STUDY OF THE EFFECTIVENESS OF MATERIALS MANAGEMENT IN THE CONSTRUCTION INDUSTRY IN IMO STATE

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CERTIFICATION

We hereby certify that this thesis is accepted in partial fulfillment of the requirement for the Award of Masters Degree in Project Management Technology in Federal University of Technology Owerri.

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EXTERNAL EXAMINER	**…….**	**…….**
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DEDICATION

TO

ALMIGHTY GOD AND MY DARLING WIFE, MRS. VERONICA ESOHE IGBOJIAKU

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ABSTRACT

Materials Management in the Construction Industry in Imo State have been investigated. In order to reduce wastage of construction materials, the study focused on Success Level in Achieving Effective Materials Management as the Dependent Variable (Y) by introducing five Independent Variables (X_1 to X_5) thus (X_1) Management of Materials; (X_2) Skilled Professionals; (X_3) Control of Materials; (X_4) Inventory Build-up and (X_5) Motivation of workers. Three indigenous construction companies were used for the study; Alems Engineering Construction Company, Esie Engineering Construction Company and Hardel and Enic Construction Company.

Three different sets of questionnaire were developed, after interview with executives and workers in the three construction companies mentioned above. The questionnaires were distributed, and responses collected were then subjected to Multiple Regression analysis to generate – R, R^2, F-ration, Student's t-test and Standard error test.

The findings revealed that "Y" variable is significantly related to all the X_s variables (x_1 to X_5). The study also established a multiple regression model for the construction industry, which can be used to predict/forecast the values of "Y" when the values of X_s are known or given. It was finally revealed that these findings had great impact on the construction industry; the contractors; the client/owners; the Nigerian economy and the common /average man on the street.

We therefore conclude that the five independent variable of the study (X_1 to X_5) contribute and have significant effect on (Y) – success level in Achieving Effective Materials Management in the construction industry.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Overview Of The Study

Materials management is a total concept involving organizational structure unifying into single responsibility the systematic flow and control of material from identification of need, through customer delivery. Included within this concept are the materials functions of planning, scheduling, buying, storing, moving and distributing. (Oyeoku, 2001). These are logically represented by the disciplines of production and inventory control, purchasing and physical distribution (I FPM M-1984).

The function “Materials management” represents an organizational concept that provides for more efficient planning, coordination, and control of all material activities occurring prior to the actual use of materials. For this reason, the scope of materials management is broad. It involves the activities of planning, and anticipating materials requirements, introducing materials into the organization and monitoring their status as current assets, and providing materials at the right time and place so as to meet operational requirements of the organization or company (Oyeoku, 2001).

Materials management/control in the Nigerian construction industry is of universal importance. According to Koontz and others (1992), the surest way of achieving a construction company's objectives (profit maximization) is through effective materials management. Effective materials management can make a construction company to grow or prosper while ineffective materials management can lead to demise.

Monks (1987) in his own contribution looked at materials management in the construction industry as the planning, organization and controlling of the flow of materials, from the initial purchase (input) to the distribution/consumption, to produce a complete project (output). His contribution therefore embraces planning, purchasing, production and inventory control, storage, material handling and physical distribution. The objective of materials management is to optimize performance in meeting customer service requirements at the same time adding to profitability by minimizing cost and making the best use of available resources.

1.2 **Statement Of The Problem**

In Nigeria today, both the construction industry and public organizations are plagued with the problem of low productivity among the workers due to:

(i) poor management of materials.

(ii) Lack of adequate and qualified staff.

(iii) poor motivation of workers

(iv) misappropriation of funds

There is therefore dire need to improve productivity in our construction industry and at the same time to conserve our foreign exchange now more than ever before. Kontangora (1991), in one of his seminar lectures (Daily Times 23/8/91), stated that unless the managers in our construction industry improve on their capabilities in terms of the management of materials, labour and equipment, we will always have low productivity in the Nigerian construction industry.

Therefore, this study is focused on: **Success Level in Achieving Effective Materials Management** in the Nigerian construction industry.

1.3 **Need For The Study**

In the past years, materials management in Nigerian construction industry was neglected, due to ignorance of its effect in construction projects and our national economy. This study became necessary, since it will help to correct this false impression and at the same time help in the growth of our national economy.

Materials management in the Nigerian construction industry therefore is of universal importance. According to Koontze and others (1992), the surest way of achieving The construction company's objective (profit maximization) is through effective materials management. Effective materials management can make a construction company to grow or prosper, while ineffective materials management can lead to demise.

According to the National Construction Policy (1991), construction projects are the ultimate in the realization of many stages of physical development in our country's economy. Thus in all of the sectors of the national economy, be it agriculture, mining, manufacturing, petroleum or commerce, there are construction projects that will enhance physical development of materials that

will increase productivity and growth. Therefore the effective management of materials that will increase productivity and growth in the country's economy is not only desirable but also indispensable.

1.4 Objectives Of The Study

The objectives of this study include:

1. To determine the success level in achieving effective materials management in the Nigerian construction industry.

2. To make recommendations that will help improve materials management and control in most construction companies in Owerri, such as ALEMS Engineering Contractors, ESIA Engineering Contractors, and Hardel and Enic Construction Company, Owerri, Imo State.

1.5 Research Questions

The research questions to which answers are attempted in this study are:

(i) Are materials managed very well in the Nigerian construction industry?

(ii) Are the right/skilled professionals heading and controlling the materials departments in the Nigerian construction industry?

(iii) Is lack of proper equipment for work affecting the efficiency/output in the Nigerian construction industry?

(iv) Is the poor performance in the Nigerian construction industry due to poor management and control of materials?

(v) Are there inventory built-up in the Nigerian construction industry?

(vi) Is poor motivation of workers in the Nigerian construction industry responsible for poor management of materials?

1.6 **The Hypotheses of the Study**

A preliminary survey involving research of relevant literature, discussion with Chief executives/Directors, site agents, site engineers, site supervisors, and site foremen, builders and quantity surveys, purchasing, and stores managers, in the construction industry, helped to identify the key construction variables (CV) that influence the **Success level in Achieving Effective Materials Management** in the Nigerian construction industry in the study organizations:

Hardel and Enic Construction Company, Alems Engineering Constructors and Esie Engineering Contractors, Owerri in Imo State (1995-2000).

On the basis of the information generated six hypotheses were developed to establish the relationships that exist between the dependent and independent variables of the study. Such relationships are than tested for there validity. For this study, the dependent variable (Y) developed from the preliminary research is: "**Success Level In Achieving Effective Materials Management**" in the Nigerian construction industry.

The six independent variables (X_1-X_6) developed are:

(1) Management of materials in the Nigerian construction industry.

(2) Skilled Professionals in materials department.

(3) Equipment for work.

(4) Control of materials.

(5) Inventory build-up.

(6) Motivation of workers.

The variables were transformed into the following six Null (H_0) hypotheses for testing:

H_{01}: Management of materials has no significant effect on the success level in the Nigerian construction industry.

H_{02}: Skilled professionals, heading materials departments, have no significant effect on the success level in the Nigerian construction industry.

H_{03}: Lack of Equipment for work has no significant effect on the output/efficiency in the Nigerian construction industry.

H_{04}: Control of materials has no significant effect on the performance of the Nigerian construction industry.

.H_{05}: Inventory build-up has no significant effect on the success level in the Nigerian construction industry.

H_{06}: Motivation of workers has no significant influence on success level of materials management in the Nigerian construction industry.

1.7 **Significance Of The Study.**

The National construction policy put in place by the Federal Government of Nigeria with effect from 18th June 1991. One of the goals of the National Construction Policy established by the Federal Government of Nigeria in June 18, 1991, is that Nigeria must achieve a state of total participation of her indigenous professionals in the construction industry in order to monitor and control how materials are used. Toward this goal, some lofty objectives have been set thus:

1. The development of political will to ensure increased participation of indigenous professionals in the construction industry.
2. Reduction of construction cost.
3. Development of construction materials, equipment and spare parts from local sources and
4. The adoption of appropriate construction technology that will be responsive to the technology conditions of the country.

Another policy that places a high responsibility on the effectiveness and control of materials in the Nigerian construction industry is the National Housing Policy, launching on February 20, 1991. According to this policy, about eight million

housing units including infrastructures were expected to be constructed in Nigeria by the Year 2005. For the two policies named above to be successfully implemented, there must be effective monitoring and control of materials.

This research is carried out to identify how effective management and control of materials could go a long way in increasing productivity, performance and managerial skills in our modern construction industry, The study is anticipated to achieving the following necessities:

(a) To help contractors (like Hardel and Enic Construction Company, Owerri) and others to determine the optimal quantity and quality of materials, equipment and labour to employ or use for a particular project.

(b) To help project managers to plan, organize and programme any project.

(c) To help local contractors to estimate the total fund, and number of workers required for a particular project at any time.

1.8 **Scope/Limitation Of the Study**

Due to time and financial constraints the study is limited to the study of appraising the effectiveness of materials management functions in these indigenous construction companies based in Owerri, Imo State: Hardel and Enic Construction Company, Alems Engineering Contractors, and Esie Engineering Contractors.

The study determined the **Success level in Achieving Effective Materials Management** in the Nigerian construction industry and made recommendations that should help improve materials management and control in the construction industry in Nigeria.

In view of the broad nature of the construction industry, and because of time and financial constraints, especially during this time of acute fuel scarcity in country, the research concentrated on the building and civil engineering sub-sectors of the construction industry in Imo State.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The word construction is an all embracing term that covers the erection of buildings for various uses such as residential, commercial, industrial, administrative, educational and recreational, building and other structures (Ademorati, 1991), These are amongst man's most tangible and enduring achievement.

According to the National Construction Policy (1991), construction covers civil engineering activities such as the construction of roads and highways, airfield, bridges, wharfs, jetties, dams, water distribution networks or water reticulation and drainage. It also covers other heavy engineering facilities like refineries, steel complexes and power works.

There is rarely any government investment on development that does not involve construction work. Bello (1982), observes that whether one is drilling or marketing oil, making social investments in health education, transport, sports, agriculture, housing or any sphere of social requirements, there is construction

involved. The all-embracing nature of the industry make many people to show interest in the industry whether or not they are directly involved in the industry.

The literature review is presented in three main parts:

(a) A review of the historical development of the construction industry in Nigeria.

(b) Determination of the importance of the construction industry to the national economy and

(c) Determination of the importance of effective management in the construction industry.

2.2 Historical Development Of The Construction Industry In Nigeria

The act of construction started much earlier than the modern scientific design. Examples of construction work which dated before scientific design include the Egyptian pyramids, the Roman Apian ways and Aqueducts, the Leaning Tower of Pisa, the irrigation network at the banks of River Nile and single and two storey mud buildings built by Africans.

The early builders were their own architects, engineers, planners and quantitative surveyors. There is now specialization in these inter-related fields,

which was brought about by science and technology. According to the Nigerian Construction Policy (1991), there were only a few modern construction projects in Nigeria during the colonial period. The few ones were handled mostly by the Public Works Department (PWD) and a few circumstances by the Royal Army Engineers, which later became the Nigeria Army Engineers.

Some foreign companies mainly, Italians and the British arrived at the scene during the period, although with limited activities. There was an influx of other foreign firms after independence in 1960. Those were notably from France, West Germany, and Bulgaria and so forth.

