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Effect of Poor Materials Management on Materials Waste in FCT, Abuja, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Materials on construction site management are critical issue within the Nigerian subcontractors. Often, movement of materials to site from one point to the other point leads to more cost of goods. Hence, management of construction materials in building industries is a crucial aspect in project management. If these are not done properly it will lead to high costs in the construction phase. The present research seeks to assess the impact of Poor Materials Management (PMM) on waste materials in project in FCT, Abuja, Nigeria.

The research collects data through questionnaires from the field survey, interview and site observation. Descriptive statistics was used for the study, mean index score method of analysis were adopted. Result of the study indicates that considerable effect on material waste generation on any construction project site were observed as a result of poor materials management; effects on quality of building projects was observed to be moderate, and effects on profitability in the construction projects were observed to be both high and moderate.

The study concludes that effective management of materials in construction projects would decrease the amount of waste generation, raise the quality of construction work, and offer

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maximum profit to the contractors. The study recommendations that the government agencies should collaborate with construction industry in Nigeria to develop policies for adoption on waste management plan for the construction industry and guarantee that senior officers adopts the training and developing the younger staff on the latest techniques for site materials management and managerial tools.

Keywords: Investigating; poor materials; PMM; building construction; good practice.

1. INTRODUCTION

Materials on construction site management are critical issue within the Nigerian subcontractors. Often, movement of materials to site from one point to the other point leads to more cost of goods [1]. The challenges of storing materials on site, due to lack of enough space, are also a challenge in building construction material management in Nigerian. Often, the problem of lack of enough space or mismanagement of other site activities has leads to inability of the machinery to be adjusted on site. Most of construction projects use paper-based techniques or manual methods for tracking materials, and this has become challenging, due to so many mix-up by human being [2]. Albert and Shakantu [3] submitted that the process of construction will rely on the people with the right prerequisite experience that are willing to deliver the project as plan and on budgeted for.

Thus, in building construction project site, construction materials management is a crucial aspect of the success of any project management. If the management of construction materials is Poor it can lead to increase of costs in the process of construction. Substantial savings in project costs are only achievable if the management of construction materials is efficient. Early procurement of construction materials may leads to the capital held up and profit charges incurred on the excess inventory of construction materials. Depreciation during storage or stealing if special care is not taken is also problems with early purchase of Construction Materials. At the time of need of any construction materials, if there is a delay in supply extras expenditure may be incurred. Also among the crucial interest of construction material management is ensuring a timely flow of construction materials to the site. The assessment of the output of construction materials management is paramount if effective managing and controlling of construction materials are desired. The value of performance calculates the effective working of a function. These performance measures may not be the same from one system to the other system. The measure splits the management of construction materials system into parts and makes the working of the system more efficient. The complete management of the construction materials system is achieved when all the measures are joined [4].

In Nigeria, Standard Organization of Nigeria (SON) is one of the well-known institutions that are saddle with the responsibility of standardization of building materials [5]. The author further reported that due to the fact that the regulations policies that exist for supervising quality and performance of materials has not been followed, its leads to too many number of collapse building we experience in Nigeria. There are many rules and regulations on governing building construction and structural requirement as well as administration and enforcement, however, how are this policies been follow is the most important consideration.

Improving productivity in construction projects is a critical aspect in management of construction materials. At all the stages of the construction process and throughout the construction and production periods, the management of construction materials needs to be put into considered. This is because the entire construction quality, time, and budget can sometimes be affected by poor management of the construction materials. The present research seeks to assess the effect of Poor Materials Management (PMM) on waste materials in building project sites and the establishing of good elements practice in construction materials management on building construction project sites in FCT, Abuja, Nigeria.

