INVESTIGATING THE EFFECTS OF POOR MATERIALS MANAGEMENT (PMM) ON BUILDING CONSTRUCTION PROJECT SITES AND ESTABLISHING ELEMENTS OF GOOD PRACTICE IN FCT, ABUJA

Abstract

Managing materials on construction sites is a serious issue among Nigerian subcontractors. Sometimes, materials on site need to be moved from one place to another, resulting in additional costs. Thus, construction materials management in building construction project site is an important element in project management. Poor construction materials management can result in increased costs during construction. Efficient management of construction materials can result in substantial savings in project costs. If construction materials are purchased too early, capital may be held up and interest charges incurred on the excess inventory of construction materials. The study used questionnaires from field survey, interview and site observation for data collection. The study of this research was analyzed using descriptive statistics including mean index score method and frequency analysis. The findings from the study revealed that poor materials management has a considerable effect on material waste generation on any construction project site; moderate effects on quality of building projects, and both considerable and moderate effects on profitability in the construction projects.

The study concludes that effective management of materials in construction projects would reduce the amount of waste generation, increase the quality of construction work, and offer optimum profitability to construction contractors. The study recommendations that the construction industry in Nigeria should collaborate with government agencies to develop guidelines for preparing a waste management plan for the construction industry and ensure that top management adopts the culture of training and developing their staff about new managerial tools and techniques for site materials management.

KEYWORDS: INVESTIGATING, POOR MATERIALS, PMM, BUILDING CONSTRUCTION and GOOD PRACTICE

1.0 INTRODUCTION

Managing materials on construction sites is a serious issue among Nigerian subcontractors. Sometimes, materials on site need to be moved from one place to another, resulting in additional costs (Arijeloye & Akinradewo, 2016). The difficulty in storing materials on site, due to limited space, is another problem in Nigerian construction material management. Sometimes, machinery cannot be adjusted on site, due to space or mismanagement of site activities. Many construction projects apply manual methods for tracking materials, and this involves paper-based techniques that can become problematic, due to many human errors (Kasim *et al.*, 2013). Albert and Shakantu (2017) posit that the construction process depends on having the right people with the appropriate skills who are able to deliver the project on time and on budget.

Thus, construction materials management in building construction project site is an important element in project management. Poor construction materials management can result in increased costs during construction. Efficient management of construction materials can result in substantial savings in project costs. If construction materials are purchased too early, capital may be held up and interest charges incurred on the excess inventory of construction materials. Construction Materials may deteriorate during storage or get stolen unless special care is taken.

Delays and extras expenses may be incurred if construction materials required for particular activities are unavailable. Ensuring a timely flow of construction materials is an important concern of construction material management. For effectively managing and controlling construction materials, the performance of construction materials management should be measured. A performance measure calculates the effective working of a function. These performance measures may differ from system to system. The measures divide the construction materials management system in parts and make the working of the system more efficient. When joined, the measures make the complete construction materials management system (Student , 2011).

In Nigeria, the only well-known body that is solely responsible for standardization of building materials is the Standard Organization of Nigeria (Oke 2002). The author further affirmed that a large population of building collapse we experience in Nigeria is directly attributed to the fact that the regulations that exist for monitoring quality and performance of materials has been done away with. It is noted that there are elaborate provision of rules and regulations governing building construction and structural requirement as well as administration and enforcement, but how enforceable are they in the most important consideration.

Construction materials management is an important function for improving productivity in construction projects. The management of construction materials should be considered at all the phases of the construction process and throughout the construction and production periods. This is because poor construction materials management can often affect the overall construction time, quality and budget. The present research seeks to investigate the effect of poor materials management (PMM) on building construction project sites and to establish elements of good practice in construction materials management on building construction project sites in FCT, Abuja, Nigeria.

