REPUBLIC OF RWANDA

ULK POLYTECHNIC INSTITUTE

P.O BOX 2280 Kigali

Website: //www.ulkpolytechnic.ac.rw

E-mail: polytechnic.institute@ulk.ac.rw

ACADEMIC YEAR 2023/2024

DEPARTMENT OF CIVIL ENGENEERING

OPTION OF CONSTRUCTION TECHNOLOGY

IMPACT OF EFFECTIVE MATERIALS MANAGEMENT ON CONSTRUCTION SITE PERFORMANCE

CASE STUDY OF GISOZI SECTOR IN GASABO DISTRICT.

Dissertation Submitted in partial fulfillment of the requirements for the Award of

ADVANCED DIPLOMA

IN CONSTRUCTION TECHNOLOGY

Presented by

HABUMUGISHA Gad: 202150241

Under the guidance of

Mrs. MUTIMUCYEYE Marie Grâce (MEng.)

Kigali, September 2024

DECLARATION

I, **HABUMUGISHA Gad** do hereby declare that the work presented in this dissertation is my own contribution to the best of my knowledge. The same work has never been submitted to any other University or Institution. I, therefore declare that this work is my own for the partial fulfilment of the award ofthe advanced diploma in civil engineering department, construction technology option at ULK Polytechnic Institute.

Name: HABUMUGISHA Gad

Roll Number: 202150241

Date of submission: …….....

Signature…….

APPROVAL

This is to certify that this dissertation work, entitled “IMPACT OF EFFECTIVE MATERIALS MANAGEMENT ON CONSTRUCTION SITE PERFORMANCE. CASE STUDY OF GISOZI SECTOR IN GASABO DISTRICT." is an original study conducted by HABUMUGISHA Gad under my supervision and guidance.

The supervisor’s names: **Eng. MUTIMUCYEYE grace**

Signature of the supervisor: …….....

Submission date: ……...

DEDICATION

This research project is dedicated to:

Our beloved families

Friends and classmates

ACKNOWLEDGMENTS

All praises are addressed to Almighty God who has given us the ability to carry out this research in a timely manner and which has made us strong and healthy when it was written. Glory to you Lord.

Our deep sense of gratitude and appreciation also goes to our supervisor, **Mrs. MUTIMUCYEYE Marie Grâce** for her encouragement and support throughout this research. Your professional experience and your practical comments from reviews and critics have made our research fruitful.

We wish to express our sincere thanks to the authorities of ULK Polytechnic Institute, in particular the Department of Civil engineering, construction technology option, for their support in terms of knowledge that leads us to the success of the university struggle.

Thanks also to our all classmates and friends for their moral support and invaluable prayers.

May God bless you all!!!

HABUMUGISHA Gad

ABSTRACT

Construction Materials Management is a vital function for improving productivity in construction projects. Poor materials management can often affect the overall construction time, quality and budget. Currently, the construction material management practice in Gisozi sector is believed to be poorly performed. Lack of standardized construction materials management system is one of the key issues facing by the building industry in Gisozi sector. The main objective of this study was to examine the impacts of effective materials management on construction site performance. The specific objectives were to examine the performance level of existing materials management process on construction project sites in Gisozi sector, to identify the roots causes of ineffective materials management in Gisozi sector and to explore the relationship between effective construction materials management process types and project delivery in terms of cost overrun and delay in Gisozi sector. Ninety nine questionnaires were distributed to project managers, project engineers, site engineers, engineer, and foreman, and they were received and analyzed. The following data analysis techniques were used: descriptive statistics were conducted to report sample characteristics, reliability and validity analyses were performed to confirm robustness of the instrument, graphical presentation such as bar charts were developed, and finally Average Mean Index Scale were constructed. The study results revealed that, 46.7% of respondent's organization obtain materials for sites without site requisition by site engineer provisions, while 28.9% of respondent's organization procure materials for sites with site requisition by project manager provisions and 13.3% of respondent's organization procure materials for site by engineer. The results indicated that currently there is no standardized and computerized construction materials management system applied in Somalia. The researcher concluded that all contracting companies are interested in using some techniques of managing construction materials such as creating and updating database for materials categories from local and international suppliers. Finally, researcher recommends to use computerized construction materials management systems on projects sites for improving productivity in construction projects and to reduce effort and time, and to achieve more accurate results.

Keywords: Materials management, construction site performance

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF APPENDIX

LIST OF ABBREVIATIONS

HoD **:** Head of Department

HR : Human Resource

HRM : Human Resource Management

RHA **:** Rwanda Housing Authority

ULK : Kigali Independent University

UPI : ULK Polytechnic Institute

CDW :Construction Demolition Waste

CIDB : Construction Industry Development Board

FIFA : Federation International De Football Association

FMEA : Failure Mode & Effect Analysis

GDP : Gross Domestic Product

GHG : Greenhouse Gas

IAQ : Indoor Air Quality

ISO : International Organisation for Standards

LCA : Life Cycle Assessment

LCC : Life Cycle Cost

PMBOK : Project Management Body of Knowledge

QIM : Quality Inspection and Management

SPSS : Statistical Package for Social Science

CHAPTER I: GENERAL INTRODUCTION

1.0. Introduction

This chapter highlights the background of the study, problem statement, and purpose of the study, objective of the study, research questions / hypothesis, scope of the study, significance of the study and organization of the research.

1.1. Introduction of the study

The Maldives' construction industry has shifted from local materials to imported ones due to the scarcity of natural resources and environmental vulnerability. The industry relies heavily on imported materials like cement, aggregates, base metals, wood, fittings, and finishing materials. This shift has led to high uncertainty in delivery time, quality, and cost, impacting project delivery. Therefore, it is crucial to conduct thorough research on material management in Maldives construction projects. Materials management involves planning and controlling the quality and quantity of materials, ensuring punctual equipment placement, and ensuring good price and quantity. This has led to the country's significant economic growth (Veraart, 2018).

Losses of building materials occur on most construction sites in Kenya, and wastage of materials is a major problem on construction sites in Kenya where the levels of wastage are considered to be fairly high. Construction material costs have been going up since 2001. For the year 2004 the cost of steel went up by 60%, cement by 10%, aggregates by 16.7% cypress timber by 10.1% and cedar timber by 50%. Though the fluctuating contracts cover the contractors against inflation and provide allowances for wastage, this is only to a limited extent. The Kenyan construction industry has occasionally been blamed for general poor quality and there is absolutely lack of general quality assurance in the industry and materials quality is an important component of the general construction quality (Tuma & Ghasemlounia, 2021).

