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AN EVALUATION OF THE CRITICAL FACTORS INFLUENCING PRODUCTIVITY OF MASONRY WORK IN CONSTRUCTION SITES IN KANO, NIGERIA

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ABSTRACT

Construction labour productivity is of great interest to practitioners and researchers because it affects the performance and success of the project. This research assesses and ranks factors that critically influenced productivity of masonry work for some selected projects within Kano metropolis, Nigeria. A total of sixty three (63) respondents which include construction experts from lower to top management levels of various positions were selected. Structured questionnaire related to masonry labour and productivity was distributed to the selected respondents. The four most critical factors that negatively influence labour productivity of masonry as identified by the respondents work were found to be delayed in payment process. Payment process discourages some qualified contractors from bidding for the job, material quantity which result in stoppage of material delivery, security of life and property. Security as a constraint has negative and significant influence on the program of projects and worker experience. Lack of labour experience has a very high effect on productivity; experience improves both intellectual and physical abilities that improve productivity. The inferences drawn from this study could be used by the project managers to take account of these factors at an early stage in order to improve labour productivity of workers on construction site in Nigerian.

Keywords: Construction sites, Critical factors, Masonry work, Labour Productivity

INTRODUCTION

The construction industry is known to be the largest industry in Nigeria, employing a good proportion of the work force and controlling over 50% of the Nation's Gross National Product (Fagbeleet *et al.*, 2011). Unfortunately, many workers have lost their employment and embargoes have been placed on employment in both public and private sector due to the long economic problem which lasted for more than a decade. Within this period, the leadership of the country had changed hands fourteen times. Each regime comes with different strategies of solving the economic problems. Therefore, the few workers (labour) that remain in the construction industry need to be properly managed if performance is to improve. (Fagbeleet *et al.*, 2011). Labour is defined as a task that requires the exertion of body and mind or both. It is also regarded as an important resource in construction because it is the one that combines all the other resources namely: materials, plant equipment and finance in order to produce various construction products (Gide, 2011).

According to Nunnaly (2005), the term productivity means the output of the

construction goods and services per unit of labour input. The labour force can be broadly categorized into; skilled labour or craftsmen and unskilled labour. The staff under the skilled labour is of varying abilities ranging from apprentices to trade foremen or supervisors. The apprentice can be described as a beginner who is willing and interested in learning a certain trade in the construction industry. The three possible avenues of training this category of people are the school, the workshop and the field (Ojo, 2009). Some of the craftsmen in this category are carpenters, masons/bricklayers, electricians, plumbers, painters, crane drivers, steel fixers, tile setters and etcetera. The unskilled labour on the other hand is a category of workers that requires no special skill and it is defined as any way of making a living with little or no degree of security of income and employment. However, they require little or no training to make them perform. Certainly, the unskilled labourers are able-bodied men and women that perform manual duties. Their major asset, therefore, lies in their strength with a healthy body (Ojo, 2009).

Understanding the productivity of masons is important for management of building projects that involve masonry works. The masonry process is perceived to be one of the labour intensive aspects of construction process from time immemorial as claimed by Chudley and Greeno (2005). Productivity of masons is measured in terms of area in square metres of block/brick work built by a single mason per unit of time preferably a day, normally eight (8) hours of work (Nalumansi and Mwesige, 2012). According to Abdel-Razek *et al.*, (2006), construction industry involves a large number of variables: the labour intensive work, the unique character and the occurrence of unpredictable events. The construction process results in relatively high costs and labour becomes a more important input in the production phase. Moreover, the labour cost is somewhere between 20% and 50% of the total project cost and the reduction of these costs can be best carried out by improving productivity (Gambao, *et al.*, 2000).

According to Polat *et al.*, (2005), policies for increasing productivity is not necessarily the same in every country and this means that critical factors in developing countries differs from that of developed countries. In order to improve productivity, a study of the factors affecting it, whether positively or negatively, is necessary (Abdullahi, 2010). Many factors can be used to measure productivity. For example, managers can generate diverse productivity data that take into account the measured productivity and the factors that influence it. These data can then be used to define an index for measuring the performance of a project, which in turn plays an important role in decision making during the project engineering process.(Yu & Lee, 2002). Based on the previous researches, 40 factors that affect construction labour have been identified and were categorized into four (4) groups according to their characteristics in relation to economic and social environment. These factors are:

- i. Material/Tools components (6 factors)
- ii. Worker components (12 factors)
- iii. Work characteristic components (7 factors)
- iv. Management and control components (15 factors).

