



## AN APPRAISAL OF MATERIAL MANAGEMENT ON CONSTRUCTION SITES IN KADUNA STATE



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**Abstract:** Ineffective material management has become a source of problem to successful construction Projects because materials take about 60 percent of the total cost of a construction project. The purpose of this study was to investigate the methods of material management on construction sites in Kaduna state. This was achieved by examining the methods of material management on construction sites, examining the challenges affecting material management on construction sites and by suggesting measures through which material management could be improved. The survey research method was used for the study. The population of the survey constituted site supervisors of selected construction sites in Kaduna state. The study used the Purposive sampling technique with a sample size of 158. 125 questionnaires representing 79.11% were returned and deemed usable for the analysis. 5 points Likert scale was used for the questionnaire. Cronbach alpha was used to determine the reliability of the data. SPSS 21.0 was used to analyze the data. Both descriptive and inferential statistics were generated between the variables. Findings from the study indicates that effective transportation and planning are the major methods used for material management in Kaduna state, design change is a major challenge of material management on construction sites in Kaduna state and proper documentation is important in improving material management on construction sites in Kaduna State. The study recommends that proper control and regular training of site supervisors is needed to improve material management on construction sites.

**Keywords:** Construction industry, construction projects, material management, performance

### Introduction

Construction materials constitute the major cost component in any construction project (Obiegbo, 2017). The efficient management of materials represents a key role in the successful completion of the construction projects. Material management is concerned with the planning, identification, procuring, storage, receiving and distribution of material. The responsibilities of material management department depend for the effective flow of material from the time the material is ordered, received, and stored until they are used is the basic responsibility of material management (Adewuyi & Otali, 2013). Material represent a major expense in construction, so minimizing procurement cost be that, as it may improves opportunities for reducing the overall project cost. Ensuring a timely flow of material is an important concern of material management (Pandey, 2013). The total cost to installed material may be 50% or more of the total cost. However the goal of material management is to ensure that the material is available at their point of use when needed hence, effective procurement of material represents a key role in the successful completion of the work (Phani *et al.*, 2013)

Lack of material management on construction site has become a problem in Nigerian construction industry, this problem has negatively affected the performance of many project (Obiegbo, 2017). Wrong material handling, unavailability of storage, pilfering of material on delivery and lack of appropriate information for material delivered to the site, caused loss in labor productivity and overall delay that can indirectly increase the total project cost (Obiegbo, 2017). Effective management of materials can reduce these costs (Olatunji & John, 2013). Effective project management of construction works must pursue the efficient utilization of construction materials. The selection and use of material that will be most appropriate for a particular circumstances and requirement, depend to a large extent on the understanding of the possible potential of the material available (Patel & Vyas, 2018). Improper material management in construction projects resulted into huge financial setbacks to builders and contractors. In addition to this, it may also cause significant effects over aesthetics, health and the general environment. These materials need to be managed and their impacts need to be ascertained to pave way for their proper material management. This research work therefore, attempts to

investigate materials management on construction sites as a way of improving material management on construction sites in Kaduna state.

In recent time, the economy has faced the challenges of increasing need for construction project, despite that concerted effort have been made in response to this by the system, the scenario has been that of more disappointment (Obiegbo, 2017). Inappropriate material management are characterized by wrong material handling, unavailability of storage, theft of material from delivery, and lack of appropriate information for materials delivered to the site. This has become a problem by making the project to have increase in construction cost, causes delay on construction project and reduction in efficiency of construction project (Karrar & Pandley, 2013). The failure of any construction project carries repercussions on the economy; these include wastage of resources in construction and the denial of the opportunity for other projects to have a continue flow of construction (Calistus, 2013). All this put together have made most effort in construction projects seem as promotion of economic waste. Khyomesh & Chetna (2011), Phani *et al.* (2013) highlighted that the traditional manual method used sometimes provides unreliable information regarding the materials. The traditional materials tracking method used in construction industry have clear limitations; therefore, this study is aimed at investigating material management on construction sites in Kaduna state.

### Material management

Material management can be defined as a scientific technique focused on planning, organizing and control of materials from point of purchase to the service point (Shorab & Roger, 2009). It can further be defined as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material. Furthermore, project management of construction projects requires knowledge of modern management as well as an understanding of the design, construction, and project management. The concept of material management is aimed at the realization of the objective of minimizing loss. It is thus an integrated process involving effective planning, controlling and coordination of material in order to reduce loss (Sreval & Chati, 2016). It is in line with this concept that Obamiro

(2017), simply defined material management as all the process needed to plan, acquire, store, control and distribute material at minimal cost to organization. The author further stated that material management is required to the last treasure for business executives in view of direct contribution towards profit improvement.