In Rwanda, building materials contribute significantly to the sustainability of the construction sector and foster economic growth. This indicates that an efficient system for managing materials during the design phase and their use throughout the building phase improves the overall performance of construction projects in terms of schedule, cost, quality, and productivity. In Rwanda. The construction project's successful handling of the building materials on the site is

crucial. Therefore, efficient material use in construction projects needs to be the main goal of competent project management. Construction projects rely heavily on the effective management of building materials. This process ensures the timely delivery of the necessary building materials at the right location, time, and quantity to reduce costs. The primary objective of construction materials management is to ensure a seamless flow of materials from order to use. An integrated materials handling procedure, including planning, identification, procurement, storage, receiving, and distribution, is crucial for effective materials management on site. The management of construction materials is essential for completing projects quickly and efficiently, making it a vital aspect of the building industry. Thus, the successful completion of construction projects relies heavily on the efficient management of building materials (Vera art, 2018).

Construction projects are increasingly focusing on materials management to reduce costs and boost profitability in the competitive construction market. Building materials account for 30-50% of a project's overall cost, and insufficient materials management is often blamed for low material quality. Effective management of construction materials is crucial for project completion and reducing duration, budget, quality, productivity, and material waste. An outstanding management system for handling materials from the design phase through the construction phase can significantly reduce project costs. Effective material management is an essential component of construction project management, as it helps to address the problem of inferior material traits and ensure the quality and productivity of the project. By addressing the issue of inferior material traits, construction projects can be completed successfully and contribute to the overall success of the project (Mahavidyalaya et al., 2011).

1.2. Problem Statement

It can be claimed that Rwandan construction projects suffer from inadequate material qualities in terms of their availability, appropriate quality, affordable cost, limited excess, and little waste. The following are examples of poor material attributes that have been observed on construction sites: emergency material purchases; work stoppages due to shortages of materials; unclear work hours (e.g., nighttime concreting); excess materials on site; inadequate storage space for materials; uncontrolled material waste; damaged materials on site; erroneous material purchases; consultant condemnations of materials and works; and material disappearance from site through theft.

If the required quantity and quality of construction materials are not being available could lead to increased cost overruns and overall delays in the construction project and could also affect the quality of the constructed facility. The overall effects of poor construction materials management could therefore significantly lead to increased time and cost overruns, and poor quality for the project but if effective construction materials management can be enhanced, the project delivery and profit levels for the contractor or savings for the client will be greatly improved.

Researches showing the uses and types of construction materials in Rwanda has been carried out, but there is a gap in the study done on its outcomes due to the fact that they didn't show the impacts of construction materials management on project sites. It's in this regards, this project aims at showing the impacts of construction materials management on project sites in Rwanda specifically in Gisozi sector.

1.3. Purpose of the study

This study was undertaken in partial fulfilment of the requirements for the Award of advanced diploma in construction technology. The purpose of this study is to conduct the impact of effective materials management on construction site performance that is fill the aim of Rwanda country of providing the improvement of construction industry. This project will promote level of managing construction materials and the project delivery and profit levels for the contractor or savings for the client will be greatly improved.

1.4. Objective of the study

1.4.1. Main objective

The main objective of this project is to conduct the impact of effective materials management on construction site performance in Gasabo district / Gisozi sector.

1.4.2. Specific objectives

The specific objectives of this research are:

1. To examine the performance level of existing materials management process on construction project sites in Gisozi sector.
2. To identify the roots causes of ineffective materials management in Gisozi sector.
3. To explore the relationship between effective construction materials management process types and project delivery in terms of cost overrun and delay in Gisozi sector.

1.5. Research questions

1. What is the performance level of existing materials management process on construction project sites in Gisozi sector?
2. What are the roots causes of ineffective materials management in Gisozi sector?
3. What is the relationship between effective construction materials management process types and project delivery in terms of cost overrun and delay in Gisozi sector?

1.6. Scope of the study

The project of providing the impacts of effective materials management on construction site performance in Gasabo District especially in Gisozi sector is the main point of interest. This study was delimited in terms of space and domain. In terms of space, this research was conducted in the Kigali city, Gasabo District especially in Gisozi sector. The study was delimited in time as it was completely done in a short time of the period academic year 2023-2024. And finally, this study was delimited in terms of domain as it was delimited in domain of construction technology. This research will only conduct the impact of effective materials management on construction site performance.

1.7. Significance of the study

The importance of this study will be regarded as the personal interest, institutional interest, and social economic interest.

1.7.1. Personal interest

This project will help the researcher as construction technology student to get advanced diploma degree in construction technology. Also, this project will help the researcher to increase his knowledge about construction materials management. This research will help the researcher to explore new locations and meet with new people. This project will help researcher to practice skills and knowledge gained in class, trip study and in internships, this project will increase our experience in managing construction materials on the project sites.

1.7.2. Academic interest.

This research will create a good picture to ULK Polytechnic Institute on the quality education they offer and will help an institution to gain another reference book in construction technology option for future students doing final year dissertation. This study also it will be used as a reference to the

other researchers and student within the next coming academic to have a clear understanding on the construction materials management.

1.7.3. Social interest

The society is composed of various individuals, mainly citizens and officers. This study will awake the citizens know the impacts of effective construction materials management. This project will provide job to people, later when it became successful and get implemented. This project develops skills and knowledge to the project report readers to know the procedures of how to manage the construction materials on their own projects and its impact's.

1.8. Organization of the study

This research project will be made up by five chapters, the first chapter will be the general introduction containing the background of the study, problem statement, general objective, specific objectives, and research questions, choice of the study, significance of the study, study delimitation, research methodology, conceptual framework, and organization of the study. The second chapter will be literature review of the study with the different sources of from different documents. The third chapter will be concerned with the research methodology. The fourth chapter will describe data presentation, analyzed and interpreted the results. Finally, the fifth chapter will deal with conclusion and recommendations.

CHAPTER II. LITERATURE REVIEW

2.1.Introduction

This section focuses on the review of literature on construction materials and construction materials management. In this project, the literature reviews mainly based on what different authors have been written about construction materials and construction materials management. This section contains an extensive and thorough review of relevant publications and studies related to the research problem under investigation in order to obtain detailed knowledge about the area under study.

2.2. Definition of key terms

The main key terms to be defined includes: construction material and construction material management. These definitions are provided in order to enable different readers to get a good understanding on variables under study.

2.2.1. Construction material

Any item, material, or supply that the contractor or a subcontractor brings to the construction site to be integrated into the building or job is referred to as construction material. An item that is brought to the location already made out of parts, components, or supplies is also included in the term. However, regardless of when or how the individual parts or components of those systems are delivered to the construction site, emergency life safety systems—such as emergency lighting, fire alarm, and audio evacuation systems—that are discrete systems integrated into a public building or work and that are produced as complete systems are evaluated as a single and distinct construction material. Supplies, not building materials, are what the government directly purchases (Veraart, 20.

Any substance used in construction is considered a construction material. Many naturally existing materials have been used to build structures, including wood, sand, pebbles, clay, and even twigs and leaves. In addition to materials found in nature, man-made products are widely used, varying in their degree of synthetic nature. Many nations have well-established industries dedicated to the production of construction materials, and the usage of these products is generally limited to

specialized crafts like carpentry, insulation, plumbing, and roofing. They supply the building blocks for homes and other constructions. (Chitte, 2018).