A study by Hussein (1991) reveals that the number of foreign construction firms operating in Nigeria has been on the increase from barely twenty in 1960 to about three hundred (reputable ones) in 1985. The Nigeria construction industry is modeled largely after the British system, although since independence, it has taken into consideration the styles of other Western countries such as Italy, Germany and France.

Hussein (1991), further notes that between 1960 and 1969, the tempo of construction in Nigeria was very low due partly to the transitional period from

colonial rule to political independence and partly to political instability arising from the civil war (1967-1970) and low level of economic activities. Between 1971 and 1975 the construction industry emerged as a significant component and contributor to the nation's economic development.

During this period, construction was motivated by the need for reconstruction and rehabilitation works following the civil war and oil boom. This period witnessed an upsurge of quacks and irregularities in the industry. Every Tom, Dick and Harry emerged as emergency contractors. People in government and even the governed did not see any reason for cost control or any regulation of practices within the industry.

However, there was a slight decline in growth of construction activities in the country between 1978 and 1980. Since this period, there has been a further remarkable downturn in construction work. The downturn of the economy has led to the abandonment of many projects and consequently escalation of project costs, inadequate maintenance, and uncompleted and substantial projects.

2.3 The Importance Of The Construction Industry To National Development

Some truism about the importance of the construction industry in Nigeria had been identified by a number of authors. Onabule (1991) notes that the output of the industry provides the skeletal framework on which virtually all the sectors of the national economy is built and within which the various processes and activities are carried out.

Therefore if the output of the industry is defective or inadequate, it will adversely affect other socio-economic activities of the nation. The self-evident truth was similar recognized by the National Construction Policy, which describes the construction industry as a potential motivator of the national economy providing the driving force necessary for either sustaining a buoyant economy or revamping a depressed one. Similarly, Adegboro (1992), writing about the British construction industry, notes that “successive British governments find the construction industry as one most suitable and appropriate industry to use in regulating the national economy”.

The direct relationship between the construction industry and national economy could be seen by comparing the growth rate of the industry and the nation’s Gross Domestic Product (GDP). According to the National Construction (1991),

the annual growth rate in the construction industry s in Nigeria in 1974 was 269.4%, when the Gross Domestic Product (GPD) grew by 131.2%, but when in 1984 the construction industry declined by 27%, the nations GDP correspondingly declined by 11%.

Another self-evident truth about the importance of the industry according to Onabule (1991), is that the primacy of construction end-products in economic development are indeed significant for social welfare, capital formation, income and employment generation, general price level and balance of payment.

Similarly, Hussein (1991), notes that construction activities in Nigeria account for about sixty percent (60%) of the nation's capital investment and thirty percent (30%) of the Gross Domestic Product. In a related discussion Oduma (1992), in a keynote address titled "Public Building Construction in an Inflation Economy" to the national conference of chief architects and heads of public buildings and housing department in Nigeria, also notes that the construction industry accounts for seventy per cent (70%) of the economic activities in the country. In terms of employment generation, Hussein (1991), acclaims that the industry is second to the Government in the employment of labour in Nigeria.

2.4 Importance Of Management In The Construction Industry

Calvert (1981), defines the management as a “social process entailing responsibility for the effective economic planning and regulation of the operations of an enterprise in the fulfillment of a given purpose or task”.

According to the author, management in the construction industry differs considerably from the tidy relation indicated in most management textbooks, that the coherence in development, manufacturing and sale does not exist within the construction industry.

Fayol (1916), defines management as an art or planning, organizing, motivation, controlling, coordinating and communicating in the field of finance, design, production, maintenance, and so forth carried out by industrial organizations.

There has been an increasing awareness that the quality of materials management is important to modern life and this has resulted in extensive analysis and study of the management process, its environment and techniques. According to Koontze and others (1982), analysis of business failures made over many years by credit firms in America shows that a very high percentage of business failures were due to unqualified or inexperienced

management. Also, companies succeed almost invariably to the extent that they are well managed and that more than 90% of business failures in the united states of America are due to managerial incompetence and inexperience.

Kayoed (1989), identifies six major aspects of business environment namely: economic, technical, managerial, organizational, commercial and financial. He agues that the managerial aspect subsumes the organizational, commercial, and financial and to some extent the technical aspects of the environment; that management is indeed the crucial determinant of the success or failure of an industrial undertaking. He further points out that the importance of management to a project's success could best be put in the following way: "if a company has nothing going for it except good management, it will make the grade. If it has everything going for it except bad management, it will flop".

Obiegbu (1991), similarly points out that it is management and not operatives who are ultimately responsible for the success of construction companies.

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2.5 **Characteristic Of the Construction Industry**

Generally, construction involves a complex, fast moving and exciting process. It is unique with each feature representing a challenge to be taken up and

overcome. According to Ward (1979), the construction industry is characteristically different from other industries in the following ways:

(i) Work is carried out in the open and is subject to interference from weather.

(ii) The plan to work on a site varies and changes from day to day.

(iii) Labour force the industry is often considered nomadic in nature. Employees not only move from site to site but also from employer to employer.

(iv) Sites are often located many kilometers away from head office or regional office of the company

(v) Construction involves a high value of specialist work and a wide range of trades and activities.

(vi) The industry is labour intensive where cost of labour often represents over fifty percent of the total cost of a project.

The above characteristics often create many technical and managerial problems for construction firms.

2.6 **The Meaning And Scope Of Materials Management**

The function ‘materials management’ represents an organizational concept that provides for more efficient planning, co-ordination and control of all material activities occurring prior to the actual use of materials. For this reason, the scope of materials management is broad. It involves the activities of planning and anticipating materials requirements, introducing materials in the organization or company, and monitoring their status as current assets, and providing materials at the right time and place so as to meet the operational requirement of the company.

From the foregoing, it will be rightly suggested that the outlook of the person holding the title of “Materials Manager” must be that of a systems manger. He must look at his job as managing a total coordinated system of materials flows. He must look at his job as managing a total coordinated system of materials flows. His responsibilities begin with the planning of material requirement and end only when the materials have been successfully used. Each of the several functions in the materials flow is regarded as only one part of an independent set of steps, each of which influences those steps proceeding and following it.

Usually, the specific objectives of materials management must be based on the overall objectives of the company. In this regard, materials management must

operate effectively, that is providing the user the materials he needs in the right quality, quantity, and made available at the time he needs them. Furthermore, it must operate effectively by providing the needed materials at a minimum ultimate cost, so that the total organization or company can provide service to the customer or consumer at a minimum cost.

Monks (1987), in his own contribution looks at materials management as the planning, organizing, and controlling of the flow of materials, from the initial purchase to the internal operations and to the distribution of finished goods. Monk's definition and contribution is best suited to construction company activities.

Materials management therefore embraces planning, purchasing, production and inventory control, storage and material handling and physical distribution. The objective of material management is to optimize performance in meeting customer service requirements at the same time adding to profitability by minimizing cost and making the best use of available resources.

Materials management was initially used in the United States within the manufacturing industry. This concept was hailed by a number of major

companies (especially construction companies as new effective approach for dealing with materials problems).

2.6 Materials Management In The Construction Industry

Some of the materials used in the construction industry are – aggregate (chippings, stone, gravel) reinforcements, (rods of different diameters), cement, sand, water, timber materials, tar of different grades - (MCO, MCI, COLAX-A, S-125) and asphalting materials. The above are the major 'inputs' in a construction company or industry, while the 'outputs' are the completed buildings, bridges and roads.

In the construction industry, materials cost over 50% of the total construction cost, while labour cost, especially in developing countries (like Nigeria) are relatively very low (Obiegbu 1992), "hence proper management and control of materials accounts for the success or failure of any construction project", whether in the field of agriculture, mining, construction (civil/building works), petroleum exploration or commerce.

Here in Nigeria, the construction industry is one of the biggest employers of labour after government, with a labour force of over a million; a figure that has

dropped steadily over the past few years. The construction industry as a whole is made up of many fragmented units; the majority of construction companies employs less than 25 people, and is classified as small-scale construction companies; the medium size companies form about 10% of the total construction industry with between 25 and 200 employees. The large construction companies employ from 200 to over 1000 people.

The building construction industry is concerned with the planning, designing and erection of buildings for various uses and also the services in and around the buildings. Popoola (1991), broadly describes the construction industry as one that is concerned with all interest in land and development. According to the author, construction works include the alteration, erection or re-erection of buildings, the construction of roads and sewers, water distribution networks, building of river walls (dams), playing fields and so forth. It also includes heavy engineering works and petrochemicals development.The construction industry is so broad that almost everybody in the country “consumes” the products of the industry.

According to the National Construction Policy (1991), construction is the ultimate in the realization of many stages of physical development in any

country. Thus in all aspect of the national economy, be it agriculture, mining, manufacturing petroleum exploration or commerce, there are construction project. Therefore the effective management of materials that increases productivity is not only desirable but indispensable in the construction industry.

2.6 **Application Areas of Materials Management**

The International Federation of Purchasing and Materials Management (IFPMM) in an international workshop in Venice (1984) defined materials management as a total concept, involving an organizational responsibility, the systematic flow and control of materials from identification of need through customer delivery. Included within this concept are the materials management functions of planning, scheduling, buying,, storing, moving and distributing. These are logically represented by the discipline of production and inventory control, purchasing and physical distribution.

From the general outlook of the above definition, it will be clear that the materials management is not only useful to firms manufacturing tangible products, (one which can be viewed, stored and physically held in the hand), but also applicable to any company or organization in which a continuous flow

of materials, parts and or supplies is necessary to accomplish the overall goals of that company.

It can therefore be applied successfully in construction industry, resulting in increased effectiveness and efficiency. It is equally applicable in other sectors like educational institutions, banks, hospitals, governmental and non-governmental agencies, utility services and a must for Independent National Electoral Commission (INEC) of Nigeria. Each of these organizations though its output might be a service rather than a 'hard' product, is virtually dependent upon an effective and efficient supply of materials to support its operations.

2.6.3 **The Concept of Materials Resource Management**

Materials management was defined as the line of responsibility, which begins with the selection of suppliers, and ends when the materials are delivered to their point of use (AMINER, 1969). Zeng (1968) in his own contribution, looks at materials management as a concept, which brings together under one management the responsibility for determining the manufacturing requirements, scheduling the manufacturing process, procuring, storing and dispensing materials. As such, it is concerned with, and controls activities involved in

acquisition and use of materials employed in the production of a finished product.

Tearon (1973), looks at materials management as the single manager organization concept, embracing planning, organizing, motivating and controlling of all the activities and personnel principally concerned with the flow of materials into an organization.

According to Lee and Dobler (1977), materials management as practiced in business and companies of today is a “confederacy of traditional materials activities bound by a common idea, the idea of an integrated management approach to planning, acquisition, conversion, flow, and distribution of production materials from the raw materials state to the finished product state”. They assert that such concept advocated the assignment of all major activities, which contribute to materials cost to a single materials management department.

Included in their major materials activities are the primary responsibilities which are generally found in the purchasing department, plus all other major procurement responsibilities like inventory management, traffic, receiving

warehousing, surplus and salvage, and frequently, production planning and control.

Much progress has been made in recent years to develop professionalism in all functions concerned with the management of materials, (aided of course by computer application). A major factor that has demanded the need for such progress has been the greatly increase cost of capital, 3-4 percent in the 1950s, and 10-15 percent in the 1980s. (Oyeoku 2001).

However, while successes have been achieved, due to effective materials management, progress towards the development of a soundly based management of materials philosophy has been generally disappointing. The importance of logistics management has long been understood. It has been applied particularly successfully in the military (Armed services), where men, equipment and materials have to be directed to the right place, at the right time. The concept of ‘input’ and ‘output’ management of materials has been propounded by a number of writers.