2.0 MATERIAL AND METHODS

2.1 The Study Area

The creation of the city of Abuja as Federal Capital City was sequel to the circumstances and conditions that made Lagos no longer suitable or conducive to deliver as the Federal Capital City of Nigeria (Jiriko *et al.,* 2015). The F.C.T. (Abuja) is located in the guinea savannah region (middle belt) of Nigeria. It is located between 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 middle belt region of Nigeria. The capital city Abuja is located within the wider Abuja Municipal Area Council. The territory is currently made up of six area councils, namely Abaji, Abuja Municipal Area Council (AMAC), Bwari, Gwagwalada, Kuje, and Kwali. AMAC is the area under study. This area consists of 11 wards, namely City Centre, Garki, Gwagwa, Gwarimpa, Jiwa, Karshi, Kabusa, Karu, Nyanya, Orozo, and Wuse. The study was carried out in the 11 wards under AMAC, but only 10 projects within the geographical area meet the purposive sampling requirement.

The humidity of Abuja rises to 50% in the rainy season and reduces to about 2% kin the dry season. This fluctuation is due to the fact that the humidity of Abuja and the entire country is highly influenced by the activities of the north east and south west trade winds. The humidity generally increases when the moisture laden southwest trade winds prevail and reduces considerably when the dry northeast trade winds begin to blow over the country. The F.C.T. has

an annual rainfall of about 1632mm the rains are usually heavy often accompanied by lightning and thunder (Jiriko *et al.*, 2015).

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 (Jiriko *et al.*, 2015).

2.2 Methods

The research design adopted for this research will therefore be the survey research approach. The choice of this research design is premised on the nature of the main research objectives mentioned earlier. Since the populations were all ongoing building construction projects and there were small populations by using census, a total sample size of 100 was adopted and used for the study. From the population of the study, a sample of ten building projects was selected, with a value of above 100 million Naira using purposive non-probability sampling techniques. The data were sourced from ten both public and private construction project sites within Abuja, Nigeria, with a project value of above 100 million Naira.

Based upon a review of current literature and research objectives, structured questionnaire was prepared and self-administered to the various respondents. For questionnaire it is essential to check internal reliability of data (Creswell 2003). The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability (Creswell 2003). Cronbach's Coefficient Alpha can be used to check reliability of questionnaire. The normal range of Cronbach's coefficient alpha value between 0.0 and + 1.0, and the higher values reflects a higher degree of internal consistency (Creswell 2003). The equation used to analyze Cronbach's Coefficient Alpha is shown in equation 2.1

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

Where K is items (variables) in the scale and r is the average of the inter-item correlations. For major activities on construction materials managements and ICT level of usage, the value of Cronbach's Coefficient Alpha analyzed using SPSS20 shows the questionnaire is reliable and most are highly reliable.

2.3 Data Analysis

Data collected from the questionnaires were analyzed using methods from descriptive and inferential statistics. These include Frequency Analysis, Mean or average Index Score, Lickert scale analysis and One Sample T-test. In order to generate the result, the researcher used Microsoft Excel and Statistical Package for the Social Sciences (SPSS).

3.0 RESULTS AND DISCUSSION

3.1 Demographic Variables and Respondents Profiles

With one hundred questionnaires which were administered to the contractors, consultants, clients

and other civil engineer professionals, a total of 87 questionnaires were returned constituting 87% response rate. From the survey results, 36 questionnaires out of 40 were received from contractors, 30 questionnaires out of 35 were received from consultants, 12 questionnaires out of 15 were received from clients or owners of buildings and 9 out of 10 were received from other civil engineer professionals constituting 41.4%, 34.5 %, 13.8% and 10.3 % responses respectively from the total questionnaire that were sent to respondents.

3.1.1 Age of Respondents

According to Figure 1, 21 % respondents were under the age range of 18-25 years, 68% under the age range of 26-35 years and 11% under the age range of 36-45 years.