2.2.2. Material management

The word "material management" refers to the inability of industrial organizations to regulate the kind, quantity, location, transportation, and timing of numerous commodities utilized in production. Planning, managing, controlling, and coordinating activities related to inventory and material requirements, starting at the point of materials' entrance into the production process, is known as material management. It starts with determining the quality of the materials and concludes with their issuing to production to satisfy client demand on time and for the least amount of money. The core business function that directly adds value to the product is material management. The term "materials management" refers to all processes involved in creating or producing the product. Information management, inventory control, material inspection upon receipt in the business, material transportation, and several other tasks. Bethel states that its obligations terminate when the customer receives a correctly completed product in good shape (Tuma & Ghasemlounia, 2021).

2.2.3. Construction materials management

Given that it accounts for a significant amount of project costs, construction materials are an essential component of construction projects. Construction materials may contribute between 50 and 60 percent of the project's total cost. Managing building materials is a crucial duty in a construction project because it is a substantial contribution to project cost. Therefore, according to Mahavidyalaya et al. (2011), material management is a crucial component of project management.

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011).

By definition, construction material management is "the process of planning and controlling all necessary efforts to ensure that the right quality and quantity of materials and equipment are specified in a timely manner, obtained at reasonable cost, and available when needed," as stated in the Modern Construction Management System (Eze, 2020) by the Business Roundtable. The management of construction materials is a crucial component of the building industry. Construction material management is the process of providing the right building material in the

right quantity and at the right time to the right location in order to lower the cost of a project. The main goal of construction materials management is to guarantee a smooth flow of materials from the time they are bought until they are used.. An appropriate integrated materials handling procedure that covers material planning, identification, procurement, storage, receiving, and distribution must be in place for materials management on site to be effective (Nama et al., 2015).

The planning, managing, directing, and coordinating of operations related to materials and inventory requirements, starting at the moment of entry into the production process, is known as construction material management. It starts with determining the quality of the materials and concludes with their issuing to production to satisfy client demand on time and for the least amount of money. Mahavidyalaya and associates, 2011.

2.2.4. Construction site

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011).

A construction site is a location or piece of land used for building. Another phrase that is occasionally used to refer to construction sites is "building sites." This usually implies that houses or other structures are being constructed, although a "construction site" encompasses a wider variety of activities. A building site is a piece of land utilized for all construction-related activities. Here, the characteristics of the landscape—soil, vegetation, look, etc.—are usually modified to establish an environment that is appropriate for fieldwork by specialists (Bolden et al., 2013).

2.3. Concept of construction materials management

2.3.1. Components of construction material management are: (Tuma & Ghasemlounia, 2021)

- ✓ Material estimation, budgeting, planning and programming.
- ✓ Scheduling, purchasing and Procurement
- ✓ Receiving and inspection.
- ✓ Inventory control, storage and warehousing
- ✓ Material handling and transport
- ✓ Waste management

- ✓ Make and Buy Decisions
- ✓ Coding and Classification of Materials
- ✓ Forecasting and Planning

2.3.1.1. Planning, organizing and communication

Planning is a decision making process in advance of action which endeavors to design a desired future and effective ways of bringing it about. Material planning is a scientific technique of determining in advance the requirements of materials as dictated by the production program. Construction process relies to a great extent on the exchange of information and permanent interactions of entities and resources. The interrelations of relevant participants in a construction process are considerable and their management will have a different impact on the success of the project. Adequate material management may involve complex communication mechanisms, education activities and training programs that must be established early in the project (Veraart, 2018).

Decisions that are made early in the planning stages of the project appear to be critical to the overall success of the project. It is important to develop a project material plan which is a fundamental and important document unique for each project. In developing the materials plan, various factors must be considered such as project size, scope, location, cash flow requirements, schedule and lead times of critical purchases, owner philosophy, owner approvals, number of project participants, inspection roles, acceptable suppliers list and extent of prefabrication (Albert et al., 2021).

There must be a clear understanding of the materials required, their packaging, quality available or required and other associated materials like thinner for paint. It is also important to understand the equipment and tools needed in the work process. The materials plan should record the assignment of responsibilities for functions involved in materials management. Engineering materials including equipment are the most visible, costly, complex and quality critical. Engineered materials will usually drive the project schedule, and major equipment lead times will influence the engineering schedule. Bulk materials' planning is more difficult because bulk materials are more numerous and quantities are never exactly known until the job is over (Chitte, 2018).

Design evolution causes continual updating of the bulk requirements. Scheduling the entire materials program is essential to meeting the project timetable. Materials schedules are as critical as those of engineering and construction and span all phases of the project from defining and approving the requirements to purchasing, vendor lead time, transportation and site management. The schedule must determine sequential distribution of quantity over a period of time to avoid cash flow problems and other problems associated with excess storage of materials like theft and damage. International materials management schedules should include time for transportation, import licensing and customs clearance (Mahavidyalaya et al., 2011).

Planning must also consider responsibility for purchasing (home office and site) including vendor selection, terms and conditions of the purchase order, forms used in purchasing, and procedures and schedules. Particular care should be given to invoicing and payment procedures, which should be discussed with accounting and the vendor to avoid any misunderstandings. The transportation plan should consider safety, cost, timely delivery, hazardous material content and point of title transfer. Of particular concern are foreign shipments, which involve considerable, additional complications in terms of export regulations, delays, tracing of shipments and licensing and import requirements (Albert et al., 2021).

Planning for site materials management includes consideration for receiving, storage, control and distribution of materials at the construction site. This includes layout and organization of lay down areas and warehouse facilities, development of storage and maintenance plans, and planning for access to and within the site. Preparations for field purchasing, materials control and expediting must also be addressed. All of these functions should be planned to allow craft labor work planning to proceed on the basis of known materials availability (Mahavidyalaya et al., 2011).

An elaborate planning should be continuously reviewed to establish minimum and maximum stock levels required at any given time of the project in order to facilitate purchasing of materials. The stock levels would depend on the rate of minimum average daily consumption, maximum storage space, ordering and lead time required, storage risk on the site, economic order quantity, working capital, available interest on financing and the likelihood of steep price fluctuations The materials quality plan is designed to ensure conformance of vendor supplied materials to project specifications (Mahavidyalaya et al., 2011).

The plan should provide for the use of realistic, achievable, specifications and address the quality aspects of purchasing documents, shop fabrications and shop tests. The inspection plan for each piece of equipment is developed during the design and rearward phases. It includes an evaluation for the need for and level of shop inspection, including hold points. Special construction techniques (prefabrication, preassembly and modularization) have significant impact on materials management. Materials' planning is usually more complex because of the additional levels of activities at multiple sites. Early decisions are needed on the assignment of responsibilities among the owner, design contractor, fabricator and the erection contractor. Organizing is that part of managing that involves establishing an intentional structure of roles for people to fill in an organization (Mahavidyalaya et al., 2011).