The responsibility of materials management is handled at both the site and the head office. In several organisations, the selection, pricing, ordering, preparation of schedules and payment of account is the responsibility of top management while the receipt, storage, potential and use is the responsibility of lower management on site. In larger construction projects, the role of material controller and site manger is separated to ensure that there is minimal loss/wastage in the lifespan of the project. The primary function of material management on site is to determine in advance point where materials are wasted or lost in the construction process and exercise strict rule and regulations over such areas (Gulghane & Khandve, 2015).

#### **Method of material management on construction sites**

According to Kanimozhi (2014); John *et al.* (2011) and Ameh & Itodo (2013) the method of material management on construction sites are as follows:

**Planning:** Materials planning includes; quantifying, ordering and scheduling. It is stressed that planning is especially significant in terms of increasing productivity, profit, and facilitating the timely completion of construction project. Hence, productivity will suffer if the material planning process is not executed properly.

**Purchasing:** Purchase of materials and services from outside the organisation to support the firm's operations from production to marketing, sales and logistics as a detailed material schedule and co-ordination of the procurement and order of material are important in assuring material availability

**Transporting:** The traffic section, which is involved in the physical movement of materials throughout the entire production stages, is important for profitability and cost reduction. Materials movement could be in house or external.

**Storage:** Storage is sometimes not properly prepared and generally the materials are stored at different points on site. Materials are sometimes exposed to wet condition and unsuitable places where machineries and vehicle continually pass can cause the fabric to deteriorate and eventually could be unusable. This may increase the proportion of loss as a result of the damaged materials.

**Controlling:** This is the process of measuring performance against set targets. If there is poor performance, reasons must be identified and necessary measures (necessary corrections) are taken to put things back on course to meet the target. Here clear, precise standards, frequent checks on performance helps to ensure that tasks are accomplished effectively and as planned.

Each of the aforementioned processes play an important role for an effective materials management. However, there are materials management issues that have not yet been tackled effectively. The following section highlights the current materials management problem faced in the construction industry.

#### **Challenges of material management on construction sites**

The challenges of material management on construction sites as identified by Ashwini & Smita, (2013); Demodara & Kini (2009); Kanimozhi (2014) and Laban & Mikael (2014) includes the following:

**Design changes:** This refers to insufficient of information about type and specifications of material on design documents. This occurs due to design changes and revisions or as a result of error in information about types and sizes of materials on design documents, specification of the types and

dimensions without considering waste. Designers can limit the incidence of design changes by rationalization of materials and components, dimensional co-ordination, manufacturing to design tolerances, packaging materials and dimensional utility.

**Lack of accurate schedule:** material management with regards to control over materials delivered to site is largely concerned with ensuring that the material as specified are delivered to the site in the right quantities when needed. The contractors purchase order gives details of the quantity, cost and delivery dates of the material covered in the order. The quantities and quality of all delivery are verified by inspection.

**Improper documentation:** Issues regarding the tracking and locating of materials on-site have received a great concern in construction industry when materials come in bulk without proper identification and documentation. The improper or inadequate management during the materials receiving process, together with the traditional materials tracking has made it difficult to track materials location in construction sites at the time they are needed.

**Improper procurement:** This occur as a result of ordering of material that do not fulfill project requirement defined on design documents, over-ordering or under-ordering due to mistakes or due to lack of coordination between suppliers and construction site supervisors.

**Ineffective communication:** These occur as a result of poor communication between parties involved. Different language between the foreign supervisors and local labourers can cause communication failure on site. This consequently causes the misunderstanding by the labor in their scope of work and can ultimately lead to poor workmanship.

**Ineffective planning:** Lack of planning is one of the major problems for construction on site. The project environment such as size, degree of uncertainty, complexity, competition, type of contract and also type of client have a direct impact on the project performance. In this case, there are some uncertainties such as the design before beginning the project, the unpredictable weather and also availability of labor or equipment for project. By gathering more information and making flexible decision the rate of uncertainty in project will be decreased.

**Lack of proper storage:** Improper storage of material is one of the most important aspects of material management to avoiding financial loss of site production and very little is done to avoid this financial loss. The problem of material mismanagement starts from the point of storage and continued through to the point of fixing. Furthermore, at the point of storage, apart from the obvious precaution, the use of primary handling equipment will remarkably reduce the loss by spoiling or abrading. Over stacking and over issuing of materials is another area where small units, probably due to the over issuing the surplus containers will results in high losses in vulnerable goods.

**Lack of training:** Lack of training for management staff and site supervisors involves recruitment, selection, placement, appraisal and development of people to occupy the roles in the organisation structure. It is important in material management to properly train site personnel on effective and efficient material management.

