.

In assessing the average performances of the various trades in the industry, average productivity and wage rate of the skilled labour in the industry are estimated with the proper knowledge of work study in a given environment. This usually involves method study work measurement of the job task containing the targeted work activities. In the process of activity sampling, a large number of observations are made of the workers over an extended period of time. The observations are at random times during the period of study to ensure statistical accuracy. The period must be the representative of the types of activities performed by the subjects. It is the statistical technique used in determining the proportion of time spent by workers in various defined categories of activity [4].

In evaluating the amount of time of various categories of work spent by the trade workers in the tasks assigned to them activity sampling helps to identify any trend affecting labour productivity. Based on this fact, work sampling provides framework with which a construction project would be completed on time and within budget. Hence, relationship between productivity rate and work sampling are usually predicted [3].

Labour is one of the basic requirements in construction work; and labour productivity usually relates manpower in terms of labor cost to the quantity of output produced. In a study titled "Energy Industry Struggling with Labor Shortage" it is confirmed that the Energy Industry in the United States (US) is facing a skilled manpower shortage which risks billions of dollars in energy investment and new technologies [5]. Furthermore, he contends that the average age of today's worker is 46, with 60 percent planning to retire at the next ten years. At the same time, the demand for energy is increasing every day. The aging trend of the workforce without commensurate new talents and skills replacing them poses the largest threat to the energy sector today. This has become so large and complex for any stakeholder or group to solve.

The National Power Training Institute of Nigeria (NAPTIN) reveals that there are 8,440 skilled workers generally running Nigeria Power System, which is not quite enough to move the projected 40,000 MW by NAPTIN [6]. This shows that there is a large gap left. It is therefore agreed that lack of skilled manpower in the

defunct PHCN is one of the major problems that plagued the development of the Nigerian Power Sector [4].

Appropriate labor output with suitable wage rate leads to effective production performance through efficient labour production and stable supply of competent labour. Since labour rate needs to be estimated based on the production capacity of the workers, the constants of labour for establishing the cost of labour in the item of works contained in the bill of quantities therefore, need not be guessed or imagined. It is then, difficult to draw reliable conclusions or accurate cost estimation without any available baseline standards. The standards (labour constants) are guided by standard supply of labour, effective labor production and activities sampling. These standards are mainly the standard time (S_t) and standard output (S_{op}) for a specified work period in a given construction environment [7].

Achieving an increase and sustainable labour productivity requires detailed studies of the labour organization and cost. Determination of the optimal labour force in any organization of labour becomes important in order to identify the least possible composition of a work team necessary to accomplish a given project at minimal labor cost and within a time frame.

Thus, on the basis of a 10 week crew based sampling study the correlation coefficient between direct work portion of work sampling and ratio of earned to actual man-hours would increase, if the definition of direct work was restricted [8]. In their work, the relationship between work sampling values and productivity measurement were investigated, with an objective of using work sampling as a surrogate productivity measure. It is concluded therefore that the work sampling could be used as a reliable estimator of construction productivity, provided the definition of direct work was narrowly defined.

In a similar study, forty five work sampling data point was used, collections were made from eleven nuclear power projects and 4 fossil fuel power projects to support the existence of relationship between work sampling and productivity rate by statistical analysis [9]. It was therefore established that work sampling is a good labour productivity indicator and also a valuable predictor in productivity projection model.

Thus, to achieve this, the following labor constants (rates) are necessary.

i. Standard time (S_t) – The normal time frame necessary for the production of a unit quality work. The unit is man – hour/m^2;

ii. Standard output (S_{op}) – The quantity of good quality work completed in a unit time frame by a tradesman or gang of tradesmen. The unit of measurement is quantity of work - hour e.g. M^3/m-h;

iii. Labour output (L_o) – Output rate on daily basis;

iv. Labour Required (L_r) – Required labour for a required quantity of work in a day and;

v. Time frame (T) – Contract time frame from commencement to the completion of work or a given quantity of work, using $\sum Pt$ (number of workmen)

The relationships between these constants are presented as follows:

$$S_t = t / q, \quad S_{op} = t / S_t, \quad L_o = S_{op}. t, \quad and \quad L_r = Q / S_{op}. t$$

Where,

q - Is quantity of quality work produced,
t - Duration of a work per day (In Nigeria, t = 8 hours), and
Q - Total quantity of good work to be accomplished.