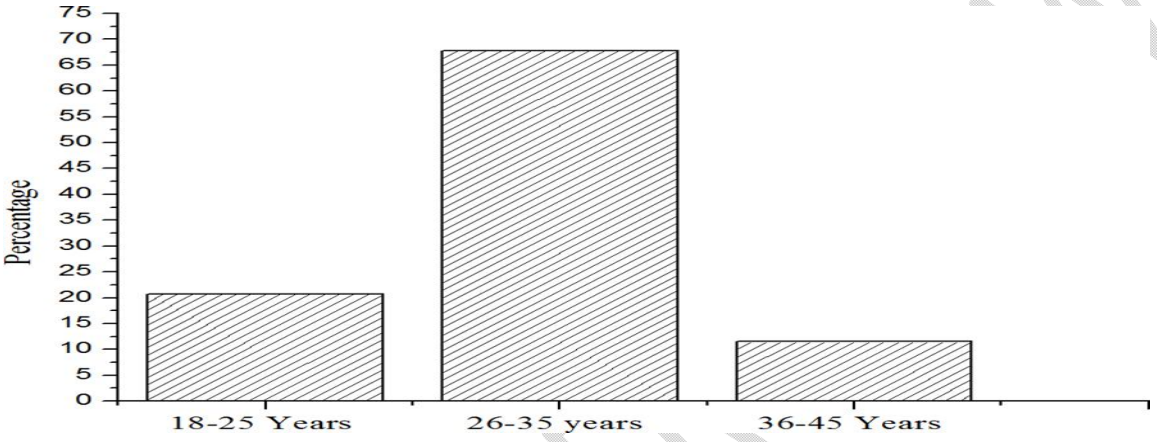

Figure 1: Age of respondents

3.1.2 Academic Qualification of Respondents

Concerning professional backgrounds of respondents, Figure 2, showed that, academic qualifications of respondents comprised diploma (9.2%), bachelor degree (64.4%), and master degree (26.4%) and there were no qualifications below diploma or above master degree.

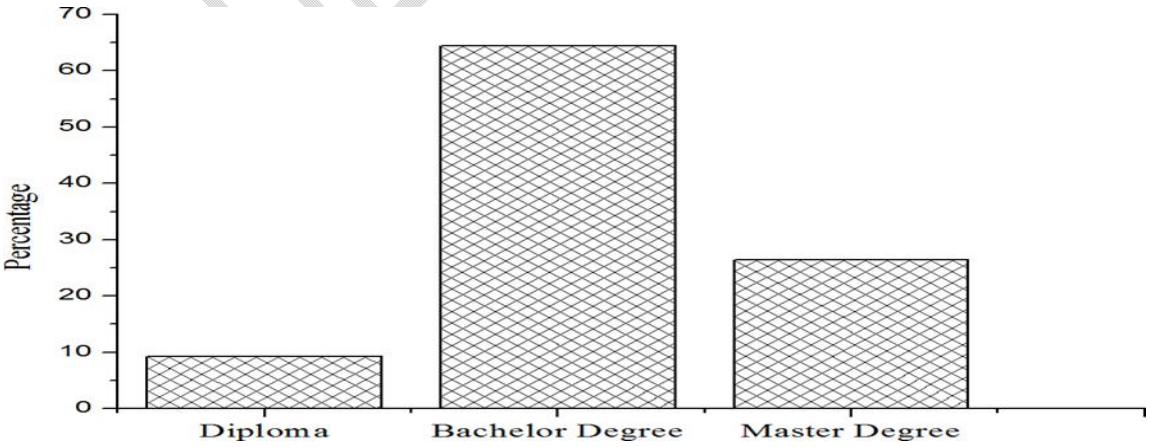

Figure 2: Academic qualification

3.1.3 Experience of Respondents

Regarding the working experience of the respondents surveyed, Figure.3 shows that ,majority of the respondents (about 47.1%) had worked in the construction industry less than 5 years, 32.2 % between 6-10 years, and 20.7% between 11-15 years. However, none of the respondents indicated professional experience of over 16 years.