These factors were used as a basis for preparing quantitative surveys in order to investigate the influence of such factors on the productivity of masonry work in construction site. These components were then further classified into those that directly influence labour productivity (workers group) and those that indirectly influence labour productivity by influencing the

works of the workers (the works characteristics, materials and management and control groups). The changing nature of factors influencing labour productivity of various trades on construction sites is not very clear especially in Kano, Nigeria. This negatively affects the accuracy of the labour constants commonly used for estimating labour costs in this part of the country. If all factors influencing productivity are known, it will be possible to forecast productivity with optimum accuracy. The result of various studies related to this topic indicates a need for systematic classification and definition of various factors that are directly or indirectly influencing productivity of labour in various trades so as to establish a strategy and action plan for managing labour productivity particularly, masonry work on construction sites (Nalumansi and Mwesige, (2012). The study is aimed at evaluation factors that influence productivity of masonry work with a view to improving labour productivity of workers on site. This research work, therefore, studied the factors that influence productivity of masonry work at different small and medium construction sites within Kano metropolis. Kano metropolis comprises of eight (8) local governments, namely: Dala, Fagge, Gwale, Kano municipal council, Kumbotso, Nassarawa, Tarauni and Ungogo.

MATERIALS AND METHODS

This study is based on a survey designed to gather all necessary information in an effective way. The survey presents thirty seven (37) productivity factors which were generated on the basis of related previous research work on construction productivity, alongside input, revision and modification from local experts. The factors were divided into four (4) components based on the previous literature and as suggested by local experts.

In this study, five (5) Likert scale measurement was used to determine the degree of influence of these factors on masonry productivity. This study was carried out within Kano metropolitan area in Nigeria. Data sets were collected from various construction projects for the purpose of this research. Kano is located in the North-western Nigeria. The city has a population of about 20 million people (in 2008 census) and it is hosting numerous construction companies operating in Nigeria. The population (N) of interest considered in respect of this study were eighty (80) "**construction experts and labour operatives**" as they are within the scope of this study. The construction experts constitute mostly the contractors, project managers, site engineers, project supervisors and the likes.

This is because they are directly involved in the construction of a residential, industrial, and commercial buildings for both public and private owners. The research also captured some relevant profile information of the population of interest.

For the purpose of this study, a structured closed ended questionnaire was used for the data gathering. The questionnaire was designed to capture the background information of the respondents and the factors that affect labour productivity of masonry work on construction site. This is imperative as it will go a long way in clearly assessing how such factors critically influence labour productivity of masonry work in the study area. The questionnaire was designed in a simple format taking into consideration the research objectives. The research questionnaire was divided into two (2) sections, that is, section A and B. Section 'A' of the research questionnaire captured the respondents' profile and background information. Section 'B' contained the nature of masonry projects being undertaken as it will help in assessing the factors that critically influence the productivity of masonry work in construction sites. It will equally assist in evaluating the factors that influence productivity of masonry work in construction sites.

Respondents from the contractors and operators were asked to rank the factors which they considered as being negatively affecting the performance of their masonry labour on sites. The illiterate/semi-illiterate respondents among the labour were however guided by reading out

the questions to them and their responses by carefully filled-in. Using Likert statistical technique on a scale of 1 to 5, the relative index (RI) was calculated using the following formula (Lim et al., 1995).

Relative Importance Index =

$$\frac{5n^5 + 4n^4 + 3n^3 + 2n^2 + n^1}{5(n^5 + n^4 + n^3 + n^2 + n^1)}$$

Where; (5- affects with "very high effect"; 4- affects "High effects"; 3- affects with "average effect"; 2 -affects with "Some effect"; and 1- affects with "Little effect").

The respondents were then asked to rate the frequency of occurrence of each factor according to three ordinal scales: High (3), Medium (2), or Low (1). The "Frequency Index" for each factor was derived from the following formula:

$$\text{Frequency Index} = \frac{3n^3 + 2n^2 + n^1}{3(n^3 + n^2 + n^1)}$$

Where n^3 is the number of respondents who answered "High", n^2 is the number of respondents who answered "Average"; and n^1 the number of respondents who answered "Low".