2. MATERIALS AND METHODS

2.1 The Study Area

The creation of the city of Abuja as Federal Capital City was due to the reasons and situations that made Lagos to be no longer suitable or conducive to save as the Federal

Capital City of Nigeria [6]. The F.C.T. (Abuja) is located in the middle belt also known as guinea savannah region of Nigeria. Its lies at latitudes 8°25' and 9°20' North of the equator as well as longitudes 6°45' and 7°30' East of the Greenwich meridian. Abuja is within the central zone of Nigeria. The Abuja capital city is situated inside the large area of Abuja Municipal Area Council. The area consist of six (6) area councils, namely Abuja Municipal Area Council (AMAC), Gwagwalada, Abaji, Bwari, Kuje, and Kwali. The focus of this study is on AMAC. This area council is made up of eleven (11) wards, namely City Centre, Garki, Gwarimpa, Gwagwa, Jiwa, Kabusa, Karshi, Karu, Nyanya, Orozo, and Wuse. The whole eleven (11) wards under AMAC was used for the study, however, only ten (10) projects within the geographical area meets the stipulated sampling requirement.

The humidity of Abuja rises to 50% in the rainy season and reduces to about 2% in the dry season. The influence of the activities of the south west and north east trade winds has leads to fluctuation in the humidity of Abuja and the entire country. The humidity always reduces considerably when the dry northeast trade winds start to blow over the country and its increases when the moisture laden southwest trade winds prevail. The annual rainfall of F.C.T. is about 1632mm the rains are usually heavy often with lightning and thunder [6].

The climate of Abuja is influenced by its position in the middle belt of Nigeria. It lies in the zone of transition between the wet south and the dry north. The highest temperatures in F.C.T. is about 37°C are recorded in the dry season. This is between the months of November and March. A contributory factor to this phenomenon is the fact that at this time in the year, the skies over the F.C.T. are cloudless and in-coming sunlight is unobstructed. The lowest temperatures of about 17°C are recorded in the wet season between the months of July and October when the cloudy skies help to shut out most of the in-coming sunlight [6].

2.2 Methods

The research design adopted survey research approach for this study. The use of this research design is based on the nature of the main objectives of the research mentioned earlier. Since the populations of the study are all building construction projects sites that are ongoing and these were small populations by adopting census, a total of one hundred (100) building sites were sample and adopted for used in the study. From the population of the study, a sample of ten (10) building projects sites was selected, with a value of above one hundred million naira (#100m) using purposive non-probability sampling techniques. Data were sourced from ten (10) public and private construction project sites inside Abuja, Nigeria, with a project cost value of above one hundred million naira (#100m).

Structured questionnaire was prepared and self-administered to the various respondents in the sites after reviewing of current literature and study objectives. Check of the internal reliability of the data for the questionnaire was very important [7]. If a little differences on the instrument was observed in repeated measurements of an attribute, the higher its reliability [7]. To check the reliability of questionnaire, Cronbach's Coefficient Alpha was used. The value 0.0 and + 1.0 are usually the range of Cronbach's coefficient alpha however, the higher the values the higher the degree of internal consistency [7]. The equation 2.1 shows the Cronbach's Coefficient Alpha.

$$a = \frac{k_r}{1 + (k-1)_r} \tag{2.1}$$

Where K means variables items in the scale while r means the average of the inter-item correlations.

2.3 Data Analysis

The descriptive statistic and inferential methods of data analysis adopted after collecting them through the questionnaires. Mean or average Index Score, as well as Lickert scale analysis were carryout. Microsoft Excel and Statistical Package for the Social Sciences (SPSS) were used to generate the result.

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics of the Respondents

The consultants, clients, contractors, and other civil engineer professionals were serve with one hundred (100) questionnaires, from which 87 questionnaires were returned with all questions answered, this makes it 87% response rate. As for the results of survey, out of 40 questionnaires

that were administered to the contractors, 36 were returned, also out of 35 questionnaires that were administered to the consultants, 30 were returned. While out of 15 questionnaires that were administered to clients or owner of buildings, 12 were returned. Also out of 10 questionnaires that were administered to other civil engineer professionals, 9 were returned. This make the respondent rate among the interviewee to be 41.4%, 34.5 %, 13.8% and 10.3 % respectively.

