An Appraisal of Control of Construction Materials in the Nigerian Building Industry: A Case Study of Abuja, Nigeria

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Abstract

An effective project control system is essential to the successful delivery of a construction project. Projects of substantial sizes or complexity need to be continually managed to guarantee any possibility of success. The project team uses control standards to continually check progress against acceptable standards. The study is aimed at studying building production control of materials in the Nigerian building industry. The study focused on articulating the existing knowledge on efficient and effective building production control of materials. Data were collected through the administration of a structured questionnaire to experienced professionals in construction sites and offices. The result shows that 60% of the sites use materials scheduling in controlling materials and the control planning is mostly carried out by quantity surveyors. It was observed that some of the major factors affecting qualitative building production control of materials are; poor planning of materials control, late delivery of materials to site, poor storage and poor material testing. It is recommended that; proper materials management will reduce time delay (delivery), cost of purchase, poor quality and thereby stopping wastes; building industries should have a prepared document for controlling building materials; an enlightening program should be conducted to educate people on the areas of material control; the three basic tool (planning material, scheduling and ABC analysis) should be included in controlling materials.

Keywords: materials purchase, schedule of materials, storage of materials and planning

Introduction

Choice of materials and construction methods has a great impact on the environment to assess. Heavy emphasis has been environmental impact of building materials, product or service, throughout its lifecycle, usually from the acquisition of raw materials to waste disposal [1]. Materials were the means of design invention, their selection, fitness, adaptability to the tools the success or failure; materials were the building, and this philosophy remains of value in our consideration of choice of materials. At the point when the materials specified by the designer became production's responsibility for ordering and later reception on the site, they become the visible interpretation of the design [2]. Failure in modern building fabric (particularly external) can be attributed to look of concern in detail, about the way the selected materials must be handled, manipulated, assembled and fixed [3].

Time for the selection materials, resulted in the lowest quantity of both time-delay and cost overrun. Allocating less or more than 2 months for the selection of construction materials increased both delay and cost of the study of residential projects. The type of materials used in the construction of residential projects also affected projects' time delays and cost overruns. Surprisingly, projects built with imported materials experienced the least amount of time-delay and cost-increase when compared to those constructed with either only local or a "combination" of local and imported materials this finding is, nonetheless in accordance with the expectations, since owners and contractors who intend to use imported materials must insure the availability of such materials prior to the start of the construction phase [4].

An effective project control system is essential to the successful delivery of a construction project. Projects of substantial sizes or complexity need to be continually managed to guarantee any possibility of success. The project team uses control standards to continually check progress against acceptable standards. For example, performance data for a single lap can be projected to overall race performance and project performance at key milestone dates can be projected to successful completion at the end of the project [5]. During the implementation stage of the project, building production control system aims at ensuring the execution of work as for the planned scheduled and the application of necessary corrective measures [6]. Building production control being a system which collects, collates, and processes data to extract and disseminate information on time, resources, cost and quality performance

needs an academically trained and statutorily registered professional to be engaged in all production processes towards achieving the goals or objective of a product.

The construction industry is very important, as it uses larger quantities of materials than any other industry [7]. The fact that construction materials are low value should not surprise us; neither should it blind us to the importance of these materials. In view of the quantities used, it should be cheap; otherwise building would be very much more expensive, and not universally affordable, as they effectively are. However, the sheer scale of consumption means that their use has a major impact on the environment, and economists [8]. The project management techniques of planning, scheduling and controlling are the tools and devices that blind the subject's knowledge areas. These techniques can be applied to all types of projects. Due to the service nature of construction business knowledge gained in planning, scheduling and controlling process is rarely disseminated. The rate of failure construction contractors is one of the highest. One of the reasons for this high rate of failure is the lack of knowledge [9].

Building Materials

Building materials is any material which is used for a construction purpose. Many naturally occurring substances, such as clay, sand wood and rocks even twigs and leaves have been used to construction buildings. Apart from naturally occurring materials, many man-made products are in use, some more and some less Synthetic [10]. The manufacture of building materials is an established industry in many countries and the use of materials is typically segmented into specific specially trades, such as carpentry, plumber, roofing, masonry and insulation work [11]. Building materials account for approximately 60% of the total cost of building projects. Building materials are produced, imported and distributed in general by another sector of the industry that is not immune to the ills of the society [12].