An integrated materials management organization plays a significant role in determining the ultimate cost of a construction project. The organization must be structured to provide for the timely performance of the work, with materials personnel located at appropriate levels of project management to contribute to and influence the decision making process. In some cases, particularly on larger projects the entire scope of materials function may be consolidated into one unit. On smaller jobs, various materials functions sometimes are assigned to individuals who have other responsibilities and assignments (Mahavidyalaya et al., 2011).

This poses significant challenges to the individual responsible for managing all materials functions. A single focus for the management of these functions is essential, even though the assigned individual may have other project duties. The organizational structure of materials management must take into consideration the size, scope, contracting strategy and location of the project. A primary requirement is the coordination between the home office and the field, which is achieved by individuals and computer systems complementing each other throughout the materials cycle. Large projects regardless of location will require a full staff of skilled professionals with a direct reporting line to project management (Mahavidyalaya et al., 2011).

These materials organizations continue to rely on home office guidance in procedure and policy development and the selection and supply of key field materials management personnel. It is essential that the organization be staffed with professionals possessing skills consistent with the scope of work. The requirements are changing to fewer semi-skilled and more professional

personnel. The required key personnel must have a thorough understanding of the projects materials plan and its functions within the total project. Prior experience in requirement definition, procurement, quality assurance/quality control, transportation and site materials management is highly desirable. Computer conversancy is increasingly important as the benefits of materials management automation become practical for even small jobs (Mahavidyalaya et al., 2011).

Although proper selection of personnel will minimize the necessary training, some training for the particular requirements of each project will be required. Much of this training can be on the job, but formal training in management, business and computers is increasingly required. Lack of training especially of site personnel has been a frequently sited factor on "problem" projects. Materials management personnel must be able to operate in the project environment, to anticipate the requirements of other organizations, to administer their program within a complex set of organizational arrangements, and to communicate the importance of materials management. The control function of materials management runs across the rest of the functions and sub functions of material management (Mahavidyalaya et al., 2011).

Although planning must precede controlling, plans are not self-achieving. Controlling is measuring and correcting individual and organizational performance to ensure that events conform to plans. It involves measuring performance against goals and plans, showing where deviations from standards exist, and helping to correct them. Thus control facilitates the accomplishment of plans (Mahavidyalaya et al., 2011).

2.3.1.2. Materials take off

Materials management process actually begins when a materials takeoff is performed to produce bills of materials. Before bills of materials can be created, materials specifications must be established. In developed industries materials coding or numbering systems/standards have been devised and high percentage of material takeoff information is being generated using computer a. As CAD software becomes more common, more efficient procedures for transferring data between computer systems have been developed. It is often easier to create a bill of materials computer file if a master or project specification file is created first (Journals, 2019).

A project specification file contains a list of all the materials items that will be used on the project, material code number, a description, a specification and the unit of measure. Unit prices and unit man-hour rates can be established for certain material items. Developing detailed bulk materials requirements is laborious and time consuming. Judgment and experience are required to determine the level of detail of the material take off. From the perspective of control and accountability, the level of detail of materials takeoff must be commensurate with the level of control detail and consistent with plans for construction work planning (Journals, 2019).

2.3.1.3. Vendor selection

Vendor performance has been observed to be a serious problem on construction projects. When vendor performance deteriorates, the potential for achieving benefits in the areas of improved labor productivity reduced materials surplus and reduced management manpower decreases accordingly. Vendor selection therefore forms the success or failure of the project. Vendors must be selected on the basis of their capabilities, geographical location, prior experience and owner preference. Measurement of capabilities includes such considerations as past performance, financial condition, bargaining agreements, shop capacity, engineering support, quality assurance/quality control programs, competitiveness, responsiveness and schedule adherence (Mahavidyalaya et al., 2011).

It is important to keep a register of public vendors/suppliers and keep updating the register for easy sourcing of the materials. In a well-managed vendor selection system, it is always advisable to send inquiries to identify vendors and invite them to make an offer. The inquiry must contain the descriptions of the goods, specifications, quantities required, supply schedule, place of delivery, delivery date, validity period and request for free sample if possible. Offers can then be received and evaluated and prices negotiated before a supply contract is entered into (Mahavidyalaya et al., 2011).

2.3.1.4. Purchasing

The purchasing function is central to material Management. The purchasing has the responsibility and the authority to commit project funds for materials. The activity may be accomplished by the home office, the field or a combination of both depending on the size and scope of the project.

Without successful purchasing it is impossible to achieve the results for which the project intends. The following are some broad well recognized principles of scientific buying:(Journals, 2019)

- Buying the right quality
- Buying the right quantity
- Buying the right price
- Buying from the right source
- Buying at the right time and place

i. Right quality

First and foremost, quality must be properly defined. No general description of the character of the material or desired attributes will be sufficient, like “high quality” or “poor or low quality”. The definition must be in greater detail and this must be described in the purchase order. This description then becomes the essence of the purchase order. Significant elements like dimension, physical, chemical and other properties, suitability and purpose must all be clearly stated.

ii. Right quantity

Since quantity is a mathematical measure, there have been many attempts to determine the optimum quantity which is most economical.

iii. Right price

Price is an important economic consideration that is a guidance factor in the terms and conditions of the purchase order. A most common equation used in determining the right price is; Value = Quality/Price. Thus value varies in direct proportion to quality and inversely to the price paid. But quality is defined in a specification, it is constant and the comparison of value can be made in terms of price alone. It would follow then that, the lower the price, the greater the value.

iv. Right source

Source selection and its importance has already been discussed under vendor selection. Vendor selection is usually considered as part of purchasing but in this paper it has been considered separately.

v. Right time

Right time implies that in order to be effective, purchases should be made, in such a way that stores and materials are made available in time when needed, it being purchasing department's duty to

see that the delivery schedule is honored. As such, timing is an important element in every purchase order, except when such purchases are made for stock purposes. Even then, in order to get some price advantage when some seasonal purchases are resorted to, timing plays its due role.

vi. Right place

Right place means right place of delivery. Every purchase contract, in addition to time of delivery, must clearly state the place of delivery and such other terms like free delivery or ex-factory delivery. Generally, F.O.B. (Free on Board), F.O.R. (Free on Rail), C.I.F. (Cost, insurance and freight) paid terms are part of the price agreement. From these basic principles, the following fundamental objectives of purchasing are derived.

a) To maintain continuity of supply to support production schedules,
b) In doing so, minimum investment in stores and materials inventory must be ensured, consistent with safety and economy,
c) Duplication of purchases, wastes, obsolescence and costly delays must be avoided,
d) Proper quality standards based on suitability criteria, must be maintained,
e) Materials must be procured at lowest possible cost, consistent with quality and service requirements, and
f) It must maintain, in so far as materials costs are concerned, company's competitive position in the market. For informal construction, the owner mainly assumes control of purchasing while holding the contractor/builder/site manager responsible for the other materials related functions. When executing either cost-reimbursable or fixed price contracts, the owner may wish to purchase the engineered and fabricated materials and assign other purchase to the contractor. Whereas the bills of materials define the project materials, the resulting purchase orders define the actions that were taken to meet those requirements.