3.1.1 Age of respondents

Fig. 1 presents age of the respondents

Result indicates that the ages of 18-25 years respondents constitute 21 %, the ages of 26-35 years respondents constitutes 68% while only 11% are between the ages of 36-45 years. The result implies that the majority of the respondent are between the ages of 26 – 35 representing a productive youths.

3.1.2 Academic qualification of respondents

Fig. 2 shows the professional backgrounds of respondents.

The result indicates that, the respondents with diploma are (9.2%), the respondents with bachelor degree are (64.4%), and with master degree are (26.4%) and no respondents with below diploma or above master degree.

3.1.3 Experience of respondent

The working experience of the respondents is shown in Fig. 3.

The results reveals that, 47.1% of the respondents have less than 5 years working with the construction industry, 32.2 % of the respondents have work between 6-10 years, and 20.7% of the respondents have work between 11-15 years. However, none of the respondents has more than 16 year's professional experience.

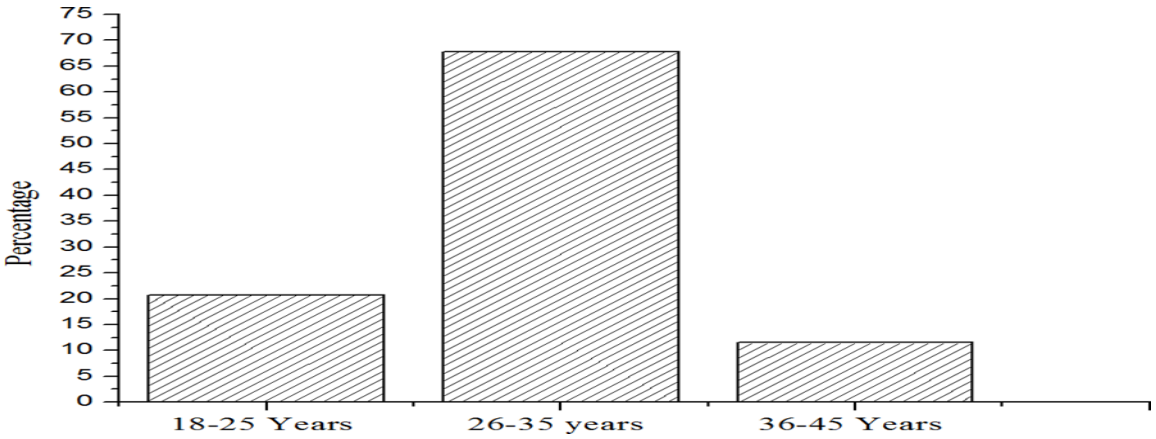

Fig. 1. Age of respondents

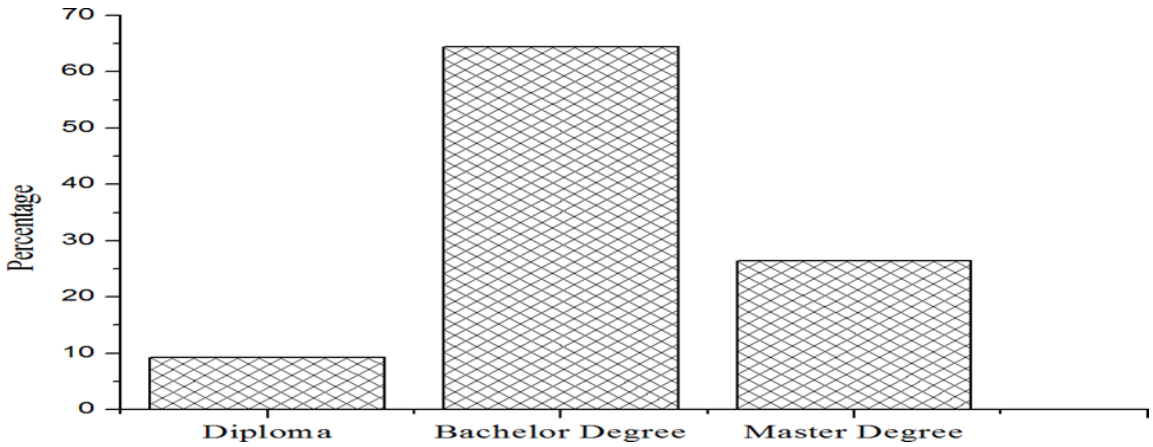

Fig. 2. Academic qualification

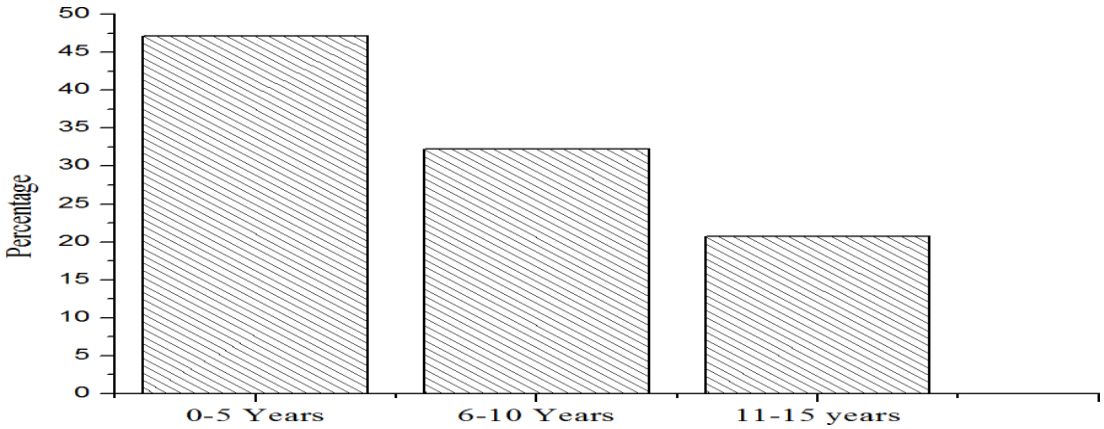

Fig. 3. Experience of respondents

3.1.4 Respondents position in the organization

Fig. 4 shows the position of the respondent in their firm.

The analysis revealed that, managing directors constitutes 2.3%, project managers constitutes 8.0%, office engineers constitutes 21.8%, with site engineers constitutes 17.2%, resident engineers constitutes 33.3%, quantity surveyors constitutes 2.3%, while others like project inspectors, Forman's, supervisors, constitutes 14.9%. The large number of resident engineers, site engineers, office engineers, and project managers are because they are the key professionals usually engaged in the construction company in the FCT.