The fundamental problem has been that of increasing professionalism within purchasing, stores, production, planning and control, inventory control,

materials handling warehouse and distribution. Materials management has tended to develop mainly in independent compartments, which has produced an insular, restricting and uneconomical approach. What is needed is a philosophy of integrated professionalism. Staff cannot operate well unless they appreciate the needs and problems of colleagues in inter-related materials management functions.

Such awareness cannot by itself produce desired results. These are achieved by each function translating awareness into action and all staff working as a team to achieve corporate objectives. Managing materials or materials management therefore must be viewed as a total concept, which is in balance with other functions, such as engineering, marketing, sales, production, finance and personnel.

2.7 **Materials Management Objectives**

The primary objective of materials management is to solve materials problems from a total organization viewpoint of anyone of the individual functions comprising materials management. To state the objectives in other terms, Fearon (1967) says it is to balance possibly conflicting objectives of the various materials functions to the net benefit of the organization as a whole. This is so

because; a number of conflicting objectives are ever present in managing materials.

Materials are the raw materials, components, sub-assemblies and the supplies used to produce a good or service. Most materials are transformed into finished products (input-output) process, but supplies are consumed in a daily operation. Materials became direct cost whereas supplies are often classified as overhead or indirect costs. The term materials (stores) are used to connect the following group of items.

(a) Raw materials

(b) Spares and components

(c) Consumable stores and

(d) Packing materials

Materials management on the other hand covers three stages namely – purchasing of materials, stock keeping and issue of materials (components). Materials management is undertaken to ensure that the right quality and quantities of materials are made available at the right place, at the right time, and at the right price. (Oyeoku, 2001). Therefore, materials management should ensure that:

(a) Materials are made available as and when required, and that production is not at any stage held up for want of materials.
(b) Materials are not over stocked to the extent that the working capital is unnecessarily locked up.
(c) Materials are of the right quantity, to produce the required standard of the finished goods.
(d) Materials are purchased at the most advantageous price without prejudice either to the quality of materials or to the period of delivery.

Materials management therefore is the planning, organizing, and controlling of the flow of materials from the initial purchase to the internal operations and to the distribution of finished goods (Monks, 1987).

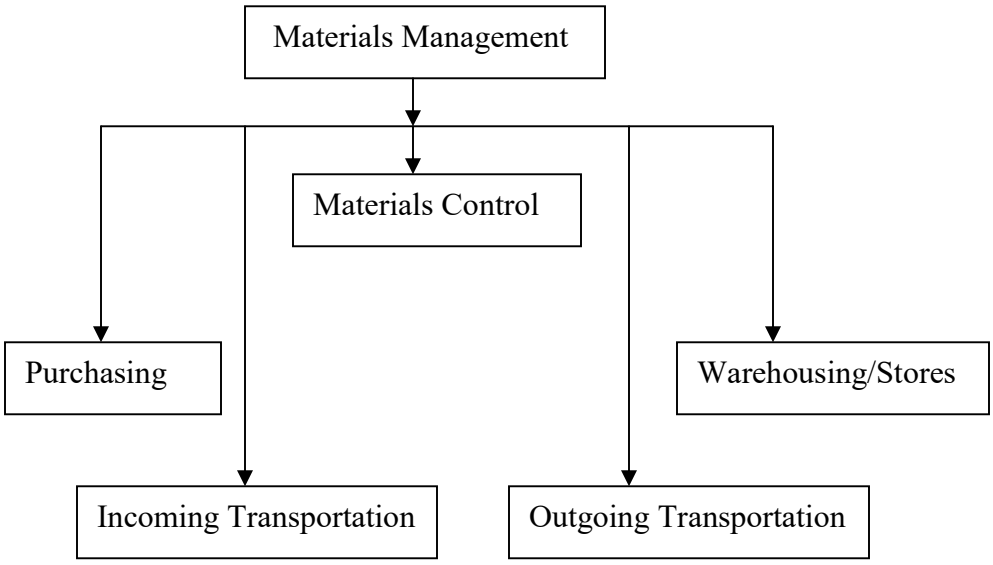
The major elements in the organization of materials management system/sub-department are:

(a) Purchasing
(b) Transportation (incoming and outgoing)
(c) Materials Management and control

(d) Warehousing/stores.

These are shown in the organization structure in Figure 1 below:

Fig 1: Materials Management Organizational Structure:



(Source: Designed from the elements of a materials management organization)

From the above figure, we can see that there are five major sub-department that make up the materials management unit. Each sub-department should work harmoniously with other sub-departments towards achieving the goals and objectives of the parent unit.

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2.7.1 Purchasing Sub-Department

According to Oyeoku (2001) purchasing is the acquisition of goods and services in exchange for money/funds. It can also be called buying or

procurement. Purchasing is a specialized activity frequently carried out by a separate department under the control of materials management unit. Purchasing function is that function entrusted with the procurement of materials, supplies, plant, machinery, tools and services required to equip, maintain an organization or company. It is thus concerned with buying the right quantity of materials of the right quality at the “right price” at the “right time” from the right source. This is usually described as the five rights of purchasing or more technically stated, the “Purchasing Mix”.

The factors concerned in reaching these objectives are:

(a) **Quality:** Maintenance of established standards based on suitability for use.

(b) **Quantity:** Maintenance of continuity of supply with the minimum investment in stock consistent with safety and economic advantage.

(c) **Price:** That which meets production and storage schedules as closely as possible thus avoiding overstocking.

(d) **Source:** One that has the ability to fulfill the above requirements without being dependent on one supplier or monopolist.

Associated with the above principal objectives of the purchasing functions are:

(i) Avoidance of duplication, waste, deterioration and obsolescence of supplies purchased.

(ii) Maintenance of the organization's competitive position as regards materials cost and quality of product. This has to be borne in mind, since 2% saving on purchases is equivalent to 10% increase in sales.

The purchasing function therefore includes the determination of:

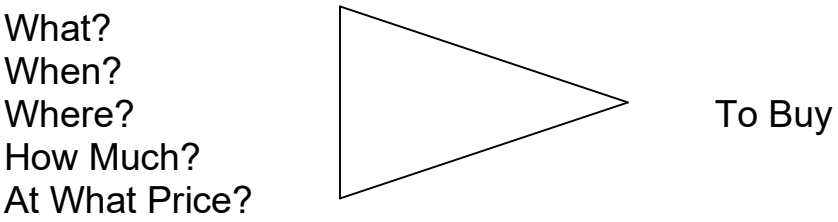

Figure 2: Purchasing Decisions
(Source: Nwachukwu (2000), Materials Management)

The purchasing department should arrange to procure those items which the organization or company are unable to manufacture and even those other items which the firm can make but does not want to produce. This is because some of the components could not be produced within.

The purchasing department should therefore be able to determine ‘What?’ to buy from outside the company. e.g. asphalting materials and chippings. The decision regarding to make or buy would depend on annual requirements of the items concerned, the frequency with which they have to be purchased, the availability of spare production capacity in the company, the price advantage; and the secrecy or patents attached to the product. This very important decision and guidance must be got from control departments.

The question of ‘When?’ to buy is dependent on the receipt of indents from the store. In case of those items the supplies of which are restricted by government control, the frequency of the purchase will depend upon the receipt of the necessary licenses, quota or permits as the case may be.

On the issue of ‘Where?’ to buy, the purchasing department normally materials maintains, for every group of materials, a list of registered supplier’s names and addresses under each group. The purchase is made from these suppliers through the system of issuing tenders and calling for quotations. However, controlled materials are purchased through permits and so forth. and where

long-term contracts have been entered into for the supply of materials bought in bulk, the source of supply is restricted to certain specific suppliers only.

The question of ‘How?’ to buy is an important question, which the purchasing officer has to decide on. The purchasing officer will decide whether to buy in one lot annually, in two lots bi-annually or monthly because the greater the frequency of purchasing, the lesser will be the quantity that will be purchased and held in stock.

Thus with increase in the cost of purchasing, there will be reduction in the cost of holding the stock. Hence, the quantity for which the sum total of cost of holding is minimum, represents the quantity to be purchased, that is, the ordering quantity. Efficient purchase control requires the determination of the ordering quantities in respect of all the important and fast moving items of stores that are held in stock.

On, at ‘What Price?’ to buy, the purchasing officer chooses the least price offered by the suppliers on the receipt of quotations and in reply to tenders, though most often than not, this is not the case, as some other factors are involved such as the reliability supplier; its financial strength; its capability on

the offered periods, and the credit facility it offers with the comparative price. The purchasing department should be able to choose their source of supply from amongst the quotations received.

Investment in materials all over the world constitutes not only the total capital outlays; it leaves a meager fund for expansion. This is more so in the developing economies. For every investment in materials constitute up to 88% of the total capital. (River Bank of India Survey, 1965). In Nigeria, the case is different. There is no known study in this regard. It therefore becomes necessary that the use of materials in the Nigerian construction industry should be controlled.

2.7.2 **Materials Purchasing Objectives**

In a typical Nigerian construction company, some basic purchasing objectives include:

1. To supply the company with a steady flow of materials and service to meet its need.
2. To ensure continuity of supply by maintaining effective relationships with existing sources and by developing other sources of supply.

3. To buy efficiently and wisely obtaining by any ethical means value of every money/naira spent.
4. To manage materials so efficiently as to give the best possible services to users at the lowest cost.
5. To maintain sound co-operative relationships with other departments, providing information and advice as necessary.
6. To develop staff policies, procedures and organization to achieve objectives.

The achievement of the above objectives will make the purchasing function effective in any construction company.

2.7.3 **Transportation (Incoming And Outgoing)**

Transportation is one of the basic factors that enhance the effectiveness of materials management in any construction company. This is done in two ways - incoming and outgoing.

(i) **Incoming Transportation**

Goods for construction (e.g. cement, spare parts, sand, chippings, blocks and so forth) purchased by the company, must be brought to

the company's headquarters or sent to the construction site, whether they are bulky or small items. The transport department provides adequate vehicles to move raw materials required by the company (input) to the construction site. This they do by providing the right vehicle at the right time and at the minimum available cost.

(ii) **Outgoing Transportation**

Goods produced by the company (output) e.g. Asphalt, must be transported out to the consumers. This is done in two different ways or methods namely:. C.I.F. (Cost Insurance Freight) and F.O.B (Free on Board) systems

.

Thus in C.I.F. (Cost Insurance Freight) method of transportation the distance or destination of the goods is always taken into consideration. The further the distance, the more costly the goods, while in F.O.B. (Free on Board) method or system, there is always a uniform rate for distribution and transportation of goods to different locations or sites, that is the rate is the same. For example, Coca Cola method of distributing goods.

2.7.4 **Materials Management Control In The Construction Industry**

Materials control is a system, which ensures the provision of the required quantity of materials, of the required quality at the required time with the minimum amount of capital. The function of a good system of materials management control includes: scheduling the requirement, purchasing, receiving and inspecting, maintaining stock records and stock control (OYEOKU 2001).

Materials management control in practice is a matter of co-ordination. A proper materials management control helps in improving the “input” ratio. Input covers all materials, which involve a considerable investment in accumulated stock far in excess of requirement, while the output in construction industry is the completed project.