#### **Measures through which material management could be improved in construction site**

According to Mohammed *et al.* (2004), materials purchased are referred to as stock items, (these are items which are taken into and held until required or as direct deliveries to the point of consumption). The control of these materials is knows as stock control. However, effective stock control ensures that materials for use on the project are made available at the right place, at the right time and in the correct quantity according to

construction programme so as to reduce materials shortage and wastage on construction site. According to Joseph (2018); Narimah *et al.* (2012); Oladiran (2009) and Olatunji & John (2013) recommend the following as measures for controlling materials in construction site.

**Adherence to design detail:** Material control should start at the design stage; late design variation should be avoided and effective material on site should be design.

**Accurate scheduling of material:** Accurate scheduling of material to programmed delivery date is important in achieving timely management of the project. Accurate information is used to update the schedule when client selection is completed and he schedule is optimized to meet construction needs. During this process, the project team will need to address the following material management issue.

1. **Documentation of material in and outflow:** Documentation should set out size, quality and delivery form of material for estimator consideration. The control of quality construction begins with an intensive review of the plans and specifications. There may be few deficiencies in the plans and specifications, some of which may have been uncovered during the estimating process, while other was unearthed by the subcontractor and vendors.
2. **Procurement:** Procurement should specify the quality, quantity delivery time and method of packaging. The best way to procure equipment and materials is through a competitive bidding process that culminates in a negotiated price to meet all specified requirement.
3. **Effective communication:** Effective communication between supplies and recipient should be established for proper material management. Material Management offer the benefit of enhancing communication by providing a communication network that reacts quickly and facilitates improved rational action throughout the system. Combining the various fragmented groups enhances communication by shortening message channels, allowing common use of data, providing greater potential use of communication through data processing equipment, and encouraging the flow of information between people.
4. **Good storage facility:** Management must establish on site procedure for reception of goods and plan for storage in advance. A material of high value should be off-site until when it is needed. The types of storage system on site vary according to space availability and company practices. Industrial guidelines are also taken into consideration for storage of particular materials.
5. **Training:** Training of both management and other staff on material management control is vital in achieving effective material management. The material manager aims at promoting teamwork and this will offer greater promotion and staff development opportunities. Organisations strive to retain experienced staff working within the firm; this can be achieved when with Material Management system is in place.

**Methodology**

The method used in this research work is the survey research method. This method has been adopted in similar studies (Joseph, 2018). The relevant information was obtained through questionnaire and semi structured interviews. The population of the survey consists of management and non-management staff of selected construction firms in Kaduna. The research used the purposive sampling techniques. This research used a sample size of 120 and 87 were returned representing 72.5%. The instrument used for data collection was structured questionnaire, design by the researcher. The respondent is limited to a list of options and the answers are

restricted to those available in the option. The questionnaire was divided into 2 sections A and B. Section A contained respondent information and B contain questions on material management they adopt on construction sites. For the purpose of this research, questions on materials management were asked and placed on a 5 points Likert scale ranging from strongly agreed (5) to strongly disagree (1) in form of statements. The Cronbach alpha was used to assess the reliability of the data; the values were over 0.70 which is acceptable.

**Results and Discussion**

Table 1 shows the methods of materials management on construction sites. The findings show that the transportation method has the highest mean of 4.67, followed by the planning method 4.53, the purchasing method is next with a mean of 4.42, the storage method has a mean of 3.99, the controlling method has a mean of 4.36 and the storage method has a mean of 3.99. The grand mean of all the methods is 4.39 and this shows that the methods were accepted except for storage and control methods whose means are lower than 4.39.

**Table 1: Methods of material management on construction sites in Kaduna State**

SN	METHOD	VO5	O4	U3	R2	N1	Mean
1	Planning	78	35	12	0	0	4.53
2	Transportation	99	15	7	4	0	4.67
3	Purchasing	79	24	18	3	1	4.42
4	Storage	25	76	22	2	0	3.99
5	Controlling	65	40	20	0	0	4.36
<b>Mean</b>							<b>4.39</b>

VO= Very Often, O= Often, U= Undecided, R= Rarely, N=Never

Table 2 shows the challenges of materials management on construction sites in Kaduna state. The findings shows that design change is the major challenge of material management with the highest mean of 4.46; this is followed by ineffective communication with a mean of 4.31, next is lack of training for personnel with a mean of 4.20, followed by improper documentation with a mean of 4.05, improper procurement is next with a mean of 4.03, ineffective planning with a mean of 3.82, lack of adequate scheduling with a mean of 3.68 and lack of proper storage with a mean of 3.38. The grand mean of all the challenges identified is 3.99. This means that the respondents agree that the following factors are the challenges of material management: design change, ineffective communication, lack of training, lack of accurate scheduling and improper procurement, their means were above the grand mean and therefore were accepted while ineffective planning, lack of adequate scheduling and lack of proper storage have means below the grand mean of 3.99 and were rejected.