Finally, an overall index which is the multiplication of "Relative Importance Index" by the "Frequency Index" was named the "Severity/Critical Index". The severity Index was used to rank the overall implication of each factor on labour productivity for masonry work.

$$\text{"Severity/Critical Index"} = \text{"Relative Importance index"} \times \text{"Frequency Index"}$$

RESULTS AND DISCUSSION

As a result of the field survey and follow up, a total of 63 out of 80 questionnaires were completed and returned from various survey

areas in Kano metropolis as depicted in table 1. A close personal contact with respondents was used due to the number of items in the questionnaire distributed.

Table 1: Survey Area

Area	Frequency (N)	Percentage (%)
Dala L.G.A	5	8
Fagge L.G.A	7	11
Gwale L.G.A	17	27
Kano municipal L.G.A	3	5
Kumbotso L.G.A	4	6
Nassarawa L.G.A	9	14
Tarauni L.G.A	12	19
Ungogo L.G.A	6	10
Total	63	100

Table 2: Number of Respondents

Questionnaire	Frequency (N)	Percentage (%)
Returned	63	79
Not returned	17	21
Total	80	100

Table 3: Position/Rank of the Respondent

Position/Rank	Frequency (N)	Percentage (%)
Top management level	21	33
Middle Mgt. level	10	16
Low Mgt. Level	3	5
Operatives	29	46
Total	63	100

Table 3 shows the categories of the respondents from contractors at top management level (33%) middle and low management levels (21%) to site operators (46%).

Table 4: Years of Working Experience

Years	Frequency (N)	Percentage (%)
Less than 5	0	0
6- 10	6	10
11- 15	4	6
16- 20	9	14
21- 25	24	38
More than 25	20	32
Total	63	100

Table 4- 10 shows that majority of the respondents (90%) have working experience of more than ten (10) years. Furthermore, over (10%) of the respondents have working experience of more than five (5) years in various building projects, particularly masonry work.

Table 5: Type of Client

Client	Frequency (N)	Percentage (%)
Public	6	9
Private	8	13
Both	49	78
Total	63	100

Table 6: Annual Turn Over

Turn over	Frequency (N)	Percentage (%)
Up to 10m	4	6
10- 100m	9	14
100- 300m	23	37
Over 300m	27	43
Total	63	100

Table 7: Type of Construction/Project Undertaken

Project	Frequency (N)	Percentage (%)
Building works	41	65
Civil Engineering works	5	8
Both	13	21
Others	4	6
Total	63	100

Table 8: Type of Building Project Undertaken

Project	Frequency (N)	Percentage (%)
Bungalow	19	30
1-3 store building	33	52
More than 3 storey bldg.	11	18
Total	63	100

Table 9: Type of Masonry Work Undertaken

Masonry work	Frequency (N)	Percentage (%)
Block work	31	49
Brick work	9	14
Both	23	37
Total	63	100

Table 10: Masonry Content

Work content	Frequency (N)	Percentage (%)
High work content	37	59
Medium work content	18	28
Low work content	8	13
Total	63	100

Results from Factors Ranking

In this article, Forty (40) related factors that negatively influence productivity have been identified and ranked according to their critical influence on masonry labour.

Worker Group

Table 11 shows the ranking of twelve (12) factors in the group. The result indicated that the most important factors that negatively

influence productivity of masonry worker are: security (0.905), worker experience (0.873), worker communication (0.835), worker motivation (0.798), worker expertise (0.790), worker health (0.756) and worker training (0.704). Other factors are: worker education (0.687), team work (0.638), worker sense of responsibility (0.556), worker capability (0.502), worker morale and attitude (0.479).

Table 11; Factors Under Worker Group

Related factors	Degree of importance					Total resp.	RII Index	Rank
	5	4	3	2	1			
Security	43	11	8	1	0	63	0.905	1 st
Worker experience	39	14	6	2	2	63	0.873	2 nd
Worker communication	31	18	6	7	4	63	0.835	3 rd
Worker motivation	23	19	19	1	1	63	0.798	4 th
Worker expertise	21	24	16	2	0	63	0.790	5 th
Worker health	25	17	8	8	5	63	0.756	6 th
Worker training	18	12	21	9	3	63	0.704	7 th
Worker education	16	13	20	10	4	63	0.687	8 th
Team work	11	12	24	10	6	63	0.638	9 th
Worker sense of responsibility	7	23	10	5	8	63	0.556	10 th
Worker capability	11	7	8	14	23	63	0.502	11 th
Worker morale and attitude	6	11	2	27	17	63	0.479	12 th

Material/Tools Group

Table 12 shows the ranking of six (6) factors in the group. The result indicated that the most important factors that negatively influence productivity of masonry work are: material

quantity (0.937), material condition (0.892), tools and equipment shortage (0.771), material transportation (0.737), material procurement (0.565), and material applicability (0.559).