2. RESEARCH METHODS AND MATERIALS

A field survey design approach was adopted in the original research study with the help of questionnaires and activity sampling. A group focus discussion for sampling process helped to form strong base for reasoning and decision making on different work trades and their conditions/categories. Thus, data obtained by way of activity sampling were used to establish labor constants and labour rate of the respective trades of defined conditions. The duration of direct observation for the sampling sequentially lasted 2 weeks, in the respective work trades. The standards eight (8) working hours in a day were maintained. Recreation, odd period and tradesman work efficiency rate in each of the days were estimated with percentage on a daily basis.

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Based on the observations carried out on the masons and carpenters working at the various sites of the study, the active (direct and supportive) and non-active (non-productive) production stages in the construction processes were identified.

2.1 Number of Observations for Sampling of the Activities

The magnitude of observations required to determine holistically the proportion of productive and unproductive times of the respective skilled construction work forces for EPP in the study area is estimated using the following expression:

$$N_{ob} = k^2 p (1- p) / L^2 \qquad (1)$$

Where,

N_{ob} = Is the required numbers of the observations on the activities for establishing realistic performance ratings,

K = Value obtained from Fisher statistical Table. (K = 2),

L = Limit of accuracy at 0.1 significance Level,

P = The percentage of activity observed, at 50%

Thus, according to Equation Equ 1, N_{ob} is calculated as:

$$N_{ob} = 2^2 \text{ x } 0.5 (1- 0.5) / 0.1^2 = 4 \text{ x } (0.5 \text{ x } 0.5) / 0.01 = 100$$

Therefore, N_{ob} is 100

3. DATA PRESENTATION, ANALYSES AND DISCUSSION OF FINDINGS

In each of the activities sampled in the study in every given time, note were taken of the cumulative time involved in the active and non active states of the respective workmen on the job. At the maximum of every 30 minutes interval, this observation would always be carried out for average assessment in the study for mason and carpentry trades respectively.

It means that observations were taken in every half hour of the 8 working hours per day.

A total of 288 observations were taken at the three sites of the respective states in more than one week. Every half hour observations were made in 8 hours in a day at each of the respective project site with average gang of tradesman and helper, for the respective trades. Out of the 288 observations made for block laying activity, 198, 216, 180, 180 and 216 observations were made as active in the respective states; while 90, 72, 108, 108 and 72 observations were non-productive ones respectively, for the average working conditions of block layers in the three project sites in the states respectively. The respective observations therefore, were calculated in percentages in the following forms.

3.1 Masonry (Block Laying) Work Activity in the South East

i. Abia State Sites

Percentage of Non-productive time = (90 / 288) x (100 / 1) = 31%

Percentage of Active time = (198 / 288) x (100 / 1) = 69%

Using the same approach, the non productive and active times of the block laying activities in other states were calculated as presented in Table 1.

3.2 Standard Time and Output on Block Laying Works in Abia State Sites Average Set of a Mason and Helper

Average observed time (OT): 8 hours

Average output: 10 m^2/day

Therefore, output per hour = 10 / 8hours = 1.25 m^2/hr

Basic time: OT + Recreation + Allowance for odds
Basic time: OT + 17%
Basic time: 8 + 1.36 = 9.36 hours (for 10 m^2)

Table 1. The non productive and active times of the block laying activities

S/N	Work conditions	Abia	Anambra	Ebonyi	Enugu	Imo
1	Non Productive Time	31	25	37.5	37.5	25
2	Active Time	69	75	62.5	62.5	75

Source: Author's Field Work, (2017)

Standard work performance rates 100%

Thus, based on the labor performances, the estimated rate is 69%.

Therefore output = (69/100) X (10/1) = 6.90 m^2/day

Since standard working hour/day is 8hours, and 6.90m^2 measure of output is delivered in 9.36 hours;

In 8 hours therefore, output = (8/ 9.36) x (6.90 /1) = 5.90 m^2/day (labor rate)

Standard Time:

For 1 m^2 = 8/5.90 m^2 = 1.36hrs

Standard Output:

For 1 hour = (5.90 m^2/ 8 hrs) = 0.74 m^2/hr

Finally, the net standard time and output of building projects were calculated as follows:

Note that net standard time of masonry work is therefore taken as the arithmetic mean of the results obtained from the various sites of the respective state sampled.

