

ANALYSIS OF FACTORS RESPONSIBLE FOR LOW UTILIZATION OF MECHANICAL PLANTS AND EQUIPMENT BY INDIGENOUS CONSTRUCTION FIRMS

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ABSTRACT

The study is concerned with identifying the problems of low utilization of plant and equipment by the indigenous building construction firms in Nigeria. The methodology involved the use of a well structured questionnaire complemented with an oral interview. The results revealed that (15) factors were responsible for low utilization of mechanical plants and equipment by indigenous construction firms in Nigeria. Some of the identified problems are; high cost of plant and equipment, high machinery maintenance cost, scarcity of spare parts, effect of government policies etc. Others are lack of indigenous manufacturing industry, domination of the construction industry by foreign firms, and lack of qualified expertise. Percentage severity index of 100% shows high cost of plant and machinery as the most severe factor, while the combined ranked agreement of the order of 15 shows a total disagreement with the shortage of manpower as the variable factor. The study recommended some factors to be considered when selecting plant and equipment for construction works. The work also reviewed the use of plant and equipment with particular attention to the indigenous construction firms in Nigeria.

Keywords: machinery, plant, equipment, indigenous contractors.

INTRODUCTION

The world is in an era of advanced technology, mechanization and automation where machines and robots have substituted labour in both the manufacturing and the construction industry for enhanced productivity and completion of tasks with great ease. It was reported that Warren A. Bechtel first entered the construction field in 1898 in Oklahoma territory and quickly built a reputation for successful railway grading, pioneered the use of motorized trucks, tractors, and diesel powered shovels in construction (Schenayder and David 2002). It is estimated that about 35-45% cost of building work is spent on materials particularly in house building (Harris 1994) most of which are handled manually, but as labour cost rises, in relation to the cost using mechanical equipment, it is inevitable that increased productivity will be sought on the construction site by improved application of machinery.

In recent past, Nigeria has witnessed very little use of mechanical plant and equipment such as conveyors, dumper and tower crane for the construction of buildings (Kazie 1987). This development perhaps explains why many have expressed concern over the possibility of the impact of their use to boost productivity in the construction industry particularly by the indigenous construction firms. Although current perception of those in the industry have not been well quantified, Harris and Stevens (1994) reported that about 45% of the cost of buildings work is spent on labour which is high in relation to the application of mechanical plant in executing tasks adding that unless there is continuity of work for a particular item of work on another project, there is little advantage to be gained from investing in large number of machines.

Construction work is capital intensive which involves spending large sums of money on construction resource such as materials, men, machines and manpower.

According to Robert and William (1985), the percentage of each of these resources depends on the nature and complexity of the work in any construction contract. However, for complex and high rise buildings, mechanical plants and equipment are very necessary because they play an important role in building construction as both money and time can be saved by their effective utilization and management.

Even though simple building works can be constructed with little or no involvement of plant and equipment, more often than not, indigenous construction firms are forced to use mechanical plants and equipment where there are no other means of carrying out such works, especially in the construction of high-rise buildings. It is therefore obvious for the indigenous construction firms in Nigeria to take full advantage of the use of construction plant and equipment so as to enable them compete favourably with their foreign counterparts for some of the derivable benefits of their use.

Furthermore, whenever the strategy of mechanization has been followed by the indigenous construction firms in Nigeria, there has been a reduction in the amount of labour deployed on building sites without a decline in the volume of production, and a corresponding improvement in material wastage (Ogunsemi 1995).

Kolawole and Owor (1993) asserts that the indigenous contractors came into the lime light with the introduction of the Nigerian enterprise promotion decree in February 1972 and have since been playing an important role in the construction industry. However, most of the indigenous construction firms in Nigeria over the years have neglected the use of mechanical plants and equipment as highlighted by Kolawole (1994).

OBJECTIVES

The objectives of the study are to:

- 1) Examine the problems associated with the use of mechanical plant and equipment by indigenous contractors in Nigeria.
- 2) Compare the ranking between construction firms and plants hiring firms with a view to identifying the factor(s) responsible for low utilization of mechanical plants and equipment in Nigeria.
- 3) Proffer suggestions based on the outcome of items (1 and 2) above which would go a long way towards enhancing the use, acquisition and effective management and optimum utilization of mechanical plant and equipment for construction projects in Nigeria.

METHODOLOGY

The methodology for the study involved the administration of a structured questionnaire to some construction firms in the capitals of Kaduna, Bauchi and Gombe states. Oral interview was also carried out as a supplement to the questionnaire. A total of 30 questionnaires were distributed equally amongst the selected construction firms in the study area. 23 firms responded by completing and returning the forms administered to them. 15 of the questionnaire returned were from construction firms engaged in building construction projects, while 8 were from plant hire firms.