3.1.5 Classification of firms in the construction business

Classification of firm of the respondents is shown in Fig. 5.

The analysis shows that, 47.1% were private organization, 32.2% were governmental or public organization, and also 16.1% were share companies while the minorities were other firms (4.6%). This means that majority of the construction firms are owned by private owners.

3.2 Effect of Poor Material Management on Building Construction Project Sites

3.2.1 Effect of poor material management on material waste

Table 1 presents the effect of poor materials management on materials waste on project site in FCT, Abuja.

A total model value of 3 implies that PMM has a high outcome on material waste in the construction industry in Abuja, Nigeria. This implies that PMM aggravate the challenge of wastage of materials on sites. This finding reveals that quantity of waste increases with PMM in the site. The result is in agreement with the report of Saidu and Shakantu [8] that imprudent management of materials does raise material waste on building construction sites, with another result of a corresponding increase in the amount of cost overrun for a project.

3.2.2 Effect of poor materials management on quality

Table 2 presents the poor materials management effects on quality on project site in FCT, Abuja. A total modal value of 2 indicates that PMM has an average impact on the quality in the construction industry in Abuja, Nigeria.

As seen from Table 2 that the statement "quality control of materials are limited by PMM" was observed to have a highest effect on quality, this is because it has a modal value of 3. This is in agreement with the work reported by Khalek et al. [9] on achieving quality in management of materials in construction projects. Quality control means all the necessary part of quality management that guarantee that services and products meet the set standards and requirements. To control the quality it is based on the examination of the products.