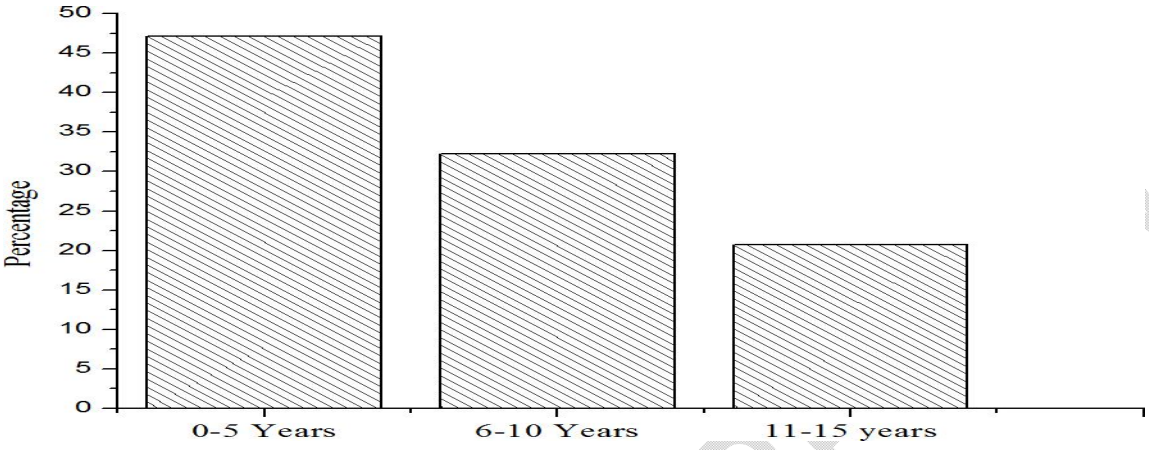

Figure 3: Experience of respondents

3.1.4 Position of Respondents in the Organization

Again, the data analysis revealed that, positions of respondents in the organizations were represented in the survey. Considering the current positions in their construction industry, Figure.4 shows that 2.3%, were managing directors, 8.0% project managers, 21.8% office engineers, 17.2% site engineers, 33.3% resident engineers, 2.3% quantity surveyors, and 14.9% others like Forman's, supervisors, project inspectors. The high representation of resident engineers, office engineers, site engineers and project managers was inevitable as these are the very key professionals usually engaged in the construction industry in the FCT.

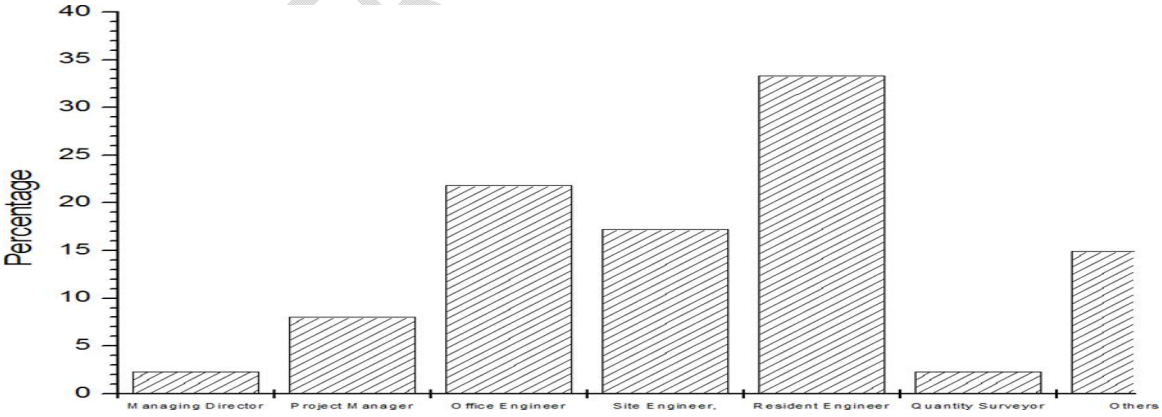

Figure 4: Position of respondents

3.1.5 Classification of Firms in the Construction Business

Concerning organizations classification of respondents, figure 5, Shows that, a majority were private organization (47.1%), governmental/ public organization (32.2%), share companies