In addition, factors responsible for low utilization of mechanical plant and equipment by indigenous construction firms were identified in the literature. This was meant to have a well balanced and fairly comprehensive perspective for the study. This made it possible to present the factors responsible for low utilization of plants and

equipment by indigenous construction firms to be fully enumerated and ranked accordingly.

The data collected through the instrument earlier mentioned above (questionnaires and interview) were analyzed using statistical methods such as Kendall's correlation coefficient, Chi Square (X^2) test of significance (Robert 2002). For this study, the severity index of each variable factor was computed by considering the number of firms that ranked a factor as excellent, very good, good etc. It is expressed as:

$$F = f_5 + f_4 + f_3 \text{-----} (1)$$

Where;

F = severity index

F₅ = number of firms that ranked the factor as excellent,

F₄ = number of firms that ranked the factor as very good,

F₃ = number of firms that ranked the factor as good factor.

The percentage severity index is calculated using the expression

$$P_s = \frac{F}{n} \times 100 \% \text{-----}(2)$$

Where;

P_s = Percentage severity index,

F = Severity index of each of the factor variable defined in equation - (1)

n = total number of firms that ranked the factor.

In order to compare ranking between construction and hiring firms, summation of the ranking for each variable factor is obtained. This summation gives the new ordered arrangement of the variables factors by the construction firms, and hiring firms. The factor with the highest summation becomes the most severe and consequently the major factor responsible for low utilization of mechanical plants and equipment in Nigeria.

To test the ordered ranking, two statistical methods were used, the Kendall's correlation co-efficient (t) and the chi squared (X^2) test of significance.

The Kendall's co-efficient of rank correlation expressed by the equation;

$$T = \frac{S^2}{K^2 n (n-3)} \text{-----} \text{equation (3)}$$

Where:

T = Kendall's coefficient of rank correlation.

S = Sum of square of standard deviation,

K = Total number of firms that ranked the variable factor,

n = Number of the listed variable factor.

The chi square (X^2) test of significance is given by the relation

$$X^2 = K (n-1) T \text{-----} \text{equation (4)}$$

Where;

n-1 = Degree of freedom within as defined in equation --(3)

K = Number of firms that ranked the variable factor.

T = Kendall's coefficient of rank correlation as defined in equation--3

X^2 = Chi Square to be tested.

Values of Kendall’s rank correlation in the range $0 \leq t \leq 1.0$ indicate good agreement and value near -1 or in the range $1 > t \geq -1.0$ implies disagreement on the factors ranked by the professionals (Harnett 1983).

While values of chi square are tested at 0.05 and 0.01 levels of significance, different sample calculations using these formulae are shown in Appendix A. However, the rank agreement factor (RA) is calculated using the relation;

$$RA = \frac{\sum CH}{n} \text{-----equation (5)}$$

Where C = Construction firms,

H = Hiring firms,

n = Number of variables factors ranked.

In addition, the percentage rank agreement factor (PRA) is computed using the relation;

$$PRA = \frac{RA_{max} - Rai}{RA_{max}} \times 100 \text{----- (6)}$$

Where;

RA = Rank agreement factor

Rai = Ran agreement factor (total)

n = Number of variable factor ranked

ICH = Sum of the order of rankings by the construction firms and Hiring firms

RESULTS AND DISCUSSION

The high cost of construction plants and equipment was identified by the study as the most severe factor responsible for low utilization of plant and equipment by both the indigenous building firms and plants and machinery hiring firms, it has a rank agreement factor of 94% (Table 3) and a percentage severity index of 100% (Table 1 and 2).

Lack of indigenous manufacturing industries is ranked second with percentage severity index of 80 and 100% for indigenous building firms and plants and machinery hiring firms respectively, and percentage rank agreement factor of 93%. The implication of this is that there is the need for the government and private investors to join hands with foreign investors to set up plant and equipment manufacturing company as this will go a long way in solving the problem.

The study also revealed that high machinery maintenance cost is another factor responsible for low utilization of mechanical plant and equipment with percentage severity index of 93 and 88% (Table 1 and 2) for indigenous building firms and plants and machinery hiring firms respectively, and a percentage rank agreement factor of 93%. This perhaps explains why many indigenous building construction firms abandon their plant and equipment on their yards.

Furthermore, the results of the study indicated that scarcity of spare parts is the forth factor with a percentage rank agreement factor of 93% (Table 3), and percentage severity index of 87 and 88% (Tables 1 and 2) for indigenous building firms and plants and machinery hiring firms respectively. The result underscores the need for the government to expand the existing machine tool and foundry industry so that spare parts and even machines for the country can be manufactured locally. It should be emphasized that this is a follow-up of one of the goals of the National Construction

Policy which emphasized thus; “encourage the adoption of appropriate construction technology responsive to the technological conditions of the country” (Chudley, 1979).

