FACTORS AFFECTING EFFECTIVE MATERIALS MANAGEMENT IN BUILDING CONSTRUCTION PROJECTS- A CASE STUDY OF SELECTED BUILDING SITES, IN IMO STATE, NIGERIA.

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ABSTRACT: This research work is on the analysis of factors affecting effective materials management in building construction projects. Having the right materials in the right place at the right time is important for effective execution of a building project. Secondary and primary data collected were subjected to statistical analysis through the use of multiple regressions. Six hypotheses were tested and the results show that significant relationship exist between the factors and effective materials management. It was recommended that organizations should incorporate materials management in the overall policy of the firms in order to eliminate some of these problems.

Keywords: Materials, Management, Building, Construction, Projects.

1.0 INTRODUCTION

Construction projects depend upon having the right people with right skills and equipment that are able to deliver the project on time and on budget. Having the right materials, in the right place at the right time equally is important and having the cash flow and capital to procure the labour and materials is also important. The materials on a project can represent anything from 30% to 70% of the cost of the work, yet materials management has not received a lot of attention. Labour, material, tools, equipment and cash are the main parts of any construction project.

Materials management is the system for planning and controlling to ensure that the right quality and quantity of materials and equipment are specified in a timely manner (Donyari and Flanagan, 2009). Materials should be obtained at a reasonable cost and be available for use when needed. The cost of materials represents a large proportion of the cost. Materials and plants for most projects can be up to 70% of the project cost depending upon the type of project and the extent of mechanization and plant used.

A good management system for materials management will lead to benefits for construction. Cash flow has become crucial for the survival of any business. If materials are purchased early, capital may be tied up and interest charges incurred on the excess inventory of material. Material may deteriorate during storage or be stolen, also delays and extra expense may be incurred if materials required for particular activities are not available.

Materials management includes procurement, shop fabrication, logistics, supply chain management, production on site and field servicing. The supply chain is a covenant term used to describe a complex web of activities. The use of new equipment and innovative method of material handling has influenced changes in construction technologies in recent years. Modern methods of materials management have been embraced by the manufacturers across a wide range of industry sectors outside of construction.

According to Ademorok (1999) material resources are the heart and life of any construction industry. This is because the production and distribution activities as well as the general overall performance of any construction firm will be shaky in the case of under stocking or poor management of materials. These materials if not properly managed, will lead to poor execution of the building project. Fearon (2001) opined that improper handling, storage and lack of adequate security for building materials can result in change and non-completion of projects on time. Ammer (2004) stated that an effective materials management system could go a long way in addressing materials related problems on site. Adams (2002) was of the view that effective materials management system cannot be evolved without basing it on an
overall work programme. One of the basic rules of management is that no project is likely to be successful unless the objectives are adequately defined and the necessary allocation made for labour and materials.

Material flow is viewed as a system by material management. This is proved by the fact that materials management sees organization as a whole rather than series of elements. Thus materials management promotes the idea of effective collaboration between the various elements of a system towards the achievement of a stated organizational goal. To achieve this, the objective must be clearly defined, which within the construction of a building is usually aimed at the completion of the building on schedules at the lowest possible price, keeping the quality of the building to specified standard. The main thrust of materials management is to avoid sub optimization and to improve the system efficiency and effectiveness. For this to occur, according to Adeniyi (2000), proper planning and control of material resources must be done. This will aid productivity and efficient use of labour and materials.

However, it has been observed that despite all efforts to plan and control resources, a lot of factors militate against these efforts. These common problems particularly on building construction sites form the basis of investigation and the need for the research.

2.0 THEORETICAL FRAMEWORK

According to Lee and Dodler (2002) effective management as practiced in building projects today is a confederacy of traditional materials activities bound by a common idea, the idea of an integrated management of production materials from the raw material state to the finished products state’. They asserted that such concept advocated the assignment of all major activities which contributes to material cost to a single material management department.