Once the vendor has been selected, orders must be placed within the validity period. For good management there must be a written purchase order for the purchase of any material regardless of quantities involved. The purchase order should include information on the description of the materials, quality, quantity, price, discounts, time and place of delivery, terms of payment, packing and dispatch instructions, inspection testing, and test certificates to accompany the materials, invoicing instructions, freight insurance, servicing and warranty.

2.3.1.5. Expediting

Expediting is an extremely important materials management function that does not always receive proper emphasis. The purpose of expediting is to provide timely information regarding anticipated materials deliveries to all concerned project personnel. Several types of expediting exist, each with a different level of intensity and cost (Mahavidyalaya et al., 2011).

The least intense type of expediting is simple status reporting. Periodic telephone contact is made with the vendor to determine the status or progress of an order, and the information is reported to the project in some systematic format. This type of expediting provides basic information to the project, but does little to prevent or overcome delays or problems with an order. Reactive or corrective expediting is more intense than the simple status reporting, but is initiated only in response to some event or action. Vendor contact may be made in response to a problem of delayed or late delivery (Journals, 2019).

Finally, proactive or preventative expediting is the most intense and aggressive type of expediting. Here, vendor and sub vendor contact is initiated as soon as the order is issued and continues through the life of the order. The expediter will review all elements of the order to ensure that the vendor understands the various submittal, testing, and delivery requirements. The expeditor will seek to gain a thorough understanding of the vendor's engineering, purchasing, and manufacturing operations as they relate to the particular order. This enables the expediter to monitor all elements of the vendor's performance with the intent of anticipating and resolving problems before they seriously impact the project (Mahavidyalaya et al., 2011).

Experienced professional expediters serve as a key bridge between the engineering and purchasing activities that specify and order materials and the field operations that are dependent on those materials for their progress. Accurate and dependable expediting information is essential for informed management of the project, and facilitates the mobilization of buyer and vendor resources in response to problems or delays (Veraart, 2018).

2.3.2. Quality' assurance and quality control

In everyday usage the word ‘quality’ usually carries connotations of excellence. However, in engineering context quality is not necessarily indicative of special merit, excellence or high status. Quality in engineering conveys the concepts of compliance with a defined requirement, of value

for money, of fitness for purpose, or customer satisfaction. Thus a palace or a bicycle shade may be of equal quality if both functions as they should and both give their owners an equal feeling of having received their money are worth. Quality therefore is a summation of all those characteristics which together make a product acceptable to the market (Mahavidyalaya et al., 2011).

Products which are lacking in quality will in the long term prove unmarketable, and the purveyors of such products will go out of business. Therefore, the need to promote and control quality is of fundamental importance to any enterprise. The management of construction quality has become a major concern of owners and contractors because they now realize that quality affects the project schedule, ultimate cost, and performance of the constructed facility. Materials quality, which is an important component of construction quality, depends for its success on an unbroken chain of positive actions by many different parties (Veraart, 2018).

Quality assurance includes verification that all participants in the fabrication and inspection program follow established and specified procedures. Management must emphasize that quality is one of the most important, if not the most important, function of materials management. Owners and contractors should emphasize that quality performance is a major factor in the selection of suppliers. Thus, supplier quality is an important link in the quality of the constructed facility (Veraart, 2018).

Owners and contractors must continually impress on their own employees as well as suppliers the need for quality products. The purchase order specification and inquiry documents should state the requirement for inspection. Details of the inspection such as test dates, forms and certifications should be established with the vendors prior to the actual inspections. Shop documentation must be meaningful, with required data reflecting actual results of fabrication and testing (Journals, 2019).

2.3.3. Transportation

The movement of equipment, materials, and personnel to the job site represents a unique and specialized element of materials management. Experienced traffic personnel can have a positive impact on the execution of the project while minimizing transportation cost. Significant savings are possible through the use of national agreements or negotiated project transportation agreements, and through various commercial arrangements for the transportation of goods,

materials, documentation, or personnel. Special consideration is required in setting terms, thereby determining the proper point for transfer of materials ownership and liability. The prime contract, especially insurance clauses, may have a direct impact on the purchasing terms and conditions concerning transportation (Tuma & Ghasemlounia, 2021).

Early specialized activities in the project planning phase, such as properly performed route surveys and consideration of local traffic Conditions, can significantly affect later execution of the work. These front end efforts affect engineering by defining shipping envelopes, weight limits, and schedule limitations. The traffic function or group has significant input to purchase documents including packing specifications, shipping instructions, invoicing instructions, and document requirements. This group's expertise is necessary in developing routing guides, shipment progress reports, and troubleshooting as transportation problems develop (Journals, 2019).

Transportation or traffic expertise aids the materials management team in handling numerous types of special loads from delicate electronics to massive modules, each requiring transport equipment that is specially designed or of limited availability. Knowledge of the requirements, source, and availability of this equipment may be critical to successful execution of the work. Transport permitting requirements also must be considered early in the project. Assigning the above responsibilities to suppliers may present an easy upfront decision, but can later lead to painful lessons if the expertise is not available to the materials management team to ensure that traffic functions are handled properly (Tuma & Ghasemlounia, 2021).

Traffic or logistics for foreign sites presents an added dimension to the transportation requirements for a project. Each phase of the transportation effort is more complex, with often stringent requirements due to ocean shipment and transportation to remote areas of the world. Each country's customs requirements are unique with potentially significant duties, taxes, and delays that must be considered in the planning efforts (Mahavidyalaya et al., 2011).

2.4. Site materials management.

Site materials management extends beyond the functions of receiving, storing, and issuing materials. It is affected by other elements of project management including engineering, procurement, expediting, and quality control. It is important, therefore, that the site functions be

well planned and executed, and that they be an orderly and logical continuation of an overall materials plan. Site materials management functions are detailed functions that increase in complexity with the size of the project, and may require specialized skills and talents. The large volumes of structural, piping, and electrical materials that must be dealt with on large industrial projects make the use of computer systems at the site a requirement (Albert et al., 2021).

The ability of these systems to catalog, sort, and combine materials by drawing, systems, areas, or other category and to allocate materials to a specific work plan can be a significant aid to craft planning. Full benefit is realized, however, only if the systems put in place on the job site are fully understood, accepted, and utilized by the crafts. This interface is the key to achieving the substantial cost savings that are possible through the use of this technology. Properly managed site procurement is important to the success of the construction effort because of the potential to impact craft productivity by late identification, purchase, or delivery of field purchased items (Mahavidyalaya et al., 2011).

