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 Nigeria.
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 (Fagbele 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. (Fagbele 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 on construction sites. 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 Northwestern 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).

\[
\text{Relative Importance Index} = \frac{5n^5 + 4n^4 + 3n^3 + 2n^2 + n}{5(n^5 + n^4 + n^3 + n^2 + n^1)}
\]

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:

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

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.

| 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            |

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

**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 |
|----------------------------------------|----------------------|-------------|-----------|------|
| Material quantity                      | 49 8 6 0 0 63        | 0.937       | 1st       |
| Material condition                     | 38 19 4 1 1 63       | 0.892       | 2nd       |
| Tool and equipment shortage            | 22 15 21 5 0 63      | 0.771       | 3rd       |
| Material transportation                | 26 15 8 4 10 63      | 0.737       | 4th       |
| Material procurement                   | 13 9 6 20 19 63      | 0.565       | 5th       |
| Material applicability                 | 15 0 18 17 13 63     | 0.559       | 6th       |
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 |
|------------------------------------------------|----------------------|------------|-----------|------|
| Work space                                      | 38 19 4 1 1 63       | 0.867      | 1st       |
| Poor weather condition                         | 27 21 8 2 5 63       | 0.800      | 2nd       |
| Work difficulty                                | 15 7 29 10 2 63     | 0.673      | 3rd       |
| Work environment                               | 5 23 27 0 8 63     | 0.654      | 4th       |
| Working field accessibility                     | 18 2 20 11 12 63   | 0.609      | 5th       |
| Work quality                                    | 3 2 23 14 21 63   | 0.448      | 6th       |
| Work method                                     | 0 0 14 10 39 63   | 0.321      | 7th       |

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), 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 |
|----------------------|------------|-----------|------|
| Payment delay        | 50 9 4 0 0 63 | 0.946 | 1st |
| Drawing and specification alteration during project execution | 32 17 6 3 5 63 | 0.816 | 2nd |
| Poor scheduling and coordination | 25 21 10 7 0 63 | 0.803 | 3rd |
| Work order           | 21 16 20 6 0 63 | 0.765 | 4th |
| Slow local authority approval | 19 7 28 6 3 63 | 0.733 | 5th |
| Lack of periodic meeting with workers | 12 9 20 17 5 63 | 0.619 | 6th |
| Safety/ accident     | 9 14 18 12 10 63 | 0.6 | 7th |
| Rework due to construction error | 8 12 16 20 7 63 | 0.581 | 8th |
| Manager capability   | 12 5 16 20 10 63 | 0.565 | 9th |
| Inspection delay     | 8 8 17 23 7 63 | 0.559 | 10th |
| Lack of labour surveillance | 11 3 19 15 15 63 | 0.537 | 11th |
| Work delay           | 2 15 15 22 9 63 | 0.533 | 12th |
| Management system    | 0 11 13 24 15 63 | 0.463 | 13th |
| Information technology | 0 2 20 25 16 63 | 0.425 | 14th |
| Work continuity      | 0 0 25 18 20 63 | 0.416 | 15th |
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                                       | 0.444| 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 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 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 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.

   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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