(16.1%) and the minorities were other firms (4.6%)

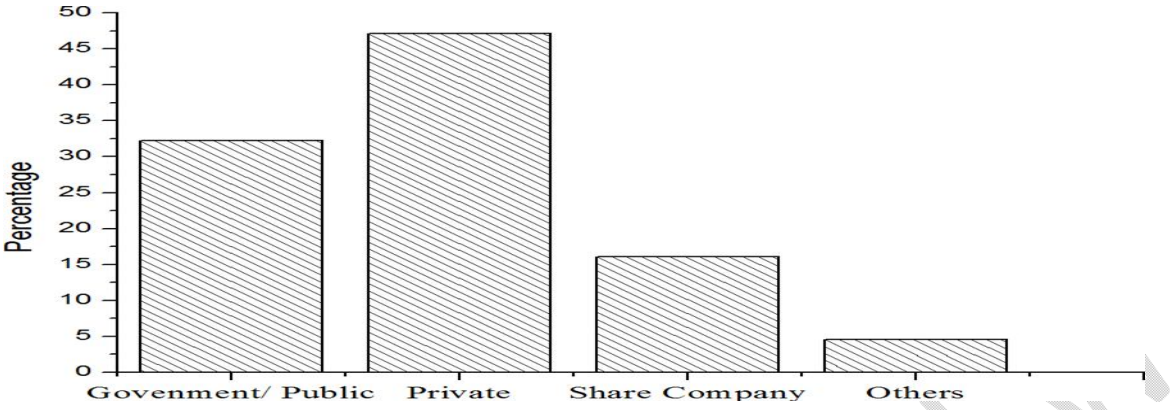

Figure 5: Classification of Firms in the Construction Business

3.2 Effect of Poor Material Management on Building Construction Project Sites

3.2.1 Effect of Poor Material Management on Material Waste

An overall model value of 3 demonstrates that PMM has a high effect on material waste in the construction industry in Abuja, Nigeria. This means that PMM exacerbates the problem of wastage of materials on sites. The results show that PMM increases the quantity of materials waste. This finding was supported by Saidu and Shakantu (2016) that imprudent materials management does increase material waste on construction sites, with an additional result of a corresponding increase in the amount of cost overrun for a project. In addition, material waste has a significant impact on the cost of a project as well as an adverse impact on the environment (Nagapan *et al*, 2012). Table 1 shows the effect of poor materials management on materials waste on project site in FCT, Abuja.

Table 1: Effect of poor materials management on materials waste

Statement	**3 = high effect; 2 = moderate effect; 1 = low effect**										**Mode**
	CS1	**CS2**	**CS3**	**CS4**	**CS 5**	**CS 6**	**CS 7**	**CS 8**	**CS 9**	**CS10**	
PMM increases quantities of waste	3	1	1	2	2	3	3	3	3	2	3
PMM negatively impacts on the waste management plan	3	1	1	1	1	3	3	2	3	2	1 & 3
PMM negatively impacts on the proposal for material waste recycling, recovering and disposal	2	2	2	2	2	2	3	3	3	2	2
PMM leads to mixing of waste	2	1	1	1	1	3	3	3	3	1	1
PMM makes it difficult to monitor the											

waste management plan	2	1	2	2	2	3	3	2	3	2	2
PMM makes it difficult to manage waste- related KPIs	2	1	1	3	2	3	2	3	3	2	2 & 3
PMM makes it difficult to manage site waste management plan cost data	3	1	1	1	3	3	2	3	2	2	3
PMM negates the effort for minimizing materials utilization	2	2	2	2	2	2	2	2	2	2	2
PMM impinges on the need to assess and identify materials waste streams	3	1	1	1	1	3	3	2	2	1	1
PMM makes it difficult to account for materials waste	3	2	2	2	2	3	3	3	3	2	2 & 3
PMM makes it difficult to implement a materials waste management policy	3	2	1	3	2	3	3	3	3	2	3
Total											3