The crafts depend on this group not only for permanent plant materials, but also for parts, supplies, tools, equipment, and services needed in the erection process. Materials handling functions (receiving, storage, control and distribution of materials) at the job site are functions that appear routine on the surface, but can significantly affect project cost and schedule. Lost, damaged, misplaced, or improperly stored and maintained equipment and materials can result in expensive delays and disruptions. These and many other materials problems can be reduced or eliminated with the proper planning and implementation of the necessary materials management systems and procedures (Veraart, 2018). Materials handling should be planned to coincide with other site activities and success will be achieved by (Eze, 2020):

i. Understanding the situation;
ii. Discussing the form of packaging beforehand;
iii. Controlling the sequence of deliveries;
iv. Using the right equipment;
v. Adopting firm control of all the operations

Materials handling is not a site problem; it is affected by the designer, the manufacturer and the contractor. Design will determine the shape, weight and consistency of the materials; presentation

of the package will depend upon the manufacturer; and the contractor's policy for mechanical handling on site will influence the total operation. Unnecessary handling of materials increases site costs, and yet often materials waste could be reduced by redirecting underemployed plant and equipment. An effective site materials control should be able to verify that the materials being delivered conform to what was ordered in terms of quantities and specifications and that what is delivered conforms to what is in the purchase order. The supplier should immediately be notified of any defects, shortfalls or failure in specifications and remedial action immediately taken to avoid delays (Mahavidyalaya et al., 2011).

Once the materials have been received, any special handling and instructions should be followed to avoid damage and deterioration of materials while on site. Materials handling at the construction site can be broadly divided into:

- ✓ Unloading from wagons/lorries and stacking in the storage yard, transportation from there to the site, unloading at the site, shifting, hoisting etc; of heavy contract materials; and
- ✓ Handling of light and medium stores.

For the first type of handling, there will be requirements of hoisting and transport machinery and facilities like; cranes, tractors, trailers, power trucks, loading and handling attachments such as hooks, grabs and clamps; wire rope slings and chains for hoisting and hauling, wooden sleepers, planks, used tires, etc., to avoid damage while unloading; lifting tackles, drums, sheaves and sprockets, power driven conveyers for handling civil engineering materials of bulk quantity, if involved and sufficiently large handling and storage area with solid approach road. These machinery and facilities shall be used both for handling of materials and erection, to avoid idling (Mahavidyalaya et al., 2011).

For the second type of handling, the requirements shall be; wheelbarrows, trolleys and forklift trucks. There also must be an orderly requisition of materials from the stores and special attention taken to minimize theft of materials. Continuous physical inspection and verification of materials is necessary to ensure that the materials are available in the right qualities and quantities and also minimize misuse and theft (Mahavidyalaya et al., 2011).

2.4.1. Surplus materials

All projects can expect a certain amount of surplus; however, the key to successful surplus materials management is a well-conceived and well executed materials management plan. Various shortcomings in the engineering, materials control, procurement, and field materials management phases of the work may result in surplus materials. Understanding and anticipating these potential problem areas are the first steps in minimizing surplus. Many causes of surplus can be identified. Surplus can be caused by a poorly performed materials takeoff (MTO). Engineering revisions and changes are yet another cause of surplus, particularly if the MTO occurs early and systems are not adequately responsive to change (Mahavidyalaya et al., 2011).

Inadequate construction materials management practices also may lead to surplus, particularly on fast track projects. Primary causes are duplicate buying and poor control systems/procedures leading to procurement of unnecessary materials. Minimizing surplus on a project requires a proactive and timely system of communication among all functions involved in the materials acquisition and installation cycle. For example, design changes must be immediately communicated to halt the acquisition of materials no longer required (Mahavidyalaya et al., 2011). Similarly, substitutions in the field must be immediately communicated so unused materials may be considered in the remaining design. An individual should be identified as the focal point with the responsibility to track these types of changes as well as to periodically review and adjust minimum/maximum inventory limits (Ronald et al., 2020).

Certain procurement practices can reduce surplus through the use of blanket price agreements. Releases are issued when engineering is sufficiently complete yet will still meet field requirements. Purchase orders for bulk materials and other commodities should include a materials return provision allowing return of surplus (Mahavidyalaya et al., 2011).

Options for disposal include using the surplus in alternative services, using the surplus materials on other projects, returning them to the vendor, or selling them to a third party. All options require complete records and timely reporting to achieve optimum results. The best option is to do the necessary planning and to implement the necessary materials management systems to reduce surplus at the source (Veraart, 2018).

2.4.2. Materials wastage

Material wastage may be defined as the difference between the net measurement on drawings and the necessary allowance for any wastage that is unavoidable. Material wastage that is attributable to problems of poor materials handling is due to one or a combination of the following factors: (Mahavidyalaya et al., 2011)

- Poor workmanship
- Construction errors
- Excessive use of materials e.g. mortar and concrete
- Breakage
- Poor storage
- Misdemeanor

Building materials wastage falls into two categories i.e. avoidable and unavoidable. Avoidable wastage can be controlled and reduced through sound site management. Unavoidable wastage refers to that part of materials considered by the estimator to be normal to the production process. According to the Standard Method of Measurements of Building Works all quantities must be given net, as they will appear in the completed building. The material wastage must be reflected in the unit prices. The wastage allowance depends on the skill and experience of the estimator. This will also vary from firm to firm depending on the efficiency of the site foremen (Veraart, 2018).

Unavoidable wastage can be further classified into six broad categories as follows:

i. **Conversion wastage:** when cutting small timber scantlings from bulks of timber of logs.
ii. **Cutting wastage:** when sheet materials have to be cut for a specific component e.g. plywood, block boards, plasterboard and felt.
iii. **Application wastage** - occurs with most wet building materials such as plaster and other finishing's. This includes wastage on many other materials such as bricks, tiles and timbers, which are cut to length.
iv. **Stockpile wastage** - when most loose materials are dispersed on the site because of partial use e.g. aggregate and sand.
v. **Residue wastage** - occurs with paints, glues and other materials, which are normally delivered in containers, and are never completely used.

vi. **Transit wastage** - occurs with brittle materials, which break on transit such as glass and tiles.