Apart from the few major manufacturers of building materials in the country, most of the roofing, windows, electrical items, pipes, sanitary wares and finishes materials are imported. It is only paint that seems to be relatively out of importation. While there are various types of the same imported materials, most of them cannot pass any standard quality test in their countries of origin, but they find their ways into other countries. For example, in Nigeria where there is no locally established quality, Standard Organization of Nigeria (SON) as to inspect the materials, with an inspection of some criteria of such inspections. They are not to fold their arms and allow any kind of material into the market, but that the organization should be well funded to enable it to perform her statutory and important roles [13].

Planning Construction Materials

Generally, the term "materials" denotes all purchased items utilized at the project site including construction materials, supporting plant and equipment, and administrative facilities and stores. Construction materials cover all types of material used in construction including electrical and mechanical fittings, fixtures, devices and instruments that are incorporated during the construction of permanent works and temporary supporting works at site. Construction materials planning involves identifying materials, estimating quantities, defining specification, forecasting requirements, locating sources for procurement plans, and monitoring flow of materials till the connected construction works are completed.

Materials requirement planning (MRP)

According to Roy [14], MRP is a scientific technique of planning the material resources. It consists of planning for the purchase of materials, usage of materials in production and monitoring of inventories (i.e., stock). It is a combination of inventory control and scheduling techniques. In Production Management, MRP. is useful when the following conditions exist

I.	The demand for the product is known; hence the required manufacturing schedule can be arrived at.

II.	The input is made up of several components / sub-assemblies / raw materials.

III.	The procurement of components / sub-assemblies / raw materials involve lead time.

IV.	The manufacturing cycle of the end-product is sufficiently long.

Materials Purchasing: Materials required for the execution of projects are to be purchased scientifically. The factors to be considered while purchasing are as follow:

A.	Quality

B.	Quantity

C.	Price

D.	Time

E.	Source

**A.	Quality:** The quality of a product is in terms of its specification. The specification includes design, material used, physical/chemical composition and properties of materials etc. For example, the specification for the cement used for construction may be specified in terms of factors like setting time, final setting time and compressive strength etc. the specification for the steel used for the construction work may be specified in terms tensile strength, carbon content etc. The quality of materials/products procured for a project shall be such that it meets the pre-determined quality standards. Quality that is below the standard fixed shall not be accepted since it will affect the end results. Similarly, quality above the standards fixed is also not accepted it will only involve additional investment without additional gain commensurate with the additional investment [15].

B. Quantity: The quantity of purchase of materials/ products at any time during the execution the project shall be optimum. 'Hand to mouth' buying in small quantities shall be avoided as it will delay implementation of the project. On the other extreme, buying in too large quantities than what is required is also not advisable. Buying in too large quantities will increase the inventory carrying cost since the materials purchased well in advance will lie idle. Economic Ordering Quantity (E.O.Q.) may be arrived at for all major materials consumed during the project implementation. A suitable Recorder level may be fixed for such materials based on lead time required for the purchase of materials from material suppliers. The quantity of purchase can be fixed at E.O.Q and order for the supply of materials can be made once the Re-order level is reached. Such judicious planning will reduce the inventory maintenance cost and will help in containing the project cost within the budget [16].

C. Price: The price of materials depends on the quality; therefore, the price is determined by the quality standards expected of the material/products. However, to buy the minimum price without sacrificing the quality standards, tender system can be followed to identify the potential suppliers who can quote the lowest for the given quality. When there are only a very few vendors for the supply of some materials/products, negotiations can be made with suppliers to arrive at an advantageous price.

D. Time: The materials required shall be made available at the time they are required. Delay in arrival of materials will delay implementation of project while purchasing and stoking of materials will in advance of their actual date of requirement amounts to wasteful expenditure in the form of inventory carrying cost and interest cost on the investment made on idle inventory [17].