3.2.2 Effect of Poor Materials Management on Quality

An overall modal value of 2 demonstrates that PMM has a moderate effect on quality in the construction industry in Abuja, Nigeria. It is clear from Table 2 that the statement "poor materials management negates materials quality control" was considered to have a high effect on quality, since it has a modal value of 3. This is in tandem with the findings of Khalek *et al.* (2016) on achieving quality in materials management in construction projects. Quality control is that part of quality management that ensures that products and services comply with requirements and standards. One way of controlling quality is based on the inspection or verification of products.

The statements with moderate effects on quality were: PMM impacts negatively on the quality of some of the materials on site; PMM negates the quality standard set up by management, and PMM makes it difficult to conduct materials quality audits. These were considered to have moderate effects on quality, because they all have modal values of 2. These results corroborate the findings of Khalek *et al.* (2016), who highlighted that onsite delivery of substandard materials and products is one of the major problems impacting negatively on the quality of materials on site.

A quality audit is a review of how well the key areas of the project quality plan are being followed. The purpose of the audit is to determine whether the quality plan is working as intended. To achieve a successful materials quality audit, first, the correct procedures specified in the quality plan should be followed and, secondly, they should be followed consistently (Oakland,

2014; Dale, Van Der Wiele & Van Iwaarden, 2007; Juran, 1999). It is the responsibility of the contractor to assure the client of continuous conformity with the appropriate standards and regulations, and to conduct quality control through self-inspection, quality assurance, quality directing, and quality auditing.

Table 2: Effect of poor materials management on quality

Statement	**3 = high effect; 2 = moderate effect; 1 = low effect**										**Mode**
	CS1	**CS2**	**CS3**	**CS4**	**CS5**	**CS6**	**CS7**	**CS8**	**CS9**	**CS10**	
Quality of work is compromised, because PMM leaves some materials spoiled	3	1	1	1	2	3	3	2	2	1	1
PMM impacts negatively on the quality of some of the materials on site	3	1	1	2	3	2	2	2	2	1	2
PMM negates the quality standard set up by management	2	2	2	2	2	2	2	2	2	2	2
PMM negates materials quality control	2	2	2	3	3	3	3	3	3	2	3
PMM makes it difficult to conduct materials quality audits	2	2	2	3	2	3	3	3	2	2	2
Total											2

3.2.3 Effect of Poor Materials Management on Profitability

Overall modal values of 2 and 3 demonstrate that PMM has a moderate to high effect on profitability in the construction industry in Abuja, Nigeria. The reason why contractors fail to achieve their desired profitability after winning a contract is that the materials required to complete the project are not managed properly during the construction period (Kerzner, 2002). It was found that PMM increases waste, thus reducing profitability of construction projects. This means that materials waste on site reduces the contractors' profits. This corroborates the submission that prevention and managing the causes of wastage may help reduce the impact on the project and increase profits (Ahankoob *et al* 2012). There is a need to reduce materials waste on site, in order to achieve profitability.

The research also found that PMM has a moderate to high effect on suboptimal accounting for materials, thus affecting profitability. This supports Wahab (2010) finding that there is a lack of record-keeping of materials supplied and used on site, thus affecting profitability. Therefore, proper records of materials receiving, and materials requisition should be kept, and materials monitoring should be done. Another high effect of PMM is on-site storage of materials, which leads to theft of materials and reduced profitability. Missing materials due to theft need to be replaced by new materials, thus reducing profitability. Another high effect of PMM was on poor site storage of materials, which leads to damage/destruction and reduces the profitability of construction projects. This finding agrees with Kasim *et al.* (2005), as highlighted in section 2.2.3 of this study. This means that, if adequate storage of materials is not put in place and if there is damage/destruction, more material is needed to replace the damaged/destroyed materials, thus decreasing profitability.