**Table 2: Challenges of material management on construction sites in Kaduna State**

SN	Challenges	VO5	O4	U3	R2	N1	Mean
1	Design change	75	33	17	0	0	4.46
2	Lack OF accurate scheduling	24	55	28	18	0	3.68
3	Improper documentation	53	25	47	0	0	4.05
4	Improper procurement	54	28	36	7	0	4.03
5	Ineffective communication	58	48	19	0	0	4.31
6	Ineffective planning	51	17	43	11	3	3.82
7	Lack OF PROPER storage	39	10	48	16	12	3.38
8	Lack of training for personnel	73	21	21	4	5	4.20
<b>Mean</b>							<b>3.99</b>

VO= Very Often, O= Often, U= Undecided, R= Rarely, N=Never

**Table 3: Measures through which material management could be improved on construction sites in Kaduna State**

SN	Measures	VO5	O4	U3	R2	N1	Mean
1	Adherence to design detail	64	39	15	0	7	4.22
2	Accurate scheduling of materials	83	34	0	2	6	4.49
3	Documentation of material	83	21	14	7	0	4.44
4	Procurement	86	36	2	0	1	4.65
5	Effective communication	69	43	8	0	5	4.37
6	Effective planning	101	12	7	0	5	4.63
7	Good storage facility	48	25	43	9	0	3.90
8	Training of site personnel	55	43	12	7	8	4.04
<b>Mean</b>							<b>3.90</b>

VO= Very Often, O= Often, U= Undecided, R= Rarely, N=Never

Table 3 shows the measures through which materials management could be improved on construction sites in Kaduna. The grand mean of all the measures was computed as 3.90. the findings show that procurement is the strongest measure through which material management could be improved with a mean of 4.65, this is followed by effective planning with a mean of 4.63, accurate scheduling of materials with a mean of 4.49, documentation of material with a mean of 4.44; effective communication with a mean of 4.37, adherence to design details with a mean of 4.22, training of site personnel with a mean of 4.04 and good storage facility with a mean of 3.90. The findings indicate that the following measures were accepted as their mean were above the grand mean of 3.90; procurement, effective planning, accurate scheduling of materials, documentation of materials, effective communication, while the following measures were below the grand mean and were rejected; adherence to design details, training of site personnel.

**Regression analysis**

The summary from the analysis of the model shows that the level of adoption of the methods of material management is 63.8%. The R2 value of the measures of materials management is 0.407 this means that the measures account for 40.7% of the variation in materials management.

**Table 4: Model summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.638(a)	0.407	0.249	5.126

**Table 5: Analysis of Variance (ANOVA)**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	270.934	4	67.733	2.578	.000(a)
	Residual	394.066	15	26.271		
Total		665.000	19			

The ANOVA shows that the factors that enhance material management on construction site are statistically significant with a p-value of 0.000 with 4 and 15 as degree of freedom. In consultation to Analysis of Variance (ANOVA), it shows that the value of R and R<sup>2</sup> are 0.638 and 0.407, respectively. The R value (0.638) indicates that there is positive linear relationship between the variables adopted in material management in construction site, since the value is less than 1. There is significant impact of material management in construction site.

**Conclusion**

To effectively practice materials management on construction sites, adequate planning, purchasing, storage, controlling and transportation and are critical to efficient materials management in construction sites and successful construction project delivery. The major challenge of material management identified from the study is design changes made during construction and also ineffective communication between suppliers and the site supervisors. Procurement has been identified to be a strong measure in improving material management this means that right materials should be ordered and delivered to where they will be utilized and at the time they are needed to avoid wastage and thus effective management of materials. Storage of materials should only be maintained at minimal level for only strategic materials and adequate storage facilities should be provided in conjunction with skillful supervision and workmanship. The study recommends that management of construction firms should ensure proper protection of supplied materials from construction sites and also ensure adequate control when issuing out the materials. Also, efforts should be made to automate the materials requirement planning and issuing system at construction sites in order to minimize errors due to human input that leads to inefficiencies. Training of site personnel is also important in ensuring efficient materials management, thus management should ensure that regular training is organized to expose site personnel on how to properly manage materials on construction sites. Stakeholders in the construction industry in Nigeria, should commission increase research in the various areas of materials planning, procurement, handling and usage on regular basis.

**Conflict of Interest**

Authors declare that there is no conflict of interest related to this study.

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