Materials management control in construction industry is exercised through periodical reports and records relating to purchasing, receiving, inspecting and issuing of materials (direct and indirect). It is effected by means of functional organization and assignment of responsibility through the use of standard

forms, accounting records and entries, and cost reports affecting materials from the initiation of purchase requisition till the material is finally consumed.

2.7.5 **Stores/Warehousing.**

Materials management in the construction industry cannot be soundly based, unless it embraces an effective, efficient stores operation. Oyeoku (2001). It has generally been the case in the past, not to recruit highly qualified staff to work in stores. However, physical store keeping assumes increasingly greater importance as efforts are directed towards an integrated professional approach to materials management. The stores department has increased greatly in importance in recent years, being a major contributor to cost containment.

The purchase and keeping of materials is known as “inventory”.The amount of inventory to purchase and store for use in the project at any point in time is concerned with two decisions as opined by Muoruh (1997). The decision includes:

1. How much material to order at a time.
2. When to order these quantities in order to minimize total cost.

There is a wide range of inventory models such as First In First Out (FIFO), First In Last Out (FILO), Last In First Out (LIFO) and Last In Last Out (LILO). In many cases, it is possible to make quite accurate decisions with relatively these simples models in stores distribution/disbursement of construction materials.

Stores/warehousing therefore is very important in materials management operations, because it is the main base for storing construction materials, like cement. They are located at company headquarters, at a central distribution point, or at a number of geographical locations depending on distribution requirements. Some goods have limited life span, as in the case of cement used for construction works. Here, the rule to apply is if First In First Out (FIFO); a good inventory model.

However, for the great majority of construction materials life constraints apply to a much less critical degree and storage space limitation could make it difficult to apply the rule because of retrieval problems.

2.8 Types Of Stores

There are many different types of stores. The main ones in general use are:

(a) **General Stores**

These form the greater majority of stores in private and public sectors, which serve the needs of most construction companies.

(b) **Production Stores**

The stock of tools, equipment and consumable materials such as cement (input) required to produce the output in a construction company.

(c) **Engineering Stores**

These stock engineering requirements needed for maintenance and servicing, including consumables. They would also hold in safe custody items of plant and equipment awaiting installation or putting into use.

(d) **Finished-Goods Stores**

These are the repositories for completed items pending dispatch to customers. These are also known as warehouse stores. A construction company's warehouse is a store for goods and materials (input) used for construction activities.

(e) **Sub-Stores**

These vary in size and number depending on geographical dispersion of the user units and the incidence of emergency situation that arise. Financial control of inventories cannot be effective without strict control of sub-store holding.

(f) **Stationery Stores**

These stock the company's range of stationary items.

(g) **Special Stores**

These stock a wide range of materials which by their nature might require segregation or to be located apart from other materials. Such materials include solvents, petroleum, radio-active materials and in special cases, explosives. Applicable safety regulations must be strictly observed.

2.9 Inventory Management In The Construction Industry

Materials, spare parts and components that are purchased and held in the form of raw materials, semi-finished goods and finished goods are known as inventory. Inventories are idling resources that posses economic value.

An inventory problem is one, which seeks to determine when it is necessary to stock physical goods, or materials for the purpose of satisfying demand over a specified time period. This type of problem, aims at knowing how much of the materials to order for and when to make the order. An overstock requires higher invested capital per unit of time but less frequent occurrence of shortages and placement of order, whereas an under stock decreases the invested capital per unit of time but increases the frequency of ordering as well as the risk of running out of stock.

It has become necessary to discuss this topic herein, because a materials manager is an inventory manager and therefore should be able to solve these inventory problems.

2.9.1 The Need For Inventory In The Construction Industry

The inventory of a firm can be described as the totality of stock of various kinds, which include basic raw materials, partly finished goods and materials, sub-assemblies, office and workshop supplies and finished goods. They are idle resources that possess economic value. They are vital to construction companies because they store raw materials and spare parts (input) used by the companies to achieve their output (completed projects).

Some of the reasons for holding inventories are as follows:

1. To serve customers with variable demands
2. To take advantage of bulk purchase discounts
3. To meet emergency shortages due to some unforeseen circumstances like strikes, breakdown of suppliers machines or vehicles.
4. To facilitate the production of different products on the same facilities.
5. To provide the means of obtaining and handling materials in economic lot sizes.
6. To help level production activity, stabilize employment and improve labour relations.
7. As a natural part of the production process like allowing metals to cool and allowing flour to rise in the production of bread.
8. To provide a means of hedging against future price and delivery uncertainties such as price increase and inflation.

2.9.2 Inventory Costs

The major costs associated with procuring and holding inventories are made of four components as follows:

2.9.2.1 Purchasing Or Manufacturing Cost

This is the price paid per unit or cost of buying or making a unit of production. It includes transportation, clerical and administrative

costs associated with the physical movement of bought goods.

2.9.2.2 Holding /Storage Or Carrying Cost

This is the cost of carrying item in storage. It includes:

(i) Cost of capital tied up in inventory.

(ii) Storage overhead cost (heat, light, rent and so forth)

(iii) Stores cost (staffing, equipment maintenance, handling).

(iv) Insurance, security, and pilferage costs

(v) Depreciation or breakages

It normally increases with the level of inventory.

2.9.2.3 Ordering And Set-Up Cost

This is the fixed cost of placing an order for a commodity from an outside vendor, which is independent of the number of units ordered for.

2.9.2.4 Shortage Penalty Or Stock out

This is a penalty incurred when we run out of stock of a needed commodity. This cost which is not easily quantifiable. It includes the loss of potential profit and the loss of customers' goodwill (which possibly affects the number and size of future orders)

These costs and others are what the materials manager is supposed to control for effective materials management.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction.

The research methodology involves the collection of data from both primary and secondary sources. The primary data were obtained through questionnaires, interviews and discussions with practitioners in the construction industry. The secondary data were obtained from journals of relevant professional bodies, such as the Nigerian Institute Of Building, architects, quantity surveyors and Nigerian Society Of Engineers, relevant textbooks, and seminar and conference papers and so on. comparative study of selected construction companies were also made.

3.2 Sampling Procedure.

A non-probability sampling techniques was adopted, since there was no way of estimating the probability with which any element of the population intended for study will be included in the sample. Therefore judgment sampling was used. The elements which constituted the sample were hand picked based on my experience in the construction industry and my belief that the elements would represent the population of study.

To ensure that responses to the questionnaires were obtained from knowledgeable people, the questionnaires were administered to professionals, sub-professionals and officers, who are not lower than supervisor, currently working with contractors, consultants, ministries, parastatals, local government and so forth. Responses were also obtained from past and present administrators in relevant government ministries and parastatals.

3.3 **Method Of Data Collection**

Structured questionnaires and oral interviews were the instruments used for data collection. The questionnaire items were tailored to verify the research questions of the study. The data collection/instruments used in the study were questionnaires, oral interview, discussions and observations. Published and unpublished documentary sources were also consulted to provide background information. The experience of the researcher was also fully utilized . The most important of these data collection instrument, the questionnaires is briefly discussed below.

3.4 **The 7- Factor Model**

The 7-factor model applied in this study is based on multiple regression, a statistical technique that helps to explain and predict one dependent variable

from several independent/explanatory variables (Anderson and Slove,1978). The multiple regression model in which the dependent variable Y is a linear function of a series of independent variables X_1, X_2 …X_K, and an error term is expressed as:

$$Y_1 = b_1X_1 + b_2X_2 + \ldots + b_KX_K + E_1 \quad (2\text{-}1)$$

Where Y = the dependent variable,

X's = the independent or explanatory variables,

E = Error term

The relationship existing between two or more variables can be expressed in a mathematical form by constructing an equation/model connecting the variables (Spiegel, 1972), (Spurr and Bonini, 1973) state that the above model is amenable to multiple regression and correlation analysis and permits the measurement of the simultaneous impact of a number of independent variable (X's) on a dependent variables (Y).

The multiple regression model assumes that the model specification is given by equation (2.1); that the X's are non-stochastic; and no exact linear relationship exists between two or more of the independent variables.

The model also assumes that the expected value of the error term will be zero; that there is a constant variance for all observations; that errors corresponding to different observations are uncorrelated and that the error variables are normally distributed (Pindyck and Rubinfield, 1981).

3.5 **The Questionnaire**

From desk research and interviews, before finally developing questionnaires, the dependent variable (Y), and six independent variables (X_1, to X_6) were determined.

The dependent variable of the study (Y), is "**Success Level In Achieving Effective Materials Management"** in the Nigerian construction industry.

The six independent variables of the study (Xs) which describe the success level in achieving effective materials in the construction industry are:

Management of Materials (X_1)

Skilled Professional In Materials Departments (X_2)

Equipment For Work (X_3)

Control Of Materials (X_4)

Inventory Build-Up (X_5)

Motivation Of Workers (X_6).

Three sets of questionnaires were finally developed; one for dependent variable (Y) "**Success Level in Achieving effective materials management"** in the Nigerian construction industry. Ten related statements were developed for the respondents to indicate their degree of agreement or disagreement. (From "Strongly Agree" to "Strongly Disagree"). For example, "Adequate motivation of workers yields good results in the construction industry" (See Section A, Questionnaire I, Appendix I).

The second questionnaire was based on the six independent variables as identified above. Five statements relating top each variable were developed to enable respondents indicate their degree of agreement or disagreement. For example, in the statement "Management of materials in the Nigerian construction industry", (X_1), the respondents were to indicate their position from

"Strongly Disagree" to "Strongly Agree" Five statements were considered adequate to provide sufficient insight into the attitude of respondents on each variable. So, for the five independent variables, there were twenty-five statements, which were responded to (See Section A, Questionnaire II, Appendix I.

The third questionnaire was intended to identify in order of priority (by ranking) some of the major factors that can help us to improve the success level in achieving effective materials management in the Nigerian construction industry (See Section A, Questionnaire III, Appendix III).

3.6 **The Regression Model Of The Study**

The regression of " **Success Level In Achieving Effective Materials Management** (Y), with the six success factors of the materials management function (X_1, X_2, X_3, X_4, X_5, and X_6) is defined by the model:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e \ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

where

Y = "**Success Level In Achieving Effective Materials Management**

In The Nigerian Construction Industry".

a = The constant, and is the value of Y at the Y-axis when X = 0 (intercept)

b = Regression coefficient, which measures the change in Y associated with a unit change in X on the assumption that all other values for the remaining independent variables are held constant.

X_1 = Management of materials in the Nigerian construction Industry (planning, organizing and control of materials).

X_2 = Skilled Professional In Materials Departments. (Having adequate and qualified professionals in materials management departments).

X_3 = Equipment For Work. (Having adequate and proper tools for work).

X_4 = Control Of Materials. (Managements capability to control their workers and materials).

X_5 = Inventory Build-Up. (Total stock of various kinds of construction materials).

X_6 = Motivation Of Workers. (Incentives to workers for higher productivity).

E = Error Term.

In addition, the 7-factor model will yield the multiple correlation coefficients (R), which measures the strength of the relationship existing between the success level in achieving effective materials management and the six independent variables. The regression model will also calculate the coefficient of multiple determination (R^2) which measures the proportion of the variance in the dependent variable (Y) explained by the dependence of Y on the independent variable X_1-X_6 included in the regression equation.

3.6 (a) **The ANOVA Table For Multiple Regression**

The ANOVA table for multiple regression (Table 2.1) was applied to obtain the sum of squares, mean square, and F-ratio which was used to test the significance of the six success factors of effective materials management function.