E. Source: Right quality of products at the right prices can be purchased only from right sources. Materials can be purchase either directly from the manufactures or form the dealers or from retailers in the open market. Each source has its own advantages and disadvantages. An analysis of the price quoted by the different sources and the cost of transportation from the source to the site can be done to arrive at suitable source for the procurement of materials. Inventory; this refers to those items that are yet to be consumed in the production of goods and services.

Storage of materials: Storage of materials can be defined as the provision of adequate space, protection and control for building materials and component held on site during the construction process (Frank, 2005) [18]. The actual requirements for specific items should be familiar to personnel in construction technology, but the need for storage and control of materials held on site can be analyzed further as:

A. Physical properties- size, shape, weight and mode of delivery will assist in determining the safe handling and stacking method(s) to be employed on site, which in turn will enable handling and storage costs to be estimated.

B. Organization- this is the planning process of ensuring that all material required are delivered to site at the correct time, in sufficient quantity; of the right quality, the means of unloading is available and that adequate space for storage or stacking has been allocated.

C. Protection- building material and components can be classified as durable or non-durable; the later will usually require some form of weather protection to prevent deterioration whilst in store.

ABC Classification of construction materials: In construction no two projects are similar. The type and quality of construction materials differ from project to project. Although some basic materials like cement, aggregate, steel water and timber are common items, others vary with the type of the project. For example, most of the finishing materials use in housing projects is not required in industrial projects [19].

The primary purpose of classifying materials is to control quality, cost and timely supply. There are many factors that need consideration while classifying materials. These include: Storage space, Shelf life, Supply reliability, Inventory costs, Ease of identification, Construction sequence, Transportation requirement, Price, Procurement time and procurement source and, Project life.

In general, the construction materials can be grouped into any one or a combination of the following categories:

I. Bulky, one tune purchases, repetitive use and minor materials.

II. Vital essential and desirable materials

III. Indigenous and imported materials.

IV. High price, medium price and low-price materials.

V. High usage value, medium usage value and low-usage value materials.

Table 1a: Format of material schedule.

BOQ/DRG REF	Description	QTY	Unit	Supplier	Planned Delivery Date	Actual DEL.Date

Source: Chitkara [6].

Material schedule: According to Ogbadu [20], Material schedule should be prepared in detail for the major materials and components. Such as; reinforcement, cement, blocks, timber, etc. It is advisable to prepare materials schedule from drawing rather than from the bill of quantities (BOQ). The schedules will help in the careful placement of orders, delivery and site storage

of materials. The delivery of materials must be precisely phased to suit the agreed construction programmed. By using this method, bottlenecks will be prevented, wasteful double handling and damages avoided. The (Table 1a) below shows the format of material schedule.

Research Method

The research method is quantitative, and the instrument adopted for the data collection for this research was questionnaires to experienced professionals controlling building materials on construction sites in Abuja, Nigeria. The population for this study targeted all experienced professionals in the construction industry such as Architects, Builders, Engineers and Quantity surveyors that are largely involved in managing/supervising of construction projects in all categories of construction firm within Abuja, Nigeria, because the proximity of the researcher's state of origin to the study area (Abuja), and the location of the construction projects in the same area makes the study more economical in terms of cost and time. From this population, a sample of fifty (50) building projects were selected with a value of 100 million Naira/5 million Rand and above, using purposive non-probability sampling techniques in which a total of 30 received giving a respond rate of 60% which is considered adequate for this research topic. The rationale for the selection is that building construction projects of this value and above are likely to have poor control of building materials compared with projects of less value. The descriptive method was used to analyses and discuss the data. The data generated were presented in the table format.

Results and Discussion

Table 1b: Control tools used for building material control based on frequency.

Tool Percentage of users	Percentage	Frequency	Percentage
Material planning	26.7	Material planning	20.0
Material scheduling	60	Material scheduling	66.7
ABC analysis	13.3	ABC analysis	13.3

(Table 1b) It can be observed from analysis made on tools that 60% of the respondents uses materials scheduling for controlling materials and 66.7% frequently used, 26.7% of the respondents uses material planning with 20% frequency of used and 13.3% of the respondents used ABC analysis and it used frequently at 13.3%. it could be noted that among the tools, scheduling is widely used; which gives knowledge about duties or events in the sequence of occurrence (set target) but could not help in determining quality and cost/price of materials which are of paramount important in the procurement of building materials.