The fifth factor is the dominance of the construction industry by the foreign firms with percentage rank agreement factor of 91% and percentage severity index factor of 73 and 75% (Tables 1 and 2) for indigenous building firms and plants and machinery hiring firms respectively. This reveals that most foreign firms import almost every type of machinery from their home country to execute construction projects, this practice does not encourage the use of local raw materials needed for construction and does not give indigenous building firms a chance to perform.

Another factor that was identified to be responsible for low utilization of mechanical plants and equipment by indigenous building construction firms is non availability of funds which ranked as the seventh factor with percentage rank agreement factor of 90% (Table 3) and percentage severity index of 100% (Tables 1 and 2) for indigenous building firms and plants and machinery hiring firms.

In addition, the study revealed that the effect of government policies is also another factor responsible for low utilization of plant and equipment by indigenous building construction firms in Nigeria with percentage rank agreement factor of 90% and percentage severity index of 87 and 75% (Tables 1 and 2) for indigenous building firms and plants and machinery hiring firms respectively. The effect of government policies on the utilization of plants and machinery implies that the issue of import duty, high tariff and other strict measures by the government should be revisited.

Lack of confidence on the indigenous construction firms ranked the ninth factor with percentage rank agreement factor of 90% (Table 3) and percentage severity index of 47 and 75% (Tables 1 and 2) for indigenous building firms and plants and machinery hiring firms respectively. This shows that the Federal and state government which are the major clients of the construction industry should allow the indigenous decree to work by honoring their obligations to indigenous construction firms as at when due.

The tenth factor is the non continuity of project by the indigenous construction firms with percentage rank agreement factor of 89% and percentage severity index of 53-75% (Tables 1 and 2) for indigenous building firms and plants and machinery hiring firms respectively. Most of the indigenous construction firms find it difficult to get jobs and even when they do, it takes longer time before they secure another one and this may also account for plant abandonment by the indigenous construction firms. Similarly, the nature and scope of jobs they get are most times better done manually; hence the acquisition of plants by them is not normally encouraged (Buba, 1991).

Tables 1 and 2 (see *Appendix*) show the statistical characteristic of the factor responsible for low utilization of mechanical plant and equipment by indigenous building construction firms and plant hiring in Nigeria respectively. From Table 3, it can be seen that the ranking order of the variable by both the indigenous construction firms and the plant hiring follows the same trend: The five most important factors are; high cost of construction plant and machinery; lack of indigenous manufacturing industry; high machinery maintenance cost; scarcity of spare parts and the dominance of the construction industry by multinational firms: others are improper planning, and non availability of funds.

On the other hand, Table 3 is the summary which shows the comparative (i.e. the combined) rank agreement factor for the variables and the associated percentage rank agreement factor 2.1 and 0.13 were found to be The maximum and minimum rank agreement factors respectively.

CONCLUSION

The highlights of the findings show that apart from slight disagreement expressed by both indigenous construction firms and plant hiring firms in Nigeria on factors responsible for low utilization of mechanical plant and equipment, they both agree that the major factors responsible for low utilization of mechanical plant and equipment are due to; high cost of construction plants and equipment, lack of indigenous manufacturing plant industries, high machinery maintenance cost, scarcity of spare parts, dominance of the construction industry by foreign firms, improper planning, and non availability of funds.

Finally, the study revealed that the factors responsible for low utilization of mechanical plant and equipment by the indigenous construction firms in Nigeria are numerous and diverse. Some of the problems could be attributed to the construction firms themselves, while others could be attributed to other parties and the industry's unique characteristics.

RECOMMENDATIONS

The following recommendations are made based on the findings of the study;

- i) The government should create an avenue where basic amenities of the industry in terms of construction plants and equipment can be easily procured by the indigenous building construction firms.
- ii) Government should expand the existing machine tool and foundries industry so that spare parts and even machines required can be manufactured locally. This is a follow up to a portion of the national construction policy (Onabule 1992).

The above mentioned strategies if implemented can help tremendously to improve the lots of the indigenous capacity in Nigeria so as to take full advantage of the benefits of the mechanization in the construction sector.

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TABLE 1: INDIGENOUS CONSTRUCTION FIRMS’ RESPONSES TO QUESTIONNAIRE.