The extent of unavoidable wastage is generally known within reasonable limits and is taken into account with some precision when taking off or tendering. The standard for unavoidable wastage of building materials will depend upon various factors as indicated above including nature, of work, type of material, method of application etc. (Mahavidyalaya et al., 2011)

Table 1**: Table below, illustrates typical unavoidable wastage considered when estimating materials for housing.**

No.	**Type of materials**	**Planned wastage**
1**.**	Cement	2%
2.	Sand	10%
3.	Aggregate	5%
4.	Concrete structural	2%
5.	Concrete blinding (lean)	10%
6.	Reinforcement steel bars	3%
7.	Reinforcement steel mesh	10%
8.	PVC sheeting	15%
9.	Steel for windows	7%
10.	Timbering in trenches	5%
11.	Stone Masonry	5%
12.	Marble lining	20%
13.	Wood for door frames	5 to 7.5%
14.	Wood for shutters	10%
15.	Wood for flooring/walling	5 to 10%
16.	Sheet roofing	21/2 %
17.	Tile roofing	5%
18.	Floor tiling	2 to5%

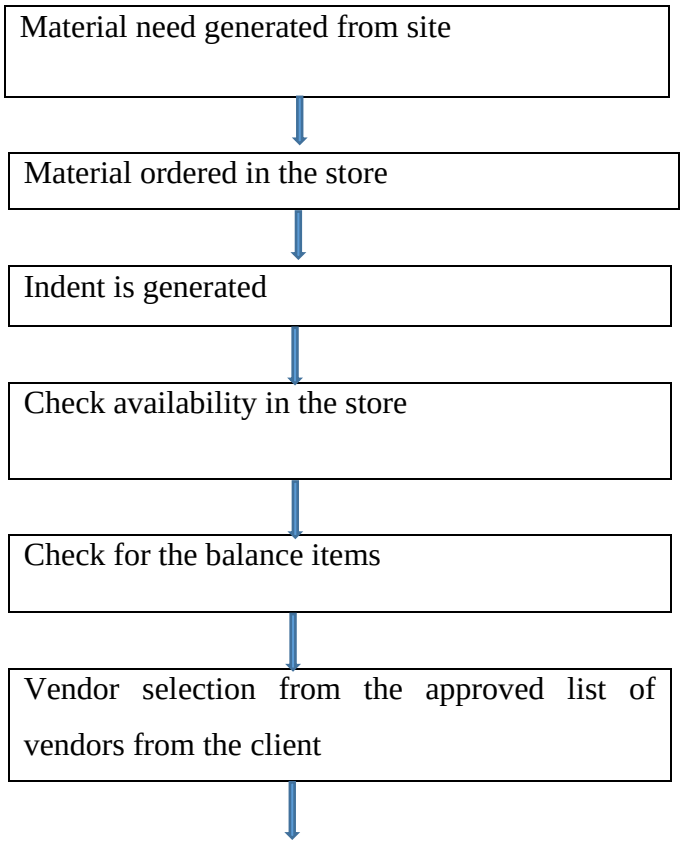
19.	Wall tiling	3%
20.	Pigments (for colors other than natural grey)	5%
21.	Paints	5%

The avoidable wastage is mainly caused by: (Mahavidyalaya et al., 2011)

- **i.** Designer's specification of non-standard materials
- **ii.** Wrongful purchases
- **iii.** Wastage in transportation
- **iv.** Damages
- **v.** Poor storage resulting in deterioration, obsolescence
- **vi.** Poor workmanship

The minimization of avoidable wastage depends on site management.

2.4.3. Process of construction materials management.



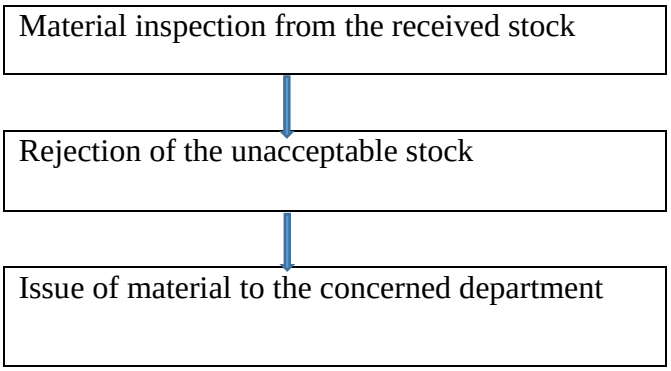


Figure 1**: Process of site material management**

2.4.4. Components of efficient construction material management

- ✓ Efficient materials planning
- ✓ Buying or Purchasing
- ✓ Procuring and receiving
- ✓ Storing and inventory control
- ✓ Supply and distribution of materials
- ✓ Quality assurance
- ✓ Good supplier and customer relationship
- ✓ Improved departmental efficiency

To fulfill all the objectives of construction materials management, it is necessary to establish harmony and good co-ordination between all the employees of material management department and this department should have good co-ordination with the other departments of the organization to serve all production centers.

2.4.5. Factors related with material management

- ✓ Planning and Scheduling
- ✓ Monitoring and Controlling
- ✓ Organization and Personnel
- ✓ Procurement
- ✓ Delivery
- ✓ Storage and Storage facilities
- ✓ Usage and Surplus and Waste control

i. Material planning

Some of The respondent's answers showed that material planning in theirs sites involves the quantification, ordering and scheduling of materials and activities to be carried out. In this regards, the usage of appropriate material management stimulates higher production and profitability to any construction companies and this can render them to high level of performance.

ii. Quality of service

Contractors said that its must in their site to choose and undertake procurement adequately taking into consideration construction materials. It is always recommended to carry out a research and assessment of various material properties to see whether they are compatible with various sites of buildings they about to work on. Procurement of construction materials must be delivered after approval of knowledgeable quality surveyor.

iii. Logistic

Site engineers said that another important procedure of material management used on their site refers to the movement and comprises of planning, execution and follow up and storage of all materials from raw to the finished ones to attain the expectation of client. This is helpful to the formulation of an effective construction site layout that may afford easy accessibility and transmitting materials in the site.

iv. Storage and inventory management

Respondents answers showed that its activities related to holding material and the process of counting as its moves on the site so as to ensure how materials are being used and keep track of it. Adequate guarantee during storage is sometimes not considered and this lead to low quality of materials or its decline and worsening. It was proposed that the storage are necessitates for enclosing, cleaning and drying adequate air condition and for some material had to be stacked on pallets and without humidity.

v. On site transportation

In construction site on site transportation hold important role for achieving effective material management and planning of access and transmission of material on the construction site are elements that necessitate to be the focus for adequate material management.

vi. Waste management

Further, the control of material wastage is very important in controlling the construction cost. Contractors specifies that material waste is estimated to nine percent by weight in construction sector and between 20 and 30 percent of purchased materials on sites. Material waste emanates

from planning, procurement, material handling and operation procedures. The construction materials wastage is not the same with the value of material provided and approved on the construction site. Material waste was seen as a main and growing issue in construction project in this sector and it may lead to ineffectiveness of construction project delivery. Appropriate control will be helpful to the enhancement of production and can ameliorate waste control in the construction (Ronald et al., 2020).

Project performance is related to the end product objective in terms of success and realization the prerequisites as well as satisfaction of clients. Therefore, project success lead to its sustainability and durability in terms of obtaining a competitive advantage, improvement of reputation for a firm, enhancing market share and attaining certain level of profitability. Project manager whose individual profile was to the ideal project manager for a specific project type was performance in effect on customer. Construction site performance level is achieved when the mentioned above procedure of material management are executed (Ronald et al., 2020).

2.4.6. The roots cause of ineffective materials management

In brief discussion regarding the site visits the general pertaining issues in material management is inability for ordering on time which lead to the delay in project implementation, wrong direction of delivering, over ordering, inadequate materials or stealing materials and double handling of material due to inadequate.