Table 2.1 **ANOVA Table For Multiple Regression**

Source of variation	Sum of squares (SSR)	Degrees of freedom (df)	Mean of square (MS)	Variance ratio (F- ratio)
Regression	$SSR = Y^2 R^2$	K	$MRS = \frac{SSR}{K}$	$F = \frac{MSR}{MSE}$
Residual ERROR	SSE = SST	n-k-1	$MSE = \frac{SSE}{n-k-1}$	
Total	$SST = Y^2$	n-1		

(Modified from Pindyck and Rubinfield, 1981)

Where SSR = sum of squares of regression
SSE = Sum of squares of Errors
SST = sum of square of total variations
k = Number of independent variables
n = Number of observations

3.6 (b) **The Test Of Significance**

The significance of all the six materials management function factors in the regression model were examined using the standard Error Test. This was achieved by calculating and comparing the standard error resulting from the complete and reduced models. As stated earlier (in equation 2.2), the complete model is expressed as:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + E \ldots\ldots\ldots\ldots\ldots\ldots (2.3)$$

The reduced models to test the significance are:

$$Y = a + b_1X_1 + b_2X_2 + E_1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.4)$$

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + E_2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.5)$$

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + E_3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.6)$$

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + E_4 \ldots\ldots\ldots\ldots\ldots\ldots (2.7)$$

The best model would yield the smallest error.

The F-statistic that was printed out by the regression program in the multiple regression models was used to test the significance of the coefficient of determination (R^2). The F-ratio is defined as:

$$F = \frac{MSR}{MSE}. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.8)$$

With k and n-k-1 degrees of freedom which enabled us to test the hypothesis that none of the independence variables helped to explain the variation of Y about its mean. The F statistic was used to test the joint hypothesis that:

H_0: $b_1 = b_2 = b_3 = \ldots = b_k = 0$ …….(2.9)

H_1: not all b_k are equal to zero …….(2.10)

The Null Hypothesis (H_0) has F-distribution with K and n-k-1 degrees of freedom, and H_0 is accepted at 5% level if significance if:

$F < F_{1-a}(k,n-k-1)$.

3.6 (C) **The t-Test**

The students t-test for multiple regression coefficient, measures the inclusion of each variable in the model, by testing the null hypothesis:

H_0: $b_i = 0$ ……(2.11)

H_1: $b_i \neq 0$ (1=1,2, ….k) …….(2.12)

Where b_i is a specific value, which could be zero. The test statistic is

$t = b_i - 0/Sb_1$ ……(2.13)

Where

t = the deviation of the sample mean from the population mean

expressed in standard error units

b_i - 0 = estimated parameter

S = estimated standard error

The null hypothesis H_0 is accepted at 5% level of significance if

[t] < t1 – n/2; n-k-1

The mean score of the data was computed by using the formula:

$\bar{X} = \Sigma X/n$ ……(2.14)

Where

$\bar{X}$ = mean score for each independent variable

ΣX = the sum of respondents scores for each Independent variable

N = number of respondents

The use of the 7-factor regression model in this study is justified for the following reasons. First, the dependent and independent variables are of the continuous type in which multiple regressions analysis is ideal. Second, the model is subject to correlation and regression analysis, a rigorous multivariate

statistical technique, for analyzing data, which measures the attitude of respondent.

Third, it is a powerful and realistic analytical and predictive tool because it measures the simultaneous influence of six factors. Fourth, the model is suitable for study because attitude data gathered through questionnaire are amenable to computer programmes that facilitate calculations.

Fifth, multiple regressions are extensively used in business, economic and sociological enquiries. For example, brand managers use multiple regressions to analysis data on respondents' age, income, family size and other variable regarding the use of particular products/services. The influence of product quality, advertising, price and packaging (explanatory/independent variables) can also be measured with multiple regressions.

CHAPTER FOUR

4.0 DATA PRESENTATION AND ANALYSIS

4.1 Introduction

In this chapter, collected data has been analyzed, organized and summarized in tables in such a way as to transform them into usable information. According to Boyd and others (1987), data analysis involves breaking data apart and critically examining the components to be able to order, arrange, structure and refine them to provide insight, information and knowledge. The data presentation and analysis of this study covers:

(i) Summary of respondents' scores from questionnaire;

(ii) Testing of hypotheses;

(iii) Ranking of respondents' responses;

(iv) Discussion of findings.

Questionnaires I and II relating to Materials Management Practices in the Nigerian Construction Industry were distributed to 135 directors, managers, executives and workers in the industry. Of the 110 questionnaires recovered, ten were discarded because of errors like incomplete answers, multiple

answers and other inconsistencies. Only 100 questionnaires (74.07%) were properly filled and therefore subjected to analysis.

Responses by the managerial staff of the study organizations to questionnaire II were considered as the dependent variable (Y), which is **"Success Level in Achieving Effective Materials Management."** The responses of construction industry workers to questionnaire I were considered the independent variables of the study, X_1 to X_6.

4.2 **Respondents Scores**

In Appendix II, we present the summary of the scores of one hundred respondents on their assessment of the extent to which the Nigerian construction industry apply the six critical variables (X_1 to X_6) that promote Effective Materials Management. Tables 4.1 and 4.2 below show how Appendix II was derived.

Table 4.1: **Respondent 1's Scores for X_1 to X_6**

	Questions/Scores					
Factors	1	2	3	4	5	Total
X_1	4	5	5	5	5	24
X_2	3	4	3	2	2	14
X_3	5	5	4	4	4	22
X_4	5	4	5	5	5	24
X_5	3	3	5	2	4	17
X_6	3	3	4	5	4	19

(Source: Computer printout of multiple regression analysis of field survey data)

As an example, in Questionnaire I (Appendix I) based on the Likert summated attitude scale, in which the maximum score for each independent variable is 25 and the minimum score is 5, each respondent was requested to indicate the degree of agreement or disagreement with the five statements related to the independent variable "Management of Materials", (X_1).

The first respondent scored 4 for statement 1, and 5 each for statements 2, 3, 4, and 5, obtaining a total score of 24 as reflected in Table 4.1 above. Adopting the same approach, the first respondent's scores for variables X_2, X_3, X_4, X_5 and X_6 were determined.

In Table 4.2 below, we present the first respondent's scores on the dependent variable "**Success Level in Achieving Effective Materials Management", (Y).** This is a measure of the respondent's satisfaction with the effort in effective materials management in the Nigerian construction industry.

Table 4.2: **Success Level in Achieving Effective Materials Management**

Dependent Variable	Questions/Scores										Total
	1	2	3	4	5	6	7	8	9	10	
Y	3	5	4	4	3	4	3	5	2	3	36

(Source: Computer print-out of multiple regression analysis of field survey data).

The same technique (as in 4.1) was adopted in deriving the first respondent's scores to Questionnaire II (also based on Likert's scale) (see Appendix I). In

Questionnaire II, there are ten statements, with a maximum score of 50 and a minimum score of 10. These statements are to assess the degree of respondent's satisfaction with efforts in effective materials management in the selected Nigerian construction companies.

4.3 **The Mean and Percentage Scores**

Table 4.3 below summarized from Questionnaire I (Appendix I) presents the mean and percentage scores of variables Y, and X_1 to X_6.

Table 4.3: **The Mean and Percentage Scores of Each of the Factors (Y, X_1 to X_6)**

Factor	Total	Mean Score	% Score
Y	3395	33.95	67.90
X_1	1945	19.45	77.80
X_2	1443	14.43	57.72
X_3	1726	17.26	68.80
X_4	2063	20.63	82.52
X_5	1871	18.71	74.84
X_6	1848	18.48	73.92

(Source: Computer printout of multiple regression analysis of field survey data).

From Table 4.3, (summarized from Questionnaire I and II in Appendix I), the study organizations achieved a **success level of 67.90%** in effective materials management, by combining the six independent variables. Control of Materials (X_4 = 82.52%); Management of Materials (X_1 = 77.80%); Inventory Build-up (X_5 = 74.84%); and Motivation of Workers (X_6 = 73.92%) have a **strong influence**

on the Success Level of Achieving Effective Materials Management. Equipment for Work (X_3 = 68.80%) and Skilled Professionals (X_2 = 57.72%) exercise an **average influence**.

4.4 The Regression of Success Level in Achieving Effective Material Management (Y) on the Six Variables (X_1 to X_6)

Table 4.4 below presents a summary of the result of the computer-aided regression and correlation of field survey data.

Table 4.4: **Result of Multiple Regression and Correlation Analysis of Y X_1 to X_6**

Variable	Coefficient	t-value	SE
X_1	0.0893	1.3673	0.0653
X_2	0.9559	0.8040	0.0695
X_3	0.2742	4.9800	0.0550
X_4	0.2658	3.2220	0.0825
X_5	0.2676	3.8290	0.0698
X_6	0.6797	4.4773	0.1518

Intercept = 3.6176; Multiple Correlation (R) = 0.8607; Coefficient of Determination (R^2) = 0.7409.
(Source: Computer printout of multiple regression analysis of field survey data)

From the analysis of data, we derived the following estimated (fitted) regression model:

$$Y = 3.617 + 0.0893X_1 + 0.0559X_2 + 0.2742X_3 + 0.2658X_4 + 0.2676X_5 + 0.6797X_6 \quad \text{(4.1)}$$

The derived multiple correlation coefficient (R) is 0.8607 while the multiple coefficient of determination (R^2) is 0.7409. The Standard Error (SE) generated by the computer analysis measures the total sampling error of the observations. It is obtained by combining the standard error of the estimate and the standard error of the regression line. Standard errors may be summed by adding their squares.

The determination of the values of the six success variables (X_1 to X_6) enables us to easily estimate the Success Level in Achieving Effective Materials Management. The coefficients in the regression model indicate the marginal effect of each of the six success factors on Success Level in Achieving Effective Materials Management, when all other factors are held constant. In effect, they represent an increase in Y, when each independent variable is increased by one unit, while holding the other variables constant.

All the coefficients of the six independent variables are positive indicating positive marginal effects on Success Level in Achieving Effective Materials Management. For example, the coefficient of X_3 is $b_3 = 0.2742$. We interpret that the Success Level in Achieving Effective Materials Management increases by

0.2742 for every unit increase in Equipment for Work. We can make similar interpretations for each of the remaining independent variables.

The multiple correlation coefficient (R) of 0.8607 indicates a strong positive relationship between “Success Level in Achieving Effective Materials Management” (Y) and the six success variables of materials management (Xs).

The multiple coefficient of determination (R^2) of 0.7409 indicates the proportion of the variance in “Success Level in Achieving Effective Materials Management” explained by all the independent variables. An R^2 value of 0.7409 indicates that Management of Materials, Skilled Professionals, Equipment For Work, Control of Materials, Inventory Build-up and Motivation of Workers jointly account for 74% of the variance in Success Level in Achieving Effective Materials Management. 26% of the variance is unexplained.

The t-values (column 3 of Table 4.4) are significant and are used to test the significance of each of the six factors of effective materials management.

4.5 **The ANOVA of the Multiple Regression Analysis**

Table 4.5: **ANOVA of Multiple Regression**

Source of variation	DF	SS	MS	F
Regression	6	1042.261	173.710	44.322
Residual	93	364.489	3.919	
Total	99	1406.75		

Standard Error = 1.979
(Source: Computer printout of multiple regression analysis of field survey data).

Table 4.5 shows that the regression sum of squares (SS) is 1042.261, the mean square (MS) is 173.710 and the F-ratio is 44.322. The F-ratio was used to test the significance of the inclusion of the six independent variables in the regression model.