Rank	Variable Factor	Excellent factor F ₅	Very Good factor F ₄	Good Factor F ₃	Poor factor F ₂	Not Applicable F ₁	Severity index F ₅ +F ₄ +f ₃ +F ₂ +F ₁	Percentage Severity Index Ps-f/nx100
1	High cost of plant And equipment	9	3	3	0	0	15	100
2	Non availability of funds	10	2	3	0	0	15	100
3	High machinery maintenance cost	10	1	3	0	1	14	93
4	Scarcity of spare Parts	5	7	1	1	0	13	87
5	Effects of Government Policy	9	1	3	1	0	13	87
6	Improper Planning	7	3	3	1	1	13	87
7	Lack of Indigenous Manufacturing Industry	6	4	2	1	2	12	80
8	Domination of construction industry By foreign firms	4	4	3	1	2	11	73
9	Lack of qualified technical expertise	4	5	2	1	2	11	73
10	Lack of co-operation Among parties to Contract	3	4	2	5	2	8	60
11	Unstable foreign exchange rate	2	4	3	2	3	9	60
12	Non continuity of project	4	2	2	1	3	8	53
13	Shortage of man power	0	0	0	1	1	-	-
14	Lack of confidence and the indigenous contractors	1	1	5	2	1	7	47
15	High interest rates charged by bankers on loans received by contractors	2	1	2	5	3	5	33

TABLE 2: INDIGENOUS HIRING FIRMS' RESPONSES TO QUESTIONNAIRE.

Rank	Variable Factor	Excellent facto F ₅	Very Good factor F ₄	Good Factor F ₃	Poor factor F ₂	Not Applicable F ₁	Severity index F ₅ +F ₄ +f ₃ +F ₂ +F ₁	Percentage Severity Index Ps-f/nx100
1	Non availability of funds	5	2	1	0	8	8	100
2	Lack of Indigenous Manufacturing Industry	2	3	3	0	0	8	100
3	Scarcity of spare Parts	2	2	3	0	1	7	88
4	High Machinery Maintenance Cost	4	1	2	1	0	7	88
5	Improper Planning	2	1	4	1	0	7	88
6	Effects of government policy	3	2	1	1	1	6	75
7	Non Continuity of Project	3	1	2	1	1	6	75
8	Lack of confidence n the indigenous Contractors	2	3	1	2	0	6	75
9	Domination of construction Industry by Foreign firms	4	1	1	1	1	6	75
10	Non Availability of Funds	1	2	2	2	1	5	63
11	Unstable Foreign Exchange rate	3	1	1	10	1	5	63
12	Lack of co-operation Among parties To contract	1	0	2	1	1	3	38
13	Lack of qualified Technical Expertise	1	1	0	2	2	2	25
14	Shortage of Man power	1	0	0	-	1	1	13
15	High interest rates charged by bankers on loans received by contractors	1	0	0	-	2	1	13

TABLE 3: COMPARATIVE RESULTS OF INDIGENOUS CONSTRUCTION FIRMS AND PLANTS AND MACHINERY HIRING FIRMS' RESPONSES TO QUESTIONNAIRE

Rank	Variable Factors	Construction firms Ranking	Hiring firms Ranking	Sum of Ranking ECII	Rank Agreement Factors ECII/n	Percentage Rank Agreement Factor $\frac{PAR}{RAMaxRaix} \times \frac{100}{RAMax}$	Standard Deviation (Is) ECII	Square Deviation	Rank Order
1	High cost of plant and equipment	1	1	2	94	94	-3.3	10.89	1
2	Lack of Indigenous Manufacturing Industry	1	1	2	93	93	-2.9	8.41	1
3	High machinery maintenance cost	1	1	2	93	93	-2.1	9.61	3
4	Scarcity of spare parts	1	1	2	93	93	-2.9	8.41	4
5	Domination of construction industry by foreign firms	1	1	2	91	91	-2.6	6.76	5
6	Improper Planning	1	1	2	0.18	91	-2.6	6.76	6
7	Non availability of funds	1	2	3	0.20	90	-2.3	5.29	7
8	Effects of Government Policy	2	1	3	0.19	90	-2.4	5.76	8
9	Lack of confidence and the indigenous contractors	2	1.3	3.3	0.23	90	-1.9	3.61	9
10	Non continuity of project	2	1	3	0.23	89	-1.5	3.24	10
11	Unstable foreign exchange rate	2	1	3	0.22	89	-1.9	3.61	11
12	Lack of co-operation among parties to contract	1.7	2.7	4.4	0.29	86	-0.9	0.81	12
13	Lack of qualified technical expertise	1.4	4	5.4	0.36	82	0.1	0.01	13
14	High interest rates charged by bankers on loans received by contractors	3	8	11	0.53	75	5.7	32.5	14
15	Shortage of manpower	15	8	23	2.1	0	17.7	313.3	15