Table 12: Factors Under Material/Tools Group

Related factors	Degree of importance					Total resp.	RII Index	Rank
	5	4	3	2	1			
Material quantity	49	8	6	0	0	63	0.937	1 st
Material condition	38	19	4	1	1	63	0.892	2 nd
Tool and equipment shortage	22	15	21	5	0	63	0.771	3 rd
Material transportation	26	15	8	4	10	63	0.737	4 th
Material procurement	13	9	6	20	19	63	0.565	5 th
Material applicability	15	0	18	17	13	63	0.559	6 th

Worker Characteristics Group

In this group, the result shows that among the seven (7) most important factors that negatively influence productivity of masonry work are: work space (0.867), poor weather condition

(0.800), work difficulty (0.673), work environment (0.654), working field accessibility (0.609), work quality (0.448), and work method (0.321) as depicted in table 13 below.

Table 13: Factors Under Work Characteristics Group

Related factors	Degree of importance					Total resp.	RII Index	Rank
	5	4	3	2	1			
Work space	38	19	4	1	1	63	0.867	1 st
Poor weather condition	27	21	8	2	5	63	0.800	2 nd
Work difficulty	15	7	29	10	2	63	0.673	3 rd
Work environment	5	23	27	0	8	63	0.654	4 th
Working field accessibility	18	2	20	11	12	63	0.609	5 th
Work quality	3	2	23	14	21	63	0.448	6 th
Work method	0	0	14	10	39	63	0.321	7 th

Management and Control Group

Table 14 shows the ranking of fifteen (15) factors in the group. The result indicated that the most important factors that negatively influence productivity of masonry work are: payment delay (0.946), drawing and specification alteration during project execution (0.816), poor scheduling and coordination (0.803), work order (0.765), slow local authority

approval (0.733), lack of periodic meeting with workers (0.619), safety/accident (0.600), rework due to construction error (0.581) and manager capability (0.565). Other factors are: inspection delay (0.559), lack of labour surveillance (0.537), work delay (0.533), management system (0.463), information technology (0.425), and work continuity (0.416).

Table 14: Factors Under Management and Control Group

	Degree of importance					Total resp.	RII Index	Rank
	5	4	3	2	1			
Payment delay	50	9	4	0	0	63	0.946	1 st
Drawing and specification alteration during project execution	32	17	6	3	5	63	0.816	2 nd
Poor scheduling and coordination	25	21	10	7	0	63	0.803	3 rd
Work order	21	16	20	6	0	63	0.765	4 th
Slow local authority approval	19	7	28	6	3	63	0.733	5 th
Lack of periodic meeting with workers	12	9	20	17	5	63	0.619	6 th
Safety/ accident	9	14	18	12	10	63	0.6	7 th
Rework sdue to construction error	8	12	16	20	7	63	0.581	8 th
Manager capability	12	5	16	20	10	63	0.565	9 th
Inspection delay	8	8	17	23	7	63	0.559	10 th
Lack of labour surveillance	11	3	19	15	15	63	0.537	11 th
Work delay	2	15	15	22	9	63	0.533	12 th
Management system	0	11	13	24	15	63	0.463	13 th
Information technology	0	2	20	25	16	63	0.425	14 th
Work continuity	0	0	25	18	20	63	0.416	15 th