4.6 **Testing the significance of the inclusion of the independent variable in the model**.

The F-ratio, suitable for tests of significance, was used to test the significance of the inclusion of all the independent variables in the model. It tested the joint hypotheses that none of the explanatory variables (X_1 to X_6) helped to explain the variation of Y about its mean. That is:

H_0: $b_1 = b_2 = b_3 = b_4 = b_5 = b_6 = 0$

H_1: not all $b_k = 0$; k = 1, 2, 3, 4, 5, 6.

The F-ratio value derived from the multiple regression analysis is 44.322, at a 5% significance level. The table F-ratio at 5% level of significance and 93

degrees of freedom, $F_{(5,93)} = 2.33$. Since $F^* = 44.322 > F_{(5, 93)} = 2.33$, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1). We then conclude that the inclusion of the six independent variables is significant. Therefore "Success Level in Achieving Effective Materials Management" is significantly related to Management of Materials, Skilled Professionals, Equipment for Work, Control of Materials, Inventory Build-up and Motivation of Workers.

4.7 **Testing the significance of each of the independent variables (X_1 to X_6)**

The dependent variable Y was regressed on each of the independent variables X_1 to X_6 to determine the significance of each variable. The objective is to estimate the extent to which each independent variable contributes to "Success Level in Achieving Effective Materials Management". Therefore, to test the significance of the independent variables in the model, the t-test statistic (which tests the significance of the difference between means when the standard deviation is unknown) was used.

Table 4.7 below presents a summary of the t-values obtained from the regression of Y on each independent variable X_1 to X_6. (Appendix I).

Table 4.7 **Summary of t-values from regression of Y on each independent variables (X_1 to X_6)**.

Regression	t-values
Y on X_1	4.451
Y on X_2	2.307
Y on X_3	3.879
Y on X_4	5.985
Y on X_5	7.388
Y on X_6	12.553

(Source: Computer printout of multiple regression analysis of field survey data).

4.7.1 Testing the Significance of Management of Materials (X_1) in the model.

It is hypothesized that Management of Materials has no significant effect in the "Success Level in Achieving Effective Materials Management".

$$H_{01}: b_1 = 0$$

$$H_{11}: b_1 \neq 0$$

As indicated in Table 4.7 above, the t-value generated by the computer analysis is t = 4.451. From the t – distribution table, the tabulated t value at 5% level of significance is 2.015. Since $|t| = 4.451 > t_{(0.5,\ 5)} = 2.015$, we reject the null hypothesis and conclude that Management of Materials has significant effect on the "Success Level in Achieving Effective Materials Management".

4.7.2 **Testing the Significance of Skilled Professionals(X_2) in the model**

It is hypothesized that “Skilled Professionals” has no significant effect on the “Success Level in Achieving Effective Materials Management”.

H_{02} : $b_2 = 0$

H_{12} : $b_2 \neq 0$

Calculated t = 2.307 (Appendix I, while tabulated t value at 5% level of significance is 2.015. Since $|t| = 2.307 > t_{(0.5,5)} = 2.015$, we reject the null hypothesis, accept the alternative hypothesis and conclude that Skilled Professionals has significant effect on the Success Level in Achieving Effective Materials Management.

4.7.3 **Testing the Significance of Equipment For Work (X_3) in the model .**

We wish to test at 5% level of significance, the null hypothesis that “Equipment for Work” has no significant effect on the “Success Level in Achieving Effective Materials Management”.

$$H_{03} : b_3 = 0$$

$$H_{13} : b_3 \neq 0$$

Calculated t = 3.879, while tabulated t at 5% level of significance is 2.015. Since $|t| = 3.879 > t_{(0.5,\ 5)}$, we reject the null hypothesis, accept the alternative hypothesis and conclude that “Equipment for Work” has a significant effect on “Success Level in Achieving Effective Materials Management”.

4.7.4 **Testing the Significance of Control of Materials (X_4) in the Model**

We hypothesized that “Control of Materials” has no significant effect on the “Success Level in Achieving Effective Materials Management”.

$$H_{04} : b_4 = 0$$

$$H_{14} : b_4 \neq 0$$

Calculated t = 5.385, while tabulated t value at 5% level; of significance is 2.015. Since $|t| = 5.385 > t_{(0.5, 5)} = 2.015$, we reject the null hypothesis, accept the alternative hypothesis and conclude that Control of Materials has a significant effect on Success Level in Achieving Effective Materials Management.

4.7.5 **Testing the Significance of Inventory Build-up (X_5) in the Model**

The hypothesis is that “Inventory Build-up” has no significant effect on the “Success Level in Achieving Effective Materials Management”.

$$H_{05} : b_5 = 0$$

$$H_{05} : b_5 \neq 0$$

Calculated t = 7.388, while tabulated t value at 5% level of significance is 2.015. Since $|t| = 7.388 > t_{(0.5, 5)} = 2.015$, we reject the null hypothesis, accept the alternative hypothesis and conclude that “Inventory Build-up” has a significant effect on the “Success Level in Achieving Effective Materials Management”.

4.7.6 **Testing the Significance of Motivation of Workers (X_6) in the Model**

We wish to test the hypothesis that "Motivation of Workers" has no significant effect on the "Success Level in Achieving Effective Materials Management".

$$H_{06} : b_6 = 0$$

$$H_{06} : b_6 \neq 0$$

Calculated t = 12.553, while tabulated t value at 5% level of significance is 2.015. Since $|t| = 12.533 > t_{(0.5, 5)} = 2.015$, we reject the null hypothesis, accept the alternative hypothesis and conclude that "Motivation of Workers" has a significant effect on "Success Level in Achieving Effective Materials Management".

In Table 4.8 below, we summarized the result of significance tests.

Table 4.8: **Summary of Significance Tests**.

Variables	t-values	t-tabulated
X_1	4.451	2.015
X_2	2.307	2.015
X_3	3.789	2.015
X_4	5.985	2.015
X_5	7.388	2.015
X_6	12.553	2.015

(Source: Computer printout of multiple regression analysis of field survey data).

Table 4.8 above shows that all the independent variables (X_1 to X_6) have significant effects and contribute to the "Success Level in Achieving Effective Materials Management".

4.8 **Testing For the Best Predictive Model from the Reduced Regression Models: Y on X_1 to X_2; Y on X_1 to X_3; Y on X_1 to X_4 and Y on X_1 to X_5.**

To determine the model that predicts best, we reduced the multiple regression models to enable us apply the standard error test to compare all the five reduced regression models to the complete model (Y on X_1 to X_6). This helped us to find the model that has the smallest standard error, which is considered a better predictor than all the others.

In Tables 4.8.1 to 4.8.4 below, we present the results of the reduced multiple regression models. (See Appendix I).

4.8.1 **The regression of Success Level in Achieving Effective Materials Management (Y on X_1 to X_2)**.

Variable	Coefficient	t	SE
X_1	0.4451	4.8570	0.0916
X_2	0.3114	2.9600	0.1052

Intercept = 20.8970; Standard Error = 3.3263; R = 0.4869;
R^2 = 0.2370
(Source: Computer printout of multiple regression analysis of field survey data).

4.8.2: **The Regression of Success Level in Achieving Effective Materials Management** (Y on X_1 to X_3)

Variable	Coefficient	t	SE
X_1	0.4861	5.7417	0.0846
X_2	0.1606	1.5660	0.1025
X_3	0.3219	4.3654	0.7377

Intercept = 16.6913; Standard Error = 3.0541; R = 0.6028;
R^2 = 0.3634).
(Source: Computer printout of multiple regression analysis of field survey data).

4.8.3: **The regression of Success Level in Achieving Effective Materials Management (Y on X_1 to X_4)**

Variable	Coefficient	t	SE
X_1	0.2986	3.9653	0.0753
X_2	0.1351	1.5921	0.0848
X_3	03873	6.2766	0.0617
X_4	0.6049	6.7469	0.0896

Intercept = 7.0308; Standard Error = 2.5243; R = 0.7547;
R^2 = 0.5696.
(Source: Computer printout of multiple regression analysis of field survey data).

4.8.4: **The regression of Success Level in Achieving Effective Materials Management (Y on X_1 to X_5).**

Variable	Coefficient	t	SE
X_1	0.1885	2.7598	0.0674
X_2	0.1464	2.0051	0.0730
X_3	0.3917	7.3787	0.0530
X_4	0.3746	4.3325	0.0864
X_5	0.4044	5.8685	0.0689

Intercept = 6.1126; Standard Error = 2.1710; R = 0.8276;
R^2 = 0.6850.
(Source: Computer printout of multiple regression analysis of field survey data).

4.9 **Summary of the Standard Error Values of the Five Models**

Table 4.9.1: Summary of the Standard Error Values of the Models

Multiple Regression	Standard Error
Y on X1 to X_6	1.9797
Y on X1 to X_5	2.1710
Y on X1 to X_4	2.5243
Y on X1 to X_3	3.0541
Y on X1 to X_2	3.3262

(Source: Computer printout of multiple regression analysis of field survey data).

From Table 4.9.1 above, the multiple regression model that includes the six independent variables (Y on X_1 to X_6), has the smallest standard error of 1.9797. This model therefore predicts better, the variance in Success Level in Achieving Effective Materials Management, than any of the other four models. This implies that in this study, the inclusion of six independent variables (X_1 to X_6) provides a better predictive tool than using a lesser number of independent variables.

4.10 Ranking of Construction Industry Resources

Table 4.10 below summarizes respondents ranking of five major resources used in the construction industry.

Table 4.10: **Respondents' Ranking of Construction Resources**

	Scores					
Resource	1	2	3	4	5	Total
Fund/finance	320	76	33	8	2	439
Materials	255	100	36	14	3	418
Management	225	140	21	18	4	408
Equipment	155	164	66	6	3	394
Labour	10	32	54	50	47	193

(Source: Analysis of Field Survey Data).

One hundred respondents ranked five major resources regularly used in the construction industry, to achieve success in the execution of contracts. Table 4.10 above shows that respondents selected "Fund/Finance" (439 points) as the most important resource, with "Materials" (418 points) closely following. "Labour" (193 points) was considered the least important.

CHAPTER FIVE

5.1 SUMMARY, CONCULIONS AND RECOMMENDATIONS

The findings of the study are presented and discussed below.

The success level attained by the construction industry in their efforts to achieve effective materials management is 67.9%. This medium-high success rate was obtained through the combined impact of management of materials, (applying management techniques in planning, sourcing and control of materials), skilled professionals (using adequate number of qualified and experienced construction professionals), equipment for work (ensuring adequate, functioning equipment for construction work, Inventory built-up (accumulating sufficient stocks of construction materials) control of materials (proper receiving, recording, issue and use of construction materials), and motivation of workers (encouraging workers to optimal productivity).

The success rate of 67.9% in achieving effective materials management in the construction industry is considered unsatisfactory because materials account for about 70% of construction cost. Therefore a greater degree of efficiency and effectiveness is required in the management of construction materials.

Indigenous construction companies are in strong competition with foreign construction companies. To ensure that indigenous construction companies succeed in bids; executive construction projects within budgeted costs and produce work of acceptable quality and performance they must strive for better materials management.

Greater attention must be paid to the application of project management techniques in planning, procuring and control of construction materials. Qualified professionals must be hired to plan and implement construction jobs. Adequate well-maintained, functioning equipment (owned or hired) must be available to execute project work. Always, there must be adequate stocks of the various materials for construction work. Adequate control must be exercised in the purchase, receipt, issue and use of construction materials. And most importantly, construction staff (managerial and non-managerial) must be adequately motivated (good pay, good working conditions, training, good leadership) towards improved levels of productivity.