Another evidence from different researchers show that the planning, procurement, vender choice and execution steps if not done in appropriate ways, they can bring huge problems to the material management. In light with the above information, the correlation between those problems and ineffective material management is characterized by transport complexities, improper working design, inadequate material delivery, inadequate material handling on site and waste (Nairobi, 2005).

2.5. Relationship between construction materials management and construction site performance

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011). The following claims about effective construction materials management demonstrate how important it is to reduce the generation of material waste on construction sites:

it facilitates the implementation of policies for the management of construction materials waste, accounts for material waste, manages site waste management plan cost data, and manages waste materials. It also positively affects waste management plans and reduces waste quantities (Ronald et al., 2020).

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011).

A construction project's ability to effectively manage its building materials would minimize waste production, improve the caliber of the job produced, and maximize contractors' profits. The quality of building projects is somewhat impacted by efficient management of construction materials, as indicated by the following claims: The quality of some of the materials on site is positively impacted by good construction materials management, which also establishes the management-established quality standard and facilitates the implementation of materials quality audits (Chitte, 2018).

Thus, material management is an essential part of project management, as stated (Mahavidyalaya et al. 2011).

It was discovered that efficient management of building materials has both strong and modest influence on profitability in the building sector. The claims were: sustainable accounting for materials increases profitability; efficient management of construction materials on project sites improves productivity in construction projects; and efficient management of construction materials decreases waste, which increases profitability (Olanrewaju & Awodele, 2020).

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011). It has been established by additional research findings that poorly managed construction materials can lead to cost overruns. Cost overruns happen when unanticipated expenses surpass the total budget that you and your client have decided upon for the project. This is due to the possibility of excessive or overuse of certain materials resulting from inappropriate management of construction supplies, which in turn may necessitate the purchase of new ones. Due to all of this, the project's final cost exceeded budget (Oladinrin et al., 2012).

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011). However, as the questionnaires show, there is a strong correlation between construction materials management and delays in construction projects. The majority of site engineers attested to the use of subpar building materials. They also noted the possibility of delays in the acquisition, purchase, and delivery of materials; in fact, when those in charge act irresponsibly and report needing materials when none are available on the site, it takes longer to acquire, buy, and deliver those materials. All of things cause the construction project to be delayed. When additional time is needed or incurred, either past the project's scheduled completion date or past the date that the project's stakeholders agreed upon, a construction project is delayed (Albert et al., 2021).

It is of great importance to make sure that the construction materials are well managed otherwise it may lead to cost overrun or delay, which is both bad for the construction firm executing the project as it may lead to total loss of that firm and unsatisfied the client (Baiburin & Baiburin, 2019).

CHAPTER III. RESEARCH METHODOLOGY

3.1. Introduction

This section described the procedures that were followed in conducting the study. The techniques of obtaining data were also explained. The study area, population, sampling techniques, sample size, data collection instruments, data collection procedures and data analysis methods will be discussed in details.

3.2. Description of the study area.

This study was conducted in Gisozi Sector which is one of the 15 administrative sectors of Gasabo district in the Kigali city of Rwanda. The geographical coordinates of Gisozi sector are: 1° 55' 6" S, 30° 3' 23" E. This sector is composed with 2 cells including Gisozi sector has two cells; Ruhango and Musezero. This sector has 75,611 Population [2022]; 9,105/km² Population Density and 8.304

3.3. Location of study area.

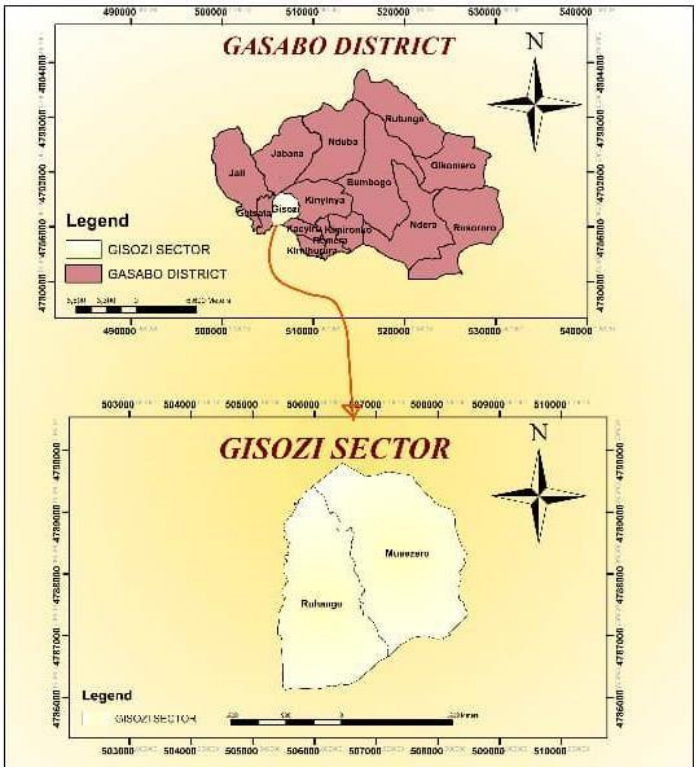


Figure 2**: Map of the study area**

3.4. Research design

A research design is a broad plan that states objectives of research project and provides the guidelines to realize those objectives. It is a plan of how a research project is conducted (Berg, 2009). The study used descriptive research design, descriptive research design is a method of collecting data by interviewing or administering a questionnaire to a sample of individuals, it helps to depict the respondents correctly and it also enhances detailed description of the problem under the study (Creswell & Plano-Clark, 2007).

The purpose of this method is to describe "what exists" with respect to situational variables i.e. it looks at relationship between independent and dependent variables. However, the study used quantitative research to gain better knowledge and understanding of the results. The quantitative research approach makes use of statistics and numbers which are mostly presented in figures. Hence, quantitative design is appropriate for this study as it enabled the researcher to quantify the impacts of construction materials management projects on the project in Gisozi sector/ Gasabo district.

3.5. Source of data collection

This study used both primary and secondary data as sources of desired information for the study. Primary data were gathered by using questionnaire and interview and secondary data were gathered using documentary review. These data were presented in the following section:

3.5.1. Primary data

Primary data comes straight from the people a researcher is researching from and is therefore the most direct kind of information a researcher can collect. The primary data is said to be the first hand observation and investigation (Cooper & Schindler, 2001). During the study, the researcher got primary data through self-administered questionnaires and interview from people on the active construction sites.

3.5.2. Secondary data

Secondary source of data involves information gotten from already conducted research work that relates to the study (Morrison, 2010). Therefore, during this study the researchers will obtain secondary data from books; reports; journals and electronic-published, maps, Google map, Orthophotos sources. A number of documents available in ULK Polytechnic Institute main library, in the active construction sites, on the internet, Gisozi sector reports; thesis and dissertations relating to