Table 15: Overall Factors

Related Factors	RII	RANK
Payment delay	0.946	1
Material quantity	0.937	2
Worker experience	0.905	3
Material condition	0.892	4
Security	0.873	5
Work space	0.867	6
Worker communication	0.835	7
Drawing and specification alteration during project execution	0.816	8
Poor scheduling and coordination	0.803	9
Poor weather condition	0.800	10
Worker motivation	0.798	11
Worker expertise	0.790	12
Tools and equipment shortage	0.771	13
Work order	0.765	14
Worker health	0.756	15
Material transportation	0.737	16
Slow local authority approval	0.733	17
Worker training	0.704	18
Worker education	0.687	19
Work difficulty	0.673	20
Work environment	0.654	21
Team work	0.638	22
Lack of periodic meeting with workers	0.619	23
Working field accessibility	0.609	24
Safety/ accident	0.600	25
Rework due to construction error	0.581	26
Manager capability	0.565	27
Inspection delay	0.559	28
Worker sense of responsibility	0.546	29
Lack of labour surveillance	0.537	30
Work delay	0.533	31
Material applicability	0.529	32
Material procurement	0.515	33
Worker capability	0.502	34
Worker morale and attitude	0.479	35
Management system	0.463	36
Work quality	0.448	37
Information technology	0.425	38
Work continuity	0.416	39
Work method	0.321	40

The ten (10) most frequent factors that negatively affect productivity of masonry work, as revealed by the respondents, could be found in table 16 below:

Table 16: Frequency Index

Related Factors	3	2	1	Total resp.	Freq. Index	Rank
Payment delay	50	13	0	63	0.931	1
Material quantity	49	14	0	63	0.926	2
Security	43	19	1	63	0.894	3
Material condition	38	23	2	63	0.857	4
Worker experience	39	20	4	63	0.852	5
Work space	38	19	6	63	0.836	6
Drawing and specification alteration	32	23	8	63	0.794	7
Worker communication	31	24	8	63	0.788	8
Poor scheduling	27	29	7	63	0.741	9
Poor weather condition	25	21	7	63	0.656	10

The ten (10) most critical factors that negatively affect productivity of masonry work were presented in table 17 below:

Table 17: Critical Index

Related Factors	Relative Important Index	Frequency Index	Critical Index	Rank
Payment delay	0.946	0.931	0.881	1
Material quantity	0.937	0.926	0.868	2
Security	0.905	0.873	0.809	3
Worker experience	0.892	0.857	0.764	4
Material condition	0.873	0.852	0.744	5
Work space	0.867	0.836	0.725	6
Worker communication	0.835	0.794	0.658	7
Drawing and specification alteration	0.816	0.788	0.647	8
Poor weather condition	0.803	0.741	0.593	9
Poor project scheduling	0.800	0.656	0.526	10

CONCLUSION

This research has identified evaluates and ranked factors that were found to be of critical influence on labour productivity for masonry work on site. The results of the research indicated that the top four (4) factors that critically influence labour productivity of masonry work were; *payment delay*, *material quantity*, *security*, *material condition* and *worker experience*.

- i. **Payment delay (financial problem)**, (Critical Index = 0.881): Payment process discourages some qualified contractors from bidding for the job. In some cases, payment process is exposed to corruption. Payment delay can influence the supplier not to deliver adequate material to the site.
- ii. **Material quantity (delivery)**, (Critical index = 0.868): The second most critical factor with negative effect on labour productivity of masonry work is the stoppage of material delivery.
 - a. Material can be short on site due to supplier's attitude as a result of non-payment from the part of the main contractors. This makes the suppliers to have no confidence on the contractors.
 - b. Lack or shortage of material on site results in the workers being idling and doing nothing and this would influence the workers' motivation and productivity.
- iii. **Security**, (Critical Index = 0.809): This is the third ranked critical factor that negatively influences productivity of masonry work. Security as a constraint has negative and significant influence on the

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program of projects. The ranking of this factor by the respondents may be connected to the current security challenges facing Kano and other part of northern Nigeria.

- iv. **Worker experience**, (Critical Index = 0.764): This is the fourth critical factor ranked by the respondents as it negatively influences productivity of masonry work. Lack of labour experience has a very high effect on productivity. The finding of this study was also supported by some research which confirmed that experience of workforce affects job site productivity. Experience improves both intellectual and physical abilities which eventually improve productivity.

RECOMMENDATIONS

From the findings of this study, the following recommendations were made;

- i. **Payment delay**: Payment should be made promptly to both contractors and suppliers for efficient project delivery.
- ii. **Material quantity**: The procurement department should always coordinate with site staff to ensure adequate material supply to site.
- iii. **Security**: Government should provide adequate security of life and properties to its citizens as this will improve productivity.
- iv. **Worker experience**: On-site training, seminars, conferences, and workshops should be encouraged for workers as this would go a long way in skills enhancement.

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