The most common reasons for choosing these controlling techniques were analyzed from Table 2, 13.3% of respondents agrees that it is client's request, 26.7% agrees that it is to be

easily understood by people, 16.7 indicated that it is for top management understanding, 13.3% of respondents shows that it is best to control, 20.0% of respondents agrees that it is good for cost control, while 6.7% of respondents indicated that it is easy for identifying wastes and 3.3% of the respondents accepted it is most commonly used technique.

Table 2: Reason for choosing the technique(s).

Reasons	Percentage
Client's request	13.3
Easily understood	26.7
For top management understanding	16.7
Best to control	13.3
Good for cost control	20
Easy for identifying wastes	6.7
Most commonly used technique	3.3

Table 3: Factors of qualitative building production control of materials.

Factor	Mean	Rating
Poor planning	3.5	1
Late delivery	3.4	2
Equipment breakdown	3.2	3
Poor storage	3.2	3
Inefficient communication	3.1	4
Shortage of personnel	3	5
Poor material testing	3	5
Incompetent of personnel	2.9	6
Improper equipment	2.8	7
Damage material	2.6	8
Deficient contractor	2.5	9
Delay payment to supplier	2.3	10
Unavailability of proper resource	2.3	10
Subcontractor bankruptcy	1.7	11

Legend: 1=most important and 10and 11= least important.

Based on the results obtained, it can be seen that most of the respondents rated poor planning with mean value 3.50 as being most important, followed by late delivery of mean 3.40, equipment breakdown with mean of 3.20, poor storage with mean of 3.20, inefficient communication was also considered to be important with mean of 3.1, the least among the factor are; delay payment to supplier with mean of 2.30, unavailability of proper resources with mean of 2.30 and also subcontractors bankruptcy having a least mean of 1.7. For the analysis (Table 3), it is observed that poor planning, late delivery, poor storage and shortage of personnel and the major factors affecting qualitative building production control of materials in the Nigerian building industries (Table 4).

The result obtained indicated that most respondents pay much attention in controlling cash flow and cost of projects having a mean of 2.5 as being most important, followed by

material allocation with the mean of 2.4, man power allocation having a mean of 2.1 is considered average base on respondents rating and major equipment having 1.7 mean is considered important and the least important in controlling area as rated by respondents is project structure with mean of 1.6.

Table 4: Level of importance in controlling areas.

Controlling area	Mean	Rating
Cash flow and cost	25	1
Materials allocation	2.4	2
Man power allocation	2.1	3
Major equipment	1.7	4
Project structure	1.6	5

Legend: 1=most important and 5=least important.

Conclusion

It could be concluded that the problems associated with qualitative control of building material with respect to construction/building industries in Abuja, Nigeria includes: poor planning of material control, late delivery of materials having a great impact on project duration and poor storage leading to theft or damages on materials and lastly, poor material testing having an effect on quality standard and specification of any building materials.

The research shows that most of the construction companies make use of material scheduling as a basic tool/technique for controlling materials having about 60% of users and 66.7% frequency of use, the respondent's opinion is that; it is easily understood by personnel. Using the technique would not have been a bad idea, but other techniques could be better used for proper control of materials.

Recommendation

Based on the results of this study, the following recommendations are made to foster effective control of materials in the Nigeria Building Industry. Those involved in material management should engage adequate knowledge with right experience largely in the practice of material control, because it was observed in the research that most of the personnel in material planning have less experience in practice than expected.

Control of Building Materials should be practiced on all sites and by all categories of building construction firms, whether large, medium or small. The extent of work, nature of work to be done, and materials to be used should be defined in order to prepare a work study and every building industry should have a document that is used for controlling materials to reduce any possible factor that may result to project failure. Control of materials can help the reduction of cost, wastes, time, and quality, therefore; personnel in building industries should be enlightened in materials control and it would be advisable if an educational establishment is made on the area of material control and train people on the importance of managing building materials.

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