Banjoko (2004) describes materials management as a set of integrated functions whose focus is the effective coordination of activities relating to the planning, requisitioning, storage of input, materials and work-in-progress, their conversion until they are delivered to the consumers. Also Fearon (2001), opined that material management is an integrated organizational arrangement establishing a single manager with authority and responsibility for policies and actions related determining the amount of material requirements acquiring needed materials, verifying, storing and issuing materials, maintaining inventory records, scheduling materials into see and disposing of materials which excess to the organization.

Zenz (2003) defines materials management as a concept which brings together under one manager the responsibility for determining the manufacturing requirement, scheduling the manufacturing process and procuring, storing and dispensing materials. As that, it is concerned with the control activities involved in the acquisition and use of material employed in the production of the finished project.

Finally, Ammer (2004) posit his chronological view of material management as a line of responsibility, which begins with the selection of suppliers and ends when the materials are delivered to their point of use. The above concept of material management have common objectives, the material organization which is most appropriate for one company may not be the best form for another company.

As a result of the deferring views of management as to what activities should be included in material management concept, the Nigerian Institute of Building and Material Management (NIOBMM) decided to issue a common definition on material management “that material management is a total concept involving an organizational structure unifying into a single responsibility, the systematic flow and control of materials for identification of the need through customer delivery. Included within this concept are the materials functions of planning, scheduling, buying, storing, moving and distributing”.

The workshop also spelt out the specific objectives of material management as contributing to increases in profitability by coordinated achievement of less total material cost. It is evident from the analysis above that the interrelationship of each activity with several or all of the functions is an essential ingredient in serving the materials needs of the organization.
In the same manner, Banjoko (2004) stated that difficulties ensuring in one function affect require adjustments in the performance of other functions. Hence, the effective material management concept provides the logical framework for binding them into unified effect.

In Nigeria, it is quite clear that structural distresses in building are as a result of shoddy work, cheap labour, cheap and substandard materials and unacceptable workmanship. Adams (2002) argued that a good design falls to pieces if a qualified builder is not engaged to translate and transform into reality the designs and material specification made. The builder of a given building must therefore be adequately qualified to understand and cope with the intricacies of today’s designs and materials specified and this is why it is said that the use of trained builder is a sine-qua-non to a successful execution of a building project in a given construction site.

2.2 MATERIALS MANAGEMENT DEFINED
The basis of material management is centered on the management of the flow of materials from the supply market into the company. Wamuo (1996) defined it as, “the concept concerned with the management of the flow of material into an organization to the point where those materials are converted into company’s output”. However, it is a general belief that the responsibilities of the material manager should include collaboration with designers on materials component specification, purchasing the right materials which search to aid location of variable economic source of supply, incoming traffic, receiving and inspection, supplier quality control, inventory control and material control.

According to Ericsein (1975) “the philosophical argument for adopting materials management envisages an organization as a service of elements”. This idea sees materials management as an instrument that promotes the economic management for profit making.

The above mean that, all departments can effectively work together as a system towards achieving a commonly stated corporate goal. It indicates that problems’ caused by attempting to optimize at the element level rather than on respect of the enterprises as a whole implying that problem in organization occur in elements rather than on whole. Another school of thought has it that material administration; physical distribution management and material management are one and are defined as a process that involves the total flow of materials from the suppliers to the customers for an end use. The wider system approach aims at achieving a successful application of the modern principle of materials management in organizations.

According to Dean (1975), “as with all system approach, the main thrust of the materials management concept in organization is to avoid sub-optimization and to look for system efficiency and effectiveness”.

2.3 MATERIALS MANAGEMENT AND METHODS OF VALUING MATERIALS ISSUES
The system adopted for pricing materials issues largely depends upon the nature of the materials, the under taking concerned and the circumstances which requires to be taken into consideration. The purpose of cost accounting is to arrive at the actual cost of each job, or the process or operation to manufacture and to this end; it is desirable to change out and store materials at cost.

Many method of valuing materials issues are available, the most used ones are FIFO (first in, first out), LIFO (last in, last out). Based stock, simple average, periodic weighted average and standard price. The FIFO ensures that materials are issued at actual cost, no profit or losses, will be incurred merely by adopting this price. It is assumed that the materials purchased are issued in strict chronological order. A great advantage of LIFO is that the change of production is as closely related to current price levels as possible; assuming the purchase of materials was in recent times, it will be necessary to ascertain market values.