Thus, Net S_t = (1.36 + 1.20 + 1.57+1.57 + 1.14 hrs) / 5

= (6.84hrs / 5) = 1.37hrs/m^2 = 82.20 mins/m^2

ii) In the same way net standard output (S_{op}) in the study area was thus calculated as follows:

Net S_{op} = (0.74 + 0.83 + 0.64 + 0.64 + 0.88m^2 / 5) = (3.73 m^2 / 5) = 0.75 m^2/hr

iii) Thus, Labour Rate which is expressed as the product of Standard Output (S_{op}) and standard day work duration (8hrs) is therefore, calculated as follows:

L_r = 0.75 m^2/hr x 8hrs = 6 m^2/day

3.3 Carpentry Work Activity in the South East

For the carpentry work trade, the average working conditions of the tradesmen sampled in the respective project sites show that out of the 288 observations in each state, the active observations made are 216, 198, 234, 198 and 216 observations respectively, while the non productive observations made are 72, 90, 54, 90 and 72 observations in the three project sites of each of the states respectively. They were calculated in percentages in the following forms.

3.4 Standard Time and Output on Carpentry Works in Abia State Sites

Percentage of Non-productive time = (72/ 288) x (100/1) = 25%

Percentage of Active time = (216 / 288) x (100/1) = 75%

Using the same approach, the non productive and active times of the carpentry activities in other states were calculated as presented in Table 2.

Abia State Sites:

Average observed time (OT): 8 hours

Output: 14.2 m^2

Therefore, output per hour (14.2 m^2 / 8) = 1.78 m^2/hr

Basic time: OT + Recreation + Allowance for odds
Basic time: OT + 16% (OT)
Basic time: 8 hours+ 1.28 = 9.28 hours (for 14.2 m^2).

Standard quality work has rating of 100%

Thus, base on the labour performances the estimated rate is 75%

Output = (75/ 100) X (14.20/1) = 10.65 m^2/day

Table 2. The non productive and active times of the carpentry activities

S/N	Work conditions	Abia	Anambra	Ebonyi	Enugu	Imo
1	Non Productive Time	25	31.20	18.80	31.20	25
2	Active Time	75	68.80	81.20	68.80	75

Source: Author's Field Work, (2017)

Table 3. Labor rates of the skilled construction workforces in the various construction projects and the EPP

S/N	Trades	Construction projects										
		Owerri metropolis			Multi-trust construction			Geo-skill engineering			EPP		
		Labor output	S_t	S_{op}	Labor output	S_t	S_{op}	Labor output	S_t	S_{op}	Labor output	S_t	S_{op}
1	Block Laying	7.70	1.10	0.96	9.12	0.90	1.14	8.80	1	1.1	6	1.37	0.75
2	Carpentry	12.30	0.65	1.54	12.32	0.65	1.54	12.80	0.63	1.6	9.52	0.85	1.19

Source: Adapted from Ikechukwu and Anekwe, (2015)

Table 4. The wage/salary structure of skilled construction workforce in Civil Service and TCN/DISCOS

S/N	Grade Level (GL)	Civil Service (#)		TCN/DISCOS (#)	
		Salary/yr	Wage/day	Salary/yr	Wage/day
1	GL 01	226,800	945	144,180	601
2	GL 02	231,269	964	147,024	613
3	GL 03	235,738	982	150,804	628
4	GL 04	240,207	1001	168,012	700
5	GL 05	244,677	1020	190,764	795
6	GL 06	249,146	1038	232,128	967

Source: Author's Field Work, (2017)

Hence, 10.65m^2 is for 9.28 hours

Since standard work hour/day is 8hours:

8 hours therefore is = (8/ 9.28) x (10.65/1) = 9.18 m^2/day (labor rate)

Standard time:

For 1 m^2 = 8/9.18 m^2 = 0.87hrs/m^2 = 52mins/m^2

Standard output:

For 1 hour = (9.18 m^2/ 8 hrs) = 1.15 m^2/hr.

For Average Standard time and output of the carpentry work in the study area consisting of the 5 respective state sites, the labor constants were obtained as follows:

Net Standard time (S_t) for the Carpentry trade work

S_t = (0.87 + 0.92 + 0.74 + 0.97 + 0.77 hrs/m^2 / 5)

Thus, S_t = (4.30 hrs/m^2 /5) = 0.85 hr/m^2 = 51 mins/m^2

Net Standard output (S_{op}) for the Carpentry trade work

S_{op} = (1.15 + 1.10 + 1.36 + 1.03 + 1.29 m^2/hr /5)

Thus, S_{op} = (5.93 m^2/hr/5) = 1.19 m^2/hr

Thus, labour rate which is expressed as the product of Standard Output S_{op} and standard day work duration (8 hrs) was therefore, calculated as follows:

L_r = 1.19 m^2/hr x 8 hrs = 9.52m^2/day

Appropriate labour rates of different study areas had therefore been established to help form the bases for improved productivity of labour, as well as the regulations of rates of productions in the various trades in the industry [4,7]. The labour constants of some of the skilled construction workforces as presented in Table 3 shows the labour rates of the masonry (block laying) and carpentry trades respectively obtained in the various Construction projects, Civil service and the EPP in the study as follows.