Management of materials; skilled professionals; equipment for work; control of materials; inventory build-up; and motivation of workers; all working simultaneously, have strong relationship with success level in achieving effective materials management. This is supported by the correlation coefficient (R) of 0.860. The high value of R indicates that the independent variable of the study working jointly, have a great impact in achieving effective materials management.

Managers in construction companies must optimally blend these independent variables to generate a higher level; of success in achieving effective materials management and overall success in project construction.

The coefficient of determination (R^2) of 0.74 indicates that 74% of the success level in achieving effective materials management is explained by management of materials; skilled professionals; equipment for work; control of materials;

inventory build-up and motivation of workers. This finding is in strong support of the arguments advanced above.

This study has established a multiple regression model for the construction industry as follows:

$$Y = 3.617 + 0.0893X_1 + 0.559X_2 + 0.2742X_3 + 0.265X_4 + 02676X_5 + 0.6797X_6 \quad \text{.....(5.1)}$$

Where

Y = Success level in achieving effective materials management

X_1 = Effort made in efficient management of materials

X_2 = Effort made in use of skilled professionals

X_3 = Effort made in having adequate equipment for work

X_4 = Effort made n proper control of materials

X_5 = Effort made in inventory build-up

X_6 = Effort made in motivating workers.

The above estimated regression equation can be used by the construction industry to forecast/predict the value of the dependent variables (Y) when the values of the explanatory (independent) variables X_1, X_2, X_3, X_4, X_5, and X6 are known/given. The estimated model can equally be used to compute the elasticity of Y with respect to X_1, X_2, X_3, X_4, X_5, and X_6.

The multiple regression analysis yielded an F-ratio of 44.3224 which confirms that the inclusion of the six independent variables in the model was significant. The hypothesis tested with t-test statistic at 5% level of significance confirmed

that the success level in achieving effective materials management is significantly related to management of materials, skilled professionals, equipment for work, control of materials, inventory build-up, and motivation of workers.

Six key independent variables, working in concert, have significant impact on the **Success Level of Achieving Effective Materials Management** in the construction industry. However, “Equipment for Work” has the most significant effect on the success level of achieving effective materials management, closely followed by “Motivation of Workers” as indicated by Table 5.1 below.

Table 5.1: **The Most Significant Independent Variable In Success Level Of Achieving Effective Materials Management.**

Variable	t-value
X_1	1.3673
X_2	0.8040
X_3	4.9800
X_4	3.2220
X_5	3.8290
X_6	4.7773

(Source: computer print –out of multiple regression analysis of field survey data).

The t-values in Table 5.1 above confirm that the variable X_3 has the most significant impact, followed by X_6. This finding suggests that organizations in the construction industry must strive to ensure that needed equipment for the

execution of construction projects is readily available. Also, all categories of workers in a construction company must be motivated to higher productivity.

Respondents selected construction resources in descending order of importance as follows:

(I) Fund/Finance
(II) Materials
(III) Management
(IV) Equipment
(V) Labour

Respondents selected materials management organizations in descending order of importance as follows:

(i) Centralized stores
(ii) Decentralized stores
(iii) Contract method
(iv) Source to site
(v) Hand to mouth

5.2 **Discussion of Findings**

5.2.1 **The Impact of the Findings on the Construction Industry**

The findings from the analysis of data revealed that effective materials management helps chief executives and the managers in the construction industry to achieve a higher level of success in project construction/execution

as explained by the coefficient of determination, R^2 of 0.74 or 74% and 67.90% success level attained.

This study established a multiple regression model for the construction industry. This model can be used in the construction industry to forecast/predict the values of the dependent variable "Success Level in Achieving Effective Materials Management" (Y), when the values of the explanatory (independent) variables (X_1 to X_6) are known or given. Also this estimated model can be used to compute the elasticity of Y with respect to X_1 to X_6.

Higher competence level in materials management was seen to help indigenous construction companies who are in serious competition with foreign construction companies to succeed in bids, execute construction projects within budgeted costs and produce work of acceptable quality and standard.

The results of the study indicate that effective materials management helps construction companies apply project management techniques in planning, procuring and control of construction materials. Effective material management enables construction industries to maximize their profit by procuring materials from the best sources and supplying same to site on time.

5.2.2 **The Impact of the Findings on Contractors**

The study reveals that higher competence levels in materials management would help contractors such as Hardel and Enic Construction Company, Esie Engineering Construction Company and Alems Engineering Construction Company, to determine the optimal quality and quantity of construction materials, equipment and labour needed for particular jobs and projects. The

study also suggests how these construction companies can effectively manage construction inputs for the production of optimal outputs. Effective materials management was also seen from the study to assist contractors to effectively plan, organize, control and programme any particular project inorder to maximize their profits.

The research findings equally enable contractors to determine the total fund, equipment and labour cost necessary for the effective execution of any project at any point in time. Finding from the study can aid local contractors to estimate the total funds and number of workers required to effectively execute a project with the time schedule.

5.2.3 **The Impact of the Findings on Clients**

Analysis of data and findings of the study reveal that effective materials management is imperative if project owners or clients are to reduce materials wasting and thus reduce the project cost and increase profitability. The findings also indicate to project owners the need for proper materials planning and funds scheduling inorder to effectively program funds disbursements in order to meet project time, budget and specifications parameters.

5.2.4 **The Impact of the Findings on the Nigerian Economy**

The findings of the study confirm that the provision of eight million housing units for Nigerians was a development target set by the successfully National Housing Policy in 1991 was successfully achieved. The success, in part, is

attributable to the effective monitoring and control of materials in the construction industry.

The study also revealed that the application of effective materials management increases productivity in the construction industry, thus the output of the industry provides the framework on which virtually all the other sectors of the national economy is built and within which the various processes and activities are carried out.

The findings of the study confirm that construction projects anchored on effective materials management is imperative in the realization of many stages of physical and infrastructural developments in the economy. Construction projects are inevitable in agriculture, mining, manufacturing, petrochemicals, commerce, transportation and so forth. These projects call for effective materials management.

By extrapolating the results of the study, we can assume that the construction companies operating in this sub sector achieve a reasonable level of effective materials management. This means that there is an improved level of effectiveness and efficiency in the acquisition and use of materials. In effect, efficiency in materials management should be adopted in constructions in the various sectors of the national economy such as education, financial, health, utilities, government agencies and parastatals and many other related institutions.

It is critical that that governance at the various federal, state and local level must also imbibe the discipline of effective materials management enunciated

by the findings of this study. This is so because in the provision of services, these organs of governance consume enormous quantities of all types of materials.

A good example can be taken from the armed forces of developed and some developing countries where effective materials management is being successfully applied and in which men, equipment and materials are efficiently procured and deployed at the right time and place, to achieve stated objectives.

The study has shown that effective materials management is of extreme importance in construction projects In the transportation sector. Effective material management enables the optimal development of road networks, air transport systems, seaports and all other transport infrastructure that facilitate the movement of people and goods within and outside the borders of the country.

5.2.5 **The Impact of the Findings on the Average Nigerian**

The result of the study indicates that it is only effective materials management that can sustain the growth and profitability of Nigerian construction industries. The resultant benefits of the application of modern materials management techniques should enable existing construction companies retain their existing and employ a greater number of people, thus reducing unemployment. Also, growth in the construction industry will attract new entrants who would provide further employment opportunities to Nigerians.

All resources belong to Nigerians. There is a responsibility for all users of limited resources to be judicious and efficient in their use. The findings of the

study stress the need for the construction industry to be more effective in the management of materials so that the society would enjoy maximum projects output from minimum materials input.

The outputs of effective material management by the construction industry such as good roads and transportation facilities, housing, water supply systems and so forth, provide clear benefits to the average Nigerian. These are in the forms of cheaper transportation of persons and goods, better access to housing, improved water supply and so on. The levels of the facilities would have been worse in the absence of effective use of materials by contractors.

The findings of the study advocate the effective and efficient management of construction materials to achieve socio-economic development that are beneficial to the average Nigerian. Such benefits include provision of social welfare, capital formation, income and employment generation, stability in the general price levels, improved balance of payments, that enhance the wealth of the nation and the standard of living of the people.

5.3 **Conclusion**

Materials management/control in the Nigerian construction industry is of universal importance. The surest way of achieving a construction company's objective (profit maximization) is through effective materials management. (Koontze et. al., 1992). Effective materials management can make a construction company to grow or prosper, while ineffective materials management can lead to demise.

Materials management embraces planning, purchasing, inventory – control, storage, materials handling and physical distribution. The objective of materials management therefore is to optimize performance in meeting customer service requirement at the same time adding to profitability by minimizing cost and making the best use of available resources.

This study attempted to identify and define the criteria/factors that enhance **Success Level In Achieving Materials Management** in the construction industry in Imo State. These crucial factors are: **Management Of Materials; Skilled Professionals; Equipment For Work; Control Of Materials; Inventory Built-Up; And Motivation Of Worker**s.

One hundred respondents expressed their opinions on these factors that determine the success level in achieving effective materials management. Regression analysis was used to generate R, R^2, F-ratio and t-statistic, which were used to analyze collected data and to test the hypotheses of the study.

The study organizations achieved a success level of 67.90% in effective materials management by combining the six independent variables: Control of materials (X_4 = 82.52%); Management of materials (X_1 = 77.80%); Inventory build-up (X_5 = 74.84%) and Motivation of workers (X_6 = 73.92%) have strong influence on the success level in achieving effective material management, while Equipment for work (X_3 = 68.80%) and Skilled professionals (X_2 =

57.72%) exercised an average influence on success level of achieving effective materials management.

The study also showed that success level in achieving effective materials management in the construction industry is significantly related to management of materials; skilled professionals; equipment for work; control of materials; inventory build-up and motivation of workers. This is confirmed by the F-ratio value of 44.322 at 5% significance level.

Six hypotheses were each tested with the student t-test at 5% significance level: management of materials; skilled professionals; equipment for work; control of materials; inventory build-up and motivation of workers, confirm that they have significant effect and contribute to the success level in achieving effective materials management in the construction industry. Equipment for work has the most significant impact/effect on the success level in achieving effective materials management followed by motivation of workers. This is confirmed by the student t-test.

The study established the multiple regression model:

$$Y = 3.617 + 0.0893X_1 + 0.0559X_2 + 0.2742X_3 + 0.2658X_4 + 0.2676X_5 + 0.6797X_6.$$

The model can be used to predict or forecast the value of success level in achieving effective materials management in the construction industry, when the values of the explanatory variables are known.

Also from analysis of the standard error values of the five reduced regression models, we observed that the multiple regression model that includes the six independent variables has the smallest standard error of 1.979. We observed also that the inclusion of the six independent variables provide a better predictive tool than using any of the reduced regression models. Therefore, we conclude that the independent variables have significant effect and contribute to the success level in achieving effective materials management in the construction industry.

Fund and materials ranked first and second as the most important resources in the construction industry. Centralized stores and decentralized stores were ranked first and second positions by respondents in selecting materials management organizations in order of priority or importance.