In stock valuation, the stock will normally contain the minimum stock plus any of the latest purchases, which have not been issued to production, perpetual inventory system is seen as a process of recording
store balance after every receipt and issues, it is sometimes termed “continuous inventory”, the balance of any account in the stores ledger should agree with the balance shown on the bin card, or stock control record for the item of material, and a frequent checking of these dual record should be made as well as actual quality in stock.

2.4 MATERIALS SCHEDULE FOR THE CONTRACT ON HAND
This will often take the form of a materials list for each manufactured product in the building production program. The materials list would indicate all the components parts or materials to be obtained for the production of that manufactured product. The schedule will show the total number of manufactured product; this is broken down into building production periods so that components and materials can be scheduled to arrive at specific times to meet period requirements.

The amount of each material and or quality of each component required or a simple building production is shown, so that by simple multiplication, the total requirement of each component can be determined. This of course is very simple example of the form a material schedule may take, where many of the material components are common to a number of manufactured products. It may be necessary to produce a composite schedule covering all manufactured products.

2.5 THE PURCHASE REQUISITION
Almost everyone who has the experience in industry will be familiar with the purchase requisition. All too frequently, it is the only method known in any company for notifying the purchasing department of material requirements. Zenz (2003) opined that in many cases, any manager or supervisor is allowed to initiate request for materials purchases and there is little or no control over the purchases made. Usually, top management (or the board) would have been intimately involved in determining the requirement in the first place and the authority to purchase will invariable involve the finalization of all documents, drawings, correspondence, etc between the managing directors confirming the authorization.

2.6 PURCHASING OF MATERIALS
The buying manager should be aware of potential suppliers by reviewing trade journal, technical, publication and directives. He should also endeavour to attend trade fairs and keep in contact with professional colleagues. Also for effective material management, he should keep personal contact and touch with key figures on the supply companies.

Although there is a system of changing goods to client through interim certification of payment as goods measured because the contractor must provide protection and storage facilities for them. Other materials not changeable can reduce cash-flow in the business by prolong stocking and heavy stockpiling. There is a problem of deteriorating, out-dating and multiple handling which can be expensive. These problems absorb money, which can be vital to maintaining fluidity. Materials on transit to the fixing point on the site must equally be accepted as a storage problem or double handling storage space is often at a premium on construction site and as a result goods are often poorly stored and insufficient space for subsequent handling. Critical activities on the site can be delayed by the store man due to lack of classification, inspection for faults and priority zooming.

For economic receipt and storage of materials, the following points should be noted and adhered to:

a. There should be smooth traffic flow (internal/external)
b. Adequate handling facilities and equipment should be in place
c. Delivery schedules should be planned to avoid bottleneck
d. Immediate verification check on goods delivered should be done\n e. Make available the right amount of space required (not too small or large)
f. Efficient stock location system should be put in place
g. Adequate security should be in place
h. Some areas should be guaranteed to maintain quality standard
i. Access should be restricted to authorized persons only.

2.7 ISSUING OF MATERIALS FOR USE
Issuing of materials to workers is another area that material lost occurs on site. Many contractors do not have a planned way of doing this. For orderly practice, each trade foreman should know what materials are required by his men and the actual quantity required. They should work hand-in-hand with material manager to ensure that the required materials are delivered as and when required. Materials should be issued and distributed through a recognized system, which may operate successfully and informally on the small site but may have to be formalized on the larger contract.

On larger sites, the materials managers should be assisted by a store man. The project/site supervisors should give a signed requisition order to the foreman, in this, the actual quantity of materials required and the purpose for need should be clearly stated and given to the materials withdrawal. The store man giving out materials on site should know whether there is a loss.

However, the word “issue” according to Campton and Jessop (2004) represents the actual results of stores activities expressed in terms of quantities issued in a given period. That is, it represents the number of issues made per day, week, month, or per production period. For the above definition, it will be rightly said that the services given by the store department to other departments becomes effective at the point where a storekeeper makes issues of goods and users will naturally judge the efficiency of the store organization by the standard of services provided to them. As used here, therefore, issue of stocks implies reference to factored goods and stock replenishment at central or branch store or even instructions by the production units for stock items. In construction firms with the departments involved as noted above, the manner of issues should be determined to take the following into account.