However the following statements shows average effects on quality: the quality of some of the materials on site are affected negatively because of PMM; the quality standard set up by management are limited by PMM, and conducting materials quality audits are made

difficult by PMM. All of these items have modal values of 2 and therefore are said to have average effects on quality. These results is the same with the work of Khalek et al. [9], who shows that delivering of substandard materials and products onsite is one of the serious issues effecting negatively on the quality of materials on site.

A quality audit means a process of reviewing how effective the key areas of the project quality plan are being carried out. The essence of the audit is to know if the quality plan is working as planned. In other to ensures a good materials quality audit, you need to firstly, have the right steps listed in the quality plan that should be should be followed and, secondly, the listed steps should be followed consistently [10,11]. Following the appropriate standards and regulations is a duty of the contractor, and also to make sure that the client continuous monitoring, and to do a quality control through self-inspection of the site.

3.2.3 Effect of poor materials management on profitability

Table 3 presents the effect of poor management of materials on profitability on project site in FCT, Abuja. Total modal values of 2 and 3 means that PMM has an average impacts on profitability in the construction industry in Abuja, Nigeria. As reported by Kerstin, [12] if the materials that are required to complete a project are not properly managed during the construction period, then it can result to contractors not having their desired profitability after getting a contract.

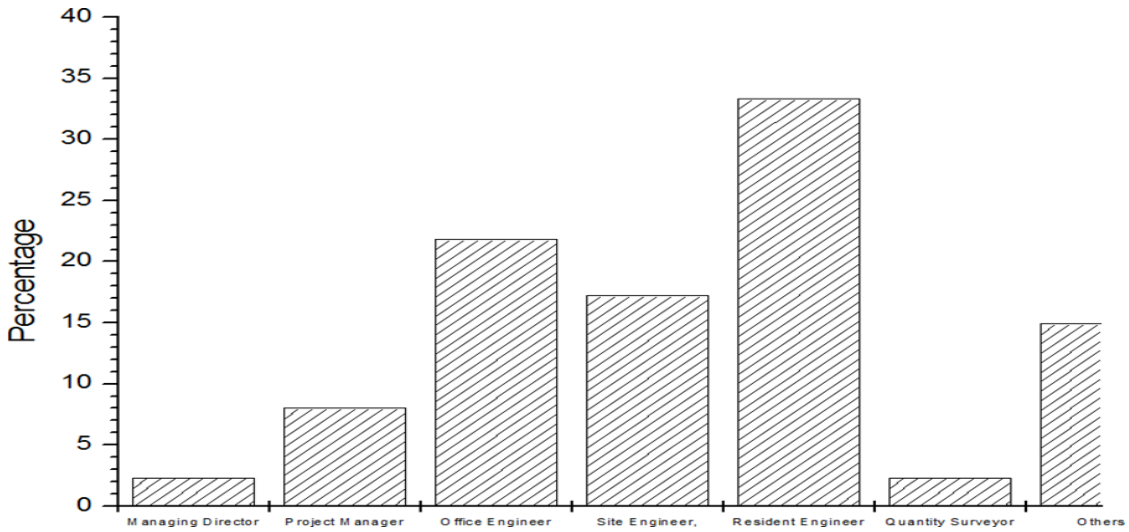

Fig. 4. Position of respondents

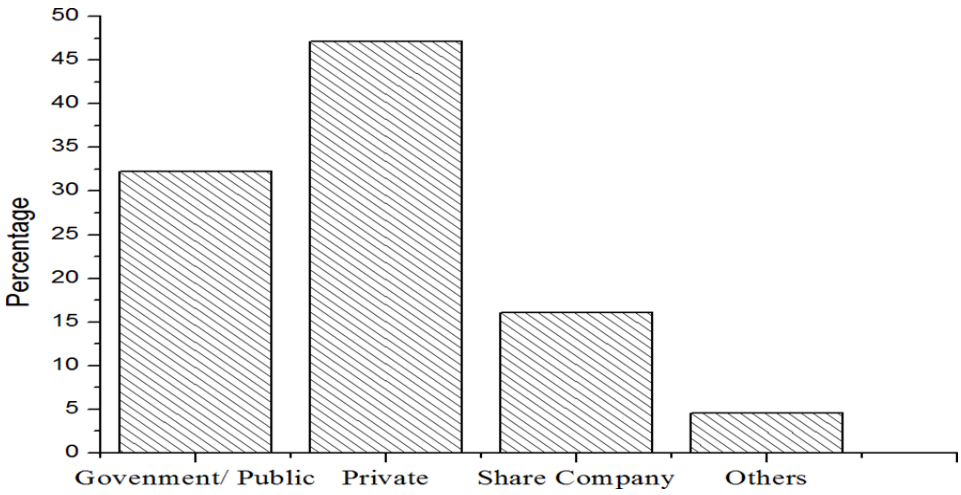

Fig. 5. Classification of firms in the construction business

Table 1. Effect of poor materials management on materials waste

Statement	3 means High Effect; 2 means Moderate Effect; While 1 means Low Effect										Mode
	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	
Quantity of waste increases with PMM	3	1	1	2	2	3	3	3	3	2	3
Impacts on the waste management plan undesirably on the PMM	3	1	1	1	1	3	3	2	3	2	1 and 3