There is a moderate effect in terms of how PMM increases suboptimal materials quality, which leads to rework and decreases profitability. Rework could adversely affect time and productivity and, ultimately, also profitability. These results are in line with the findings of Sun and Meng (2009), Aiyetan (2013), as well as Hughes and Thorpe (2014), that the direct impacts of rework on construction projects would likely include additional time for rework; additional costs for covering rework occurrences; additional materials for rework and subsequent wastage handling, and additional labour for rework and related extensions of supervision manpower. All these studies agree that rework in construction projects has the potential to make at least a moderate contribution to the total project cost and to decrease profitability.

In addition, the study found that PMM has a high effect on the occurrence of health and safety incidents, leading to claims/expenses and affecting profitability. This finding agrees with Muhwezi *et al.*'s (2012) assertion that materials waste on building projects caused not only financial setbacks to contractors, but also significant health incidents. During this study, it was observed that construction workers on sites lacked appropriate protective equipment. For example, workers were observed carrying out activities such as painting, excavations and concreting without the right protective gear such as helmets, masks, ear muffs, goggles, and overalls. There are always claims/expenses for health and safety incidents on site whenever they occur.

Table 3: Effect of poor materials management on profitability

Statement	3 = high effect; 2 = moderate effect; 1 = low effect										Mode
	CS1	CS 2	CS 3	CS 4	CS 5	CS 6	CS 7	CS 8	CS9	CS10	
PMM increases waste, thus reducing profitability	2	1	1	2	2	3	3	3	3	2	2 & 3
PMM leads to suboptimal accounting for materials, thus affecting profitability	2	2	1	2	2	3	3	3	3	1	2 & 3
Poor site storage of materials leads to theft of materials, thus leading to low profitability	3	3	1	3	3	3	2	2	1	2	3
Poor site storage of materials leads to damage/ destruction, thus reducing profitability	2	2	1	2	2	3	3	3	3	2	2
PMM increases suboptimal materials quality, thus leading to rework and decreasing profitability	3	2	1	2	2	2	2	2	2	1	2
PMM increases health and safety incidents, thus leading to claims/expenses and affecting profitability	3	3	2	1	1	3	3	2	3	2	3
Total											2 & 3

3.3 Good Practice in Construction Material Management on Project Sites.

This section analyzed measures for effectiveness on construction materials management on building construction project sites in the town. The measures for effectiveness on construction materials management on building construction project sites in the town was analyzed using mean index score method asindicated above. The mean ratings on the measures for effectiveness were also calculated based on a scale of 1-5 (from “strongly disagree” to “strongly agree”). Table 4 presents the measures for effectiveness on construction materials on sites

Table 4 Measures for effectiveness on construction materials on sites

Measures for effectiveness	N	Mean	Std.	Ranking
Training people on how to reduce waste	87	4.60	0.769	1
Usage of packaging in an efficient way	87	4.51	0.525	2
Getting samples for materials approved	87	4.44	0.758	3
Reporting the situation of materials in the project's store	87	4.40	0.619	4
Daily recording of using materials in the project	87	4.40	0.723	5
Considering required communication methods for material	87	4.37	0.612	6
Planning and monitoring construction activities	87	4.33	0.623	7
Work done by qualified employees	87	4.33	0.710	8
Accepted materials used	87	4.30	0.733	9
All quality problems have been fixed	87	4.26	0.842	10
Scope of work requirements achieved	87	4.26	0.559	11
Controlling over-ordering and purchasing	87	4.26	0.869	12
Preparing for material storage	87	4.25	0.669	13
Using suitable, safe and secure storage	87	4.22	0.754	14
Consideration off-site construction	87	4.21	0.593	15
Following up the prices in the market and recording prices	87	4.18	0.691	16
Defining accurate materials specifications	87	4.17	1.070	17
Employment of store keeper and security personnel	87	4.15	0.815	18
Completed preceding work segments	87	4.09	0.725	19
Forecasting materials price in market	87	4.07	1.021	20
Attention to weather condition	87	4.05	0.861	21
Forecasting of field condition, weather and event in the future	87	4.03	.982	22
Identifying Material Schedule	87	4.02	0.889	23
Performing recycle and reuse methods for surplus and waste materials	87	3.97	1.083	24
Reporting the problems (wastage and loss-storage in delivery)	87	3.97	0.813	25
Consideration efficient mechanical systems and machinery	87	3.89	0.722	26
Locating sources of materials for procurement	87	3.87	0.998	27
Installation specifications met	87	3.80	1.087	28
Average mean		**4.19**		