1. Construction materials may be issued in quantities and at time specifies by the machine loading plan.
2. Materials may be issued on demand.
3. Where demand is steady, standard daily issues may be prepared, only variation can affect the quantities stipulated.
4. In some assembly shops, parts schedules are made available to the stores in time to enable them to assemble all the items required for each job.
5. The issue of all the valuable items should always be authorized by the appropriate senior official.
6. Circumstance where issues may be without documentation should be clearly defined.
7. Circumstance where no receipt signatures are needed should also be defined.
8. Items that are to be dealt with on a far basis must be defined.
9. Each store man should be given a list with specimen signature, of those entitled to draw materials from the store under his control.
10. Arrangement needed to have material available for construction where the work does not justify keeping the store open must be defined and such instruction duly communicated to the storekeeper.

2.8 USE OF MATERIALS ON SITE
The process described so far in this research work has dealt with the way material requirements are determined and how they are made available in the right quantities at the right time for effective material management in a building construction site. There is need to state here that many of the failures in materials, in function of a building structurally and constructional does not necessarily arise from the desire of the developers to recklessly build cheaply although all developers have a limit to the amount of money they can afford and spending on a building.
The point therefore is that client does not necessarily insist on cheap possible good building.

Adeniyi (2003) argued that if the above study is expected by Nigerians, then what we need to worry about are the two folds, thus failure in the design of the building as a whole and its elements and in the choice of materials. Also, the manner in which the building is erected and put together and how materials are used. The two main aspects mentioned above involve the designers of buildings on the one hand and the builder that construct, amongst designers you have other professionals such as Architect, the Building surveyor, the Structural engineer and the Serviced engineers.

Adams (2002) stated that contractors are mainly those professionals trained in the act of management of the business of building and because they are trained, they help the designers to achieve the clients three prong necessity for a good building which are stability, economic, and aesthetics. The use of materials on site should be carefully undertaken by professionals as mentioned above because of the way the construction industry has been natively accused of being wasteful, inefficient and unsafe, and of falling short quality targets and being late on delivery.

According to Fearon (2001), as quoted in John Walker-Dine in his paper “Material Control and waste in Building” defines wastes as “The difference between the value of the material delivered and accepted at site and those properly used as specified and accurately measured in the work, after deducting the cost saving of substituted materials and materials transferred elsewhere” the difference could be expressed as the percentage of the total materials delivered for the project.

There are simple options which when applied will go a long way in internalizing the use of materials on construction site by dampening demand for construction materials and increasing affordability. The immediate options include the following:-

a) Using minimum acceptable (but functional and safe) materials for concrete blocks and reinforcements. This implies that from the onset that is from planning stage the “Architects” specifications should take account of development economics and individual affordability.

b) Using cheaper but functional materials such as plastics pipes instead of steel pipes for conduit installation.

c) Designing structures to optimize use of standardized materials such as timber, roofing materials and rods.

d) Retaining professionals in new design principle which emphasize functionality, resource economy and use of local material for future housing design.

3.0 METHODOLOGY

MODEL FORMULATION
In this study, the linear regression model was adopted for analysis. Its formulation is as follows:

\[ Y = a_0 + b_1 X_1 + b_2 X_2 + b_n X_n = e_0 \]

Where

\[ a_0 + b_1 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \]

represents the coefficients to be estimated.

\[ Y: \text{ Is the dependent variable, which represents effective materials management on building construction site.} \]

\[ X_1: \text{ Failure to order on time.} \]

\[ X_2: \text{ Delivery at wrong time.} \]

\[ X_3: \text{ over-ordering.} \]

\[ X_4: \text{ Error in direction of materials.} \]

The regression parameters were computed using the following formulae:

\[ b_1 = \frac{N \sum X_i Y_i (\sum X_i) (\sum Y_i)}{N \sum X_i^2 (\sum X_i)^2} \]

And
\[
\sum Y_1 - \beta_1 \sum X_1
\]