Impacts on the proposal for material waste recycling, regaining and disposal undesirably on the PMM	2	2	2	2	2	2	3	3	3	2	2
Mixing of waste is caused by PMM	2	1	1	1	1	3	3	3	3	1	1
Monitoring of the waste management plan becomes burdensome with PMM	2	1	2	2	2	3	3	2	3	2	2
Managing waste- related KPIs becomes difficult with PMM	2	1	1	3	2	3	2	3	3	2	2 and 3
Managing site waste management plan cost data becomes hard with PMM	3	1	1	1	3	3	2	3	2	2	3
The struggle for minimizing materials utilization is nullify by PMM	2	2	2	2	2	2	2	2	2	2	2
The need to examine and identify materials waste streams is impacted by PMM	3	1	1	1	1	3	3	2	2	1	1
Accounting for materials waste becomes cumbersome with PMM	3	2	2	2	2	3	3	3	3	2	2 and 3
Practicing materials waste management policy becomes difficult with PMM	3	2	1	3	2	3	3	3	3	2	3
Total											3

Table 2. Effect of poor materials management on quality

Statement	3 Means high effect; 2 Means moderate effect; While 1 Means low effect										Mode
	CS1	CS2	CS3	CS4	CS5	CS6	CS7	CS8	CS9	CS10	
PMM leaves some materials spoiled, because quality of work is compromised,	3	1	1	1	2	3	3	2	2	1	1
The quality of some of the materials on site are affected negatively because of PMM	3	1	2	2	1	2	2	3	1	1	2
The quality standard set up by management are limited by PMM	2	2	2	2	2	2	2	2	2	2	2
Quality control of materials are limited by PMM	3	3	3	2	2	3	2	3	2	1	3
Conducting materials quality audits are made difficult by PMM	2	3	3	3	2	3	2	2	2	2	2
Total											2

Observing the statement that, PMM increases waste, hence limiting profitability of construction projects. This indicates that to have a materials waste on site means to decreases the contractors' profits. This agrees with the work of Ahankoob et al. [13] who reported that managing and preventing the causes of wastage will decrease the impact on the project and increase

profits. This implies that there is a need to decrease waste of materials on site, in order to achieve high profit.

The study also shows that, PMM has an average impact on suboptimal accounting for materials, hence decreasing the profit. Wahab [14] reported that poor record-keeping of all the materials supplied to the site and used reduces the profit. Hence, good records of all the materials receiving, and materials requisition should be well kept, and observation of all materials should be done.