Based on the findings of the study, the following conclusion can reasonably be made:

(i) The combined impact of all the independent variables: management of materials (applying management techniques in planning, sourcing and control of materials) skilled professionals (using adequate number of qualified and experienced construction professionals); equipment for work (ensuring adequate, functioning equipment for construction work); control of materials (proper receiving, recording, issue and use of construction materials); inventory build-up (accumulating sufficient stocks of construction materials) and motivation of workers (encouraging workers to optimal productivity); all contribute and work together to ensure a reasonable success level in achieving effective materials management. We then conclude that the inclusion of all the

six independent variables is significant and contribute to the success level in achieving effective materials management in the construction industry.

(ii) The high value of multiple correlation coefficients (R) of 0.860 showed or indicated that the independent variables of the study working jointly had a great impact in achieving effective materials management in the construction industry.

(iii) The coefficient of determination (R^2) of 0.74 showed or indicated that 74% of the success level in achieving effective materials management in the construction industry was explained by all the independent variables ($X_1 – X_6$).

(iv) The F-ratio value of 44.322 at 5% significant level indicates that the success level in achieving effective materials management is significantly related to all the independent variables.

(v) The six hypotheses tested with the student t-test at 5% significance level of each independent variable, confirm that they have significant effect and contribute to the success level in achieving effective materials management in the construction industry.

(vi) The factor that has the greatest impact on success level in achieving effective materials management is Control of materials (X_4 = 82.52%) which leads to the conclusion that materials must be properly controlled and managed in order to achieve success in the construction industry.

(vii) In the analysis of the standard error values of the five reduced regression model, we observed that the multiple regression model that includes the six independent variables has the smallest standard error of 1.9707. We then conclude that the inclusion of the six independent variables provides the best predictive tool and therefore contributes and have significant effect on the success level in achieving effective materials management in the construction industry.

Finally we conclude that to achieve the objective (profit maximization) in the construction industry, materials must be properly controlled and managed and that the six independent variables of the study contribute and have significant effective on the success level in achieving effective materials management in the Nigerian construction industry.

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5.4 **Recommendations**

Based on the analysis, and conclusion of the study, the following recommendations are made for improving the **Success Level In Achieving Effective Materials Management In The Construction Industry.**

(a) Control of materials has the greatest impact on the success level in achieving effective materials management; therefore greater attention should be paid to the application of project management technique in planning, procuring and control of construction materials.

(b) The study organization can use the estimated regression line to forecast or predict the value of the success level in achieving effective materials

management (Y) when the values of the explanatory variables (X_1 to X_6) are known.

(c) Construction companies must develop competent subordinates within their organizations. They must adopt good selection/recruitment methods. Only qualified and competent professionals and in sufficient numbers must be engaged at all levels to plan and implement construction jobs, especially in the stores department for effective materials management.

(d) Professionals, management staff as well as chief executives of construction firms, must engage themselves in continuous professionals development (CPD) through attendance of conferences, seminars and workshops conducted by professional bodies/institutes and higher institutions, and short term courses on materials management. CPD must be made compulsory for all management staff and professionals in order to keep abreast of latest development in materials management, construction technology and information technology.

(e) Adequate well-maintained functioning equipment (owned or hired) must be available to execute most of the project work in construction contracts.

(f) The stores department in the construction companies must build inventory for construction materials in order to minimize holding cost, acquisition cost, stock out and so forth. Also, adequate control measures must be exercised in the purchase of construction materials.

(g) Construction staff (managerial and non-managerial) must be adequately motivated (good pay, good working conditions, training, good leadership and so forth) towards improved levels of productivity.

(h) There should be proper education in the form of seminar, symposium, workshops and so on of construction workers on the need to understand the importance of effective management of materials, as this will enhance profitability.

(i) There is need for a closer link between the academia in Nigeria and the construction companies. This will enable the academicians to know the needs of the industry and plan their academic and research programs to meet these demands and needs.

(j) Construction companies, especially stores departments, should avail themselves of the knowledge and use of computers and the management tools of Critical Path Methods (CPM) Project Evaluation Review Techniques (PERT) and so on. They should adopt project management approaches to their project execution and management by objectives in running of their companies.

(k) Government (local, state and federal) must effectively discharge their statutory roles of providing badly needed infrastructure (good roads, steady power supply, good communication network, efficient water supply and enabling environment) to encourage construction companies to discharge their duties very well.

(l) Professional bodies, individuals, academicians; contractors and others should mount pressure on the federal government to adequately implement without further delay, the provision of the National Construction Policy, and also to develop policies that will regulate standards and qualities of construction materials.

(k) Finally the production of indigenous construction materials must be encouraged by the Federal Government's research institutes and professional bodies. Materials also developed should be adopted by the construction industries.

5.5 **Areas of Further Research**

The findings of the study, have revealed related areas for further investigation as follows:

5.5.1 Strategies to increase the participation of indigenous contractors in the execution of local contracts.

5.5.2 Enhancing the professionalism of Nigerian staff in the construction industry.

5.5.3 Identification and eradication of the causes of project abandonment in the Nigerian construction industry.

5.5.4 An appraisal of the effectiveness of materials management, cost and labour, in the Nigerian construction industry.

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APPENDIX I

QUESTIONNAIRE I (Y-VARIABLE)
(FOR DIRECTORS, MANAGERS AND EXECUTIVES IN THE CONSTRUCTION INDUSTRY ONLY)

Instructions*:* For each of the following statements, indicate the extent to which you agree or disagree that the statements describe the factors that can improve productivity in the Nigerian construction industry through effective materials management functions. In the 5–points scale provided, mark a cross (X) at the point that represents your felling.

SD = Strongly Disagree = 1 point
D = Disagree = 2 points
N = Neutral = 3 points
A = Agree = 4 points
SA = Strongly Agree = 5 points

	Success Level In Achieving Effective Materials Management (Y)	**SD**	**D**	**N**	**A**	**SA**
1	Adequate motivation of workers yield good results in the construction industry					
2	Regular meetings between management and their workers in the construction industry also yields good results and profits					
3	Good inventory build-up in the construction industry makes for savings in materials					
4	Plant/machine operators require training, workshops, seminars in the construction industry.					
5	New plants/machine only should be used in the construction industry for maximum production or output.					
6	Professionals in the construction industry should organize, teach and conduct seminars on a regular basis.					
7	Experience rather than certificate should be used in determining workers position in the construction industry					

8	For more positive result in the construction industry the right/skilled professionals should be heading and controlling the materials department.					
9	Materials should be stored in a well-planned and properly designated location for adequate safe guard and supervision.					
10	The operation of a central stores system should be used where bulk purchase makes maximum profit savings in materials.					

QUESTIONNAIRE II (X-VARIABLES)
(FOR ALL WORKERS IN THE CONSTRUCTION INDUSTRY)

Instructions: For each of the statements, indicate the extent to which you agree or disagree that the statement describes materials management function in the Nigerian construction industry as it affects your company. In the 5-points scale provided, mark across (X) at the point that represents your feeling.

SD = Strongly Disagree = 1 point
D = Disagree = 2 points
N = Neutral = 3 points
A = Agree = 4 points
SA = Strongly = 5 points

A	**Management of Materials (X_1)**	**SD**	**D**	**N**	**A**	**SA**
1	This includes the planning, organizing and controlling of the flow of materials from initial purchase (input) to the consumption and distribution of finished goods (output).					
2	Contributes to survival and profit by providing materials at the lowest total cost.					
3	Represents an organizational concept that provides for more efficient planning, coordination and control of all materials					
4	The operation of a system of stores					

	control and issue that there will be delivery of materials upon requisition to department in the right amount at the time they are needed.					
5	The storage of materials in a well planned and properly designated location for adequate safe guards and supervision.					
B	**Skilled Professionals (X_2)**	**SD**	**D**	**N**	**A**	**SA**
1	Qualified, skilled professionals are heading and controlling the materials departments in the construction industry in Nigeria.					
2	Materials are provided at the right time and place so as to meet operational requirements of the company.					
3	There are laid down procedures for employing the right professionals in the construction industry.					
4	Experience rather than certificates help to determine employment position in the construction companies.					
5	Professionals in the construction industries organize, teach and conduct seminars and lectures often.					
C	**Equipment For Work (X_3)**	**SD**	**D**	**N**	**A**	**SA**
1	Construction companies in Nigeria have the appropriate working equipment, tools and machines.					
2	Most of the construction tools, equipment and machines are not easily acquired or bought.					
3	The cost of hiring some of the equipment and machines are relatively very expensive in Nigeria.					
4	Only big and well established construction companies are able to bear the cost of buying and repairs of construction equipment and machines.					
5	There is difficulty in sourcing for spare					

	parts for the maintenance of broken down machines and equipment.					
D	**Control Of Materials (X_4)**	**SD**	**D**	**N**	**A**	**SA**
1	Management and control of materials in public (government) construction companies are more likely to misuse materials than private construction companies.					
2	Workers in construction companies are given the necessary training and authority to perform their functions/duties.					
3	There are laid down procedures or rules for communication in the construction industry.					
4	Most private construction companies have no board of directors, but have one chief executive that runs the company the way he likes.					
5	There are regular meetings between management and their workers in the construction industry.					
E	**Inventory Build-Up (X_5)**	**SD**	**D**	**N**	**A**	**SA**
1	Inventory in the construction industry is the totality of stock of various kinds of goods including raw materials, workshop supplies and finished goods.					
2	Inventory holding or build-up helps construction companies to take advantage of bulk purchase discounts.					
3	Inventory build-up helps in proper stock taking on site.					
4	It helps construction companies to meet emergency shortage of materials, due to some unforeseen circumstances like strike action by workers or breakdown of vehicles during supplies.					
5	Inventory problem is one, which sees to determine when it is necessary to stock physical materials (input), for purpose of					

	satisfying demand (output) over a specified time period in a construction company.					
F	**Motivation of Workers (X_6)**	**SD**	**D**	**N**	**A**	**SA**
1	There is poor remuneration or pay to workers in the Nigerian construction industry.					
2	Poor motivation of workers in the construction industry can make the workers uncommitted and unproductive.					
3	Some of the machine operators willfully damage some of the equipment out of frustration due to poor salary and motivation.					
4	Poor motivation leads to loss of materials, pilfering and waste of materials.					
5	The technical and managerial training given to plant operators in construction companies are inadequate.					

QUESTIONNAIRE III
(RANKING)

Instructions: This section of the questionnaire is intended to identify, in order of importance or priority, some of the major factors that can improve productivity in the Nigerian construction industry (mark 5 for the most important 4 for the next …1 for the least).

(1) Rank the following statements, which describe materials management functions in the Nigerian construction industry as it affects your company.

a. Storage of materials in a well planned location
b. Proper coordination among storages departments
c. Planning, organizing and control of raw materials from inception (INPUT) to consumption (OUTPUT)
d. Provision of materials at the right time and place in order to meet operational demand.
e. Provision of materials at the lowest total cost.

(2) Rank the following statements which describe the Success Level In Achieving Effective Materials Management.

a. Adequate motivation of workers.
b. Good inventory built of materials
c. Regular meetings between management and workers.
d. Timely and adequate funding
e. Availability of skilled men on project site.

(3) Rank the following statement in a construction industry, which determines a success project.

a. Project outcome acceptable to client/owner
b. Completion of project within budget
c. Completion of project within time schedule
d. Completed project meets technical performance standard

(4) Rank the following construction industry resources

in their order of importance to you.

a. Materials
b. Management
c. Fund/finance
d. Equipment
e. Labour

(5) Rank the following types of stores organizations used in the construction industry.

a. Centralized stores organization.
b. Decentralized stores organization
c. Hand to mouth type
d. Delivery of raw materials right from source to project site.
e. Through contract method