The correlation coefficient (R) is determined using

\[
R = \frac{N \sum X_1 Y_1 (\sum X_1)(\sum Y_1)}{(N \sum X_1^2 (\sum X_1)^2) [N \sum X_1^2 (\sum X_1)^2]}
\]

The coefficient of determination (R\(^2\)) is determined using the formula:

\[
R^2 = \frac{SSR}{SST}
\]

Where:

SSR = \( b_1 \left( \sum X_1 Y_1 - \frac{\sum X_1 \sum Y_1}{N} \right) \)

And

SST = \( \sum Y_1 - (\sum Y_1)^2 \)

SSR is the sum of squares due to regression while SST is the total sum of squares, which is equal to:

SSR + SSE

Where SSE is the sum of squares due to error.

The mean square due to regression (MSR) is obtained as

\[
MSR = \frac{SSR}{K}
\]

Where “k” is the number of independent variable. The mean squares due to error is obtained as:

\[
MSE = \frac{SSE}{n-k-1}
\]

**ANOVA TABLE**

<table>
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<tr>
<th>SOURCE OF VARIATION</th>
<th>SUM OF SQUARES</th>
<th>DEGREE OF FREEDOM</th>
<th>MEAN SQUARES</th>
<th>F-RATIO</th>
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<tr>
<td>Regression</td>
<td>SSR = R(^2) \sum Y^2</td>
<td>K</td>
<td>MSR = SSR/K</td>
<td>F = MSR/MSE</td>
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<td>Error</td>
<td>SSE = ( \sum Y^2 - R(^2) \sum Y^2 )</td>
<td>n-k-1</td>
<td>MSE = SSE/n-k-1</td>
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<td>Total</td>
<td>SST = ( \sum Y^2 )</td>
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**DECISION RULE:**

Having computed the F-ratio, the null hypothesis (H\(_0\)) is accepted at \( \alpha = 0.05 \) significant level if: \( F* \leq F_{1-\alpha} \): K, n-k-1 degrees of freedom, otherwise H\(_0\) is rejected in favour of the alternative hypothesis (H\(_1\)), for a one-tail test. Here \( F_{1-\alpha} \): k, n-k-1.
4.0 RESULTS AND DISCUSSION

SUMMARY OF WEIGHTED SCORES BASED ON FIELD RESPONSES

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53 18 14 14 14 16
54 17 14 16 15 17

\[ n = 54 \]
\[ R^2 = 0.17 \]
\[ \text{Adjusted } R^2 = 0.12 \]
\[ SE = 1.0 \]

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<tr>
<th>Term</th>
<th>Coefficient</th>
<th>95% CI</th>
<th>SE</th>
<th>t statistic</th>
<th>DF</th>
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<td>0.0342</td>
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<td>X2</td>
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<td>0.103984</td>
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<td>X3</td>
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<td>0.3026 to 0.0642</td>
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<td>Total</td>
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DISCUSSION OF FINDINGS

At 5\% confidence interval, the P-value for X1 (Failure to order on time) was found to be 0.0342 which is less than X = 0.05, we reject the null hypothesis and therefore conclude that there is sufficient evidence to support the alternative hypothesis. This shows there is a significant relationship between failure to order on time and effective materials management on building construction projects.

At 5\% confidence interval, the P-value for delivery at the wrong time (X2) was found to be 0.0546 which is greater than X = 0.05. We do not reject the null hypothesis. And conclude there is insufficient evidence to support the alternative hypothesis. This implies that there is no significant relationship between delivery at the working time and effective material management on building construction projects.

At 5\% confidence interval, the P-value for over-ordering (X3) was found to be 0.0299 which is less than X = 0.05. We reject the null hypothesis and therefore conclude there is sufficient evidence to support the alternative hypothesis. This shows there is a significant relationship between over-ordering and effective materials management on building construction projects.
CONCLUSION

The use of effective materials management in a building construction site is most important. Material management leads to effective cost control and materials control, reduces failure of a project and also reduces the incidence of project abandonment. Management should therefore incorporate materials management in their corporate policy to improve the quality and time execution of their projects.

REFERENCES


Brockina (1989); Financial Management. DPS Publications, Britain.