The high impact of lack of proper storage of materials results to stealing of materials, hence resulting to small profit. Lost of materials due to stealing will call for a replaced by new materials, hence limiting profitability. This result agrees with the work of Kasim et al. [15]. This indicates that, lack of adequate storage of materials on site will leads to lose and if there is damage or destruction, another material will be needed to replace the damaged or destroyed materials, hence limiting the profit.

Average effect is observed in terms of how PMM increases suboptimal materials quality, hence resulting to repeat of work and reducing the profit. Repeat of work could seriously affect time and productivity and, definitely, also profit. These agrees with the work of Aiyetan [16], and Hughes and Thorpe [17] that said direct impacts of repeat of work on construction projects would likely include more time for repeat of work; more costs for covering repeat of work occurrences; more materials for repeat of work and thereafter wastage handling, and more labour for repeat of work and also will leads to extensions of supervision and manpower. All these works validate the fact that repeat of work in construction projects has the potential to make at least an average contribution to the total project cost and to reduces its profit.

Also, the research indicated that health and safety incidents increase with PMM, hence resulting to expenses or claims and impacting profit. This result is in agreement with the work of Muhwezi et al. [18] who reported that waste of materials on building projects cause more cost to contractors, and also affects significantly the health incidents. From the field experience during this research, it was discovered that most of construction workers on sites do not have access to appropriate protective equipment. For instance, most workers were seen carrying out their normal site activities such as excavations, painting, and concreting without the use of protective gear such as masks, helmets, goggles, and overalls. There are always expenses or claims for health and safety incidents on site if such occurs.

Table 3. Effect of poor materials management on profitability

Statement	**3 Means high effect; 2 Means moderate effect; and 1 Means low effect**										**Mode**
	CS1	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**CS7**	**CS8**	**CS9**	**CS10**	
PMM increases waste, hence limiting profitability	3	3	2	1	3	2	2	1	2	3	2 and 3
PMM results to suboptimal accounting for materials, hence decreasing profitability	1	3	2	3	3	1	2	2	2	3	2 and 3
Lack of proper storage of materials results to stealing of materials, hence resulting to small profit	2	1	3	3	2	3	3	3	2	1	3
Lack of proper storage of materials results to damage or destruction, hence it reduces the profit	3	3	2	3	1	2	2	2	2	3	2
PMM raises suboptimal materials quality, hence resulting to repeat of work and reducing profitability	1	3	2	2	2	3	1	2	1	2	2
Health and safety incidents increases with PMM, hence resulting to expenses or claims and impacting profitability	1	2	1	3	3	1	2	3	2	3	3
Total											2 and 3

Table 4. Measures for effectiveness on construction materials on sites

Measures for effectiveness	N	Mean	Standard deviation	Ranking
Training people on how to limits waste	87	4.58	0.758	1
An efficient way Using packaging	87	4.43	0.497	2
Ensuring samples get materials approved	87	4.41	0.693	3
The situation reports of all the materials in the project's store	87	4.38	0.598	4
Daily record of used materials in the project store	87	4.38	0.598	5
Consideration of the right communication paths for material	87	4.36	0.586	6
Preparing and observing the construction activities in the site	87	4.32	0.547	7
All work done by the qualified employees	87	4.32	0.547	8
All the accepted materials that are used in the site	87	4.28	0.721	9
Quality challenges have been fixed	87	4.25	0.840	10
Requirements for the extent of work achieved	87	4.25	0.554	11
Monitoring of over- buying and ordering	87	4.25	0.867	12
Getting all material ready for storage	87	4.23	0.665	13
Use of safe, suitable, and secure storage	87	4.21	0.752	14
Consideration of off-site construction	87	4.20	0.590	15
Follow and record all the prices in the market	87	4.17	0.695	16
Define the right materials specifically	87	4.15	1.068	17
Recruitment of security personnel and store keeper	87	4.14	0.813	18
The preceding work segments should be Completed	87	4.07	0.722	19
Estimating all the materials price in the market	87	4.06	1.019	20
Paying attention to weather situation	87	4.04	0.867	21
Assumption of field situation, weather and event in the near future	87	4.02	0.971	22
Identify all the Material needed	87	4.01	0.885	23
Performs reuse and recycle methods for waste materials and surplus materials	87	3.89	1.084	24
Wastage and loss-storage in delivery should be reported	87	3.89	0.812	25
Consider efficient machinery and mechanical systems	87	3.86	0.721	26
Surveying sources of materials before purchasing	87	3.85	0.876	27
Installation of specifications met	87	3.82	1.056	28
Average mean		4.19		