Wage Rate Determination: A satisfactory wages scheme is characterized with high productivity level, and low labour turnover. Wage means of remuneration for the skilled construction workers within the south eastern geopolitical region of Nigeria ranges between three thousand naira (₦3000) to four thousand naira (₦4000) per day.

For the reason of wage rate analysis, remuneration (salary) of skilled construction workforces in the civil service and various EPP commissions in particular were interpreted into wages on the basis of five (5) working days in a week. Presented in Tables 4 are the salary structure of skilled construction workforces in civil service and TCN/DISCOS annually, with their corresponding wage rates per day.

Thus, the skilled construction workers in the civil services and TCN/DISCOS commissions are commonly within the grade cadres of GL 04 to GL 06. Hence, the average wages of the civil service and TCN/DISCOS workers, as well as the average wage rate of skilled construction workers in the study area per day were calculated to be ₦1,020, ₦821 and ₦3,500 respectively.

4. SUMMARY OF THE MAJOR FINDINGS

Information obtained through the activity sampling shows that the skilled workers have not been productive in general, especially when compared with the production rates of the workers in the private construction firms within the study area. Although the active working periods observed in the activity sampling ranges from 62.50% to the maximum of 81.20% on average, it is seen that carpentry tradesmen utilize more of their working hours than the masonry tradesmen. With these situations, decision making during analysis for improved labor performance would be reliable for effective delivery of EPP in the study area. Thus, the labor constants established have average of 1.37hrs/m2 and 0.75 m2/hr for standard time and standard output respectively for masonry trade, while the average of 0.85 hr/m2 and 1.19 m2/hr for standard time and standard output respectively are for carpentry trade.

The wage rates of the respective skilled workforce in the EPP pose the worst scenario; where their respective remunerations on wage analysis are about 25% value of their counterpart in the surrounding private construction firms (Table 4). With the existing poor wage scheme in EPP delivery management, results show that the average labor rates of the block laying and carpentry trades stand as low as 6 m2/day and 9.52 m2/day respectively.

Although the remuneration of the skilled workers in the civil service and TCN/DISCOS commissions are characterized with life accruing benefits like; job security, gratuity and pension, the differences in their remuneration and that of the skilled workers in the construction firms are alarming; to the expense of the workers in civil services, and in the EPP especially. Thus, considering the comparison of the ratio of wage-labor rates of the major private construction firms with that of the TCN/DISCO in the area which stand at #410/m2 and #281/m2 for block laying and carpentry trades respectively, and the corresponding #137/m2 and #87/m2 for block laying and carpentry trades respectively, the workers of the TCN/DISCO employment are quite underpaid compared to their counterparts in the private construction firms; hence the implication of the poor wage rate outweighs the attached benefits of the civil service and EPP workers respectively.

This condition explains the reason the skilled labor rates of the skilled workers in the civil services and the TCN/DISCOS workers are relatively less than the labor rates in the construction firms around. It therefore supports the belief that remuneration issue is very critical in an effort to improve on the delivery of EPP. If the wages/salaries of the skilled labor in TCN/DISCOS are very well improved on, their labor outputs will automatically be improved at that same rate when they are properly trained, retrained and monitored.

5. CONCLUSION

In conclusion, the study explains therefore the reason the model analyses on relationships between the labour determinants and effective EPP delivery in another study pointed at remuneration as the single most significant influential factor for improved productivity in the power sector; as well as the main cause of poor production drive that results to low output rate of the workers in the study. This therefore supports the belief that wage rate affects workers productivity in EPP. Since the wage rate of an EEDC/TCN staff is lesser than the wage rate of similar grade of staff in the civil service and even much lesser than those in the private construction firms, the skilled workers therefore are concluded to be underpaid in their services to the power sector. This ofcourse makes the skilled workforces put less effort to work in the study area. No wonder the ratios of wage rate to labour rate of the skilled labour in the power sector is lesser than ratios of wage-labour rates in other areas of similar employment especially, those in private construction firms in the current study. To address this problem sustainably, a framework that will checkmate the remuneration of the skilled workers appropriately therefore is recommended to strategically help in improving the performance of the skilled labour for effective EPP delivery.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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