Based on the table 4, the study has shown that more than half of the measures for effectives for construction materials management on building construction project sites in the organization were above average (average mean score of 4.19). From the total of 28 activities indicated

above, 24 activities had a standard deviation less than 1.0. This is an indication that,almost all of the respondents, had agreement among the rating of their measures for effectiveness on construction materials management in their activities while a minority offour had a standard deviation greater than 1.0 indicating had variations in the respondents' ratings.

According to table 4, the Excessive measures for effectiveness for construction materials management on building construction project sites were Training people on how to reduce waste (mean = 4.60) and Usage of packaging in an efficient way (mean = 4.51) and the most measures for effectiveness for construction materials management on building construction project sites were Getting samples for materials approved (mean = 4.44), Reporting the situation of materials in the project's store and daily recording of using materials in the project (mean = 4.40), Considering required communication methods for material management (mean = 4.37).

Others includes Planning and monitoring construction activities and Work done by qualified employees(mean = 4.33), Accepted materials used (mean = 4.30), All quality problems have been fixed, Scope of work requirements achieved and Controlling over-ordering and purchasing (mean = 4.26), Preparing for material storage (mean = 4.25), Using suitable, safe and secure storage (mean = 4.22), Consideration of-site construction (mean = 4.21) and other most measures for effectiveness for construction materials management on building construction project sites but below the average value were Following up the prices in the market and recording the variations of prices(mean = 4.18), Defining accurate materials specifications (mean = 4.17), Employment of store keeper and security personnel (mean = 4.15), Completed preceding work segments (mean = 4.09), Forecasting materials price in market (mean = 4.07).

Also, Attention to weather condition (mean = 4.05), Forecasting of field condition, weather and event in the future (mean=4.03), Identifying Material Schedule (mean = 4.02) while Performing recycle and reuse methods for surplus and waste materials and Reporting the problems for examples (wastage and loss-storage in delivery)(mean = 3.97), Consideration efficient mechanical systems and machinery for moving materials(mean = 3.89), Locating sources of materials for procurement(mean = 3.87) and Installation specifications met(mean = 3.80) were the least rated.

Generally the findings presented above shown that, Training people on how to reduce waste and usage of packaging in an efficient way were the most highly identified while Getting samples for materials approve, Reporting the situation of materials in the project's store and daily recording of using materials in the project, Considering required communication methods for material management were highly identified for measures for effectiveness in the construction materials management activities on building construction projects sites in the study area. The finding from site observation and interview also has shown the same result with the findings from the questionnaire survey.

4.0 CONCLUSION AND RECOMMENDATION

The study concludes that effective management of materials in construction projects would reduce the amount of waste generation, increase the quality of construction work, and offer optimum profitability to construction contractors.

The following recommendation were done base on the findings of the research:

- Construction materials management department should support the management of an organization in the production activities, as it could help in marketing, selling, promotion

and even control of all types of construction materials for its quantity, quality and cost for effective construction materials management.

- The construction industry in Nigeria should collaborate with government agencies to develop guidelines for preparing a waste management plan for the construction industry and ensure that top management adopts the culture of training and developing their staff about new managerial tools and techniques for site materials management.

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