3.3 Measures for Effectiveness on Construction Materials on Sites in FCT, Abuja

Table 4 presents the measures for effectiveness on construction materials on sites in FCT, Abuja. This section examines the various measures for effectiveness on construction materials management on construction project sites. This was done with the use of mean index score. The calculation of the mean ratings on the measures for effectiveness was done based on a scale of 1-5 (from "strongly disagree" to "strongly agree").

From Table 4, the research has shown that items that has above average (average mean score of 4.19) are more than half of the measures for effectives for management of the construction materials on building construction project sites. From the overall 28 items indicated above, 24 activities accounted for less than 1.0 standard deviation. This implies that, the majority of the respondents, had the same rating of their measures for effectiveness on management of the construction materials in their activities however, a small number of four (4) items had a standard deviation that is more than 1.0 showing differences in the respondents' ratings.

From Table 4, the excessive measures for effectiveness for construction materials management on building construction project sites were Training people on how to limits waste (mean = 4.58) and An efficient way Using packaging (mean = 4.43) and the most measures for effectiveness for management of the construction materials on building construction project sites were ensuring samples get materials approved (mean = 4.41), The situation reports of all the materials in the project's store and daily record of used materials in the project

store (mean = 4.38), consideration of the right communication paths for material (mean = 4.36).

Others includes preparing and observing the construction activities in the site and All work done by the qualified employees (mean = 4.32), All the accepted materials that are used in the site (mean = 4.28), Quality challenges have been fixed, Requirements for the extent of work achieved and Monitoring of over- buying and ordering (mean = 4.25), Getting all material ready for storage (mean = 4.23), Use of safe, suitable, and secure storage (mean = 4.21), Consideration of off-site construction (mean = 4.20) and other most measures for effectiveness for construction materials management on building construction project sites. However, the following items have an average value: Follow and record all the prices in the market (mean = 4.17), Define the right materials specifically (mean = 4.15), Recruitment of security personnel and store keeper (mean = 4.14), the preceding work segments should be Completed (mean = 4.07), Estimating all the materials price in the market (mean = 4.06).

Also, Paying attention to weather situation (mean = 4.04), Assumption of field situation, weather and event in the near future (mean=4.02), Identify all the Material needed (mean = 4.01) while Performs reuse and recycle methods for waste materials and surplus materials and Wastage and loss-storage in delivery should be reported (mean = 3.89), Consider efficient machinery and mechanical systems (mean = 3.86), Surveying sources of materials before purchasing (mean = 3.85) and Installation of specifications met (mean = 3.82) were the least rated.

Generally the result shows that, Training people on how to limits waste and uses of packaging in an efficient way, are the most highly observed while Installation of specifications met recorded the lowest mean of 3.82. The result from the field survey and interview has also indicates the same opinions with these result of the questionnaire survey.

4. CONCLUSION AND RECOMMENDATION

The study concludes that effective management of materials in construction projects would decrease the rate of waste generation, add to the quality of construction work, thereby offering maximum profit to the contractors.

The study recommends the following base on the results of the study:

- The government agencies should collaborate with construction industry in Nigeria to develop policies for adoption on waste management plan for the construction industry and guarantee that senior officers adopts the training and developing the younger staff on the latest techniques for site materials management and managerial tools.
- Management of the construction materials sector should encourage the management of an organization in their production activities, as this could assist in the promoting, marketing, and selling, also controlling of all types of construction materials for its quality, quantity, and cost for efficient management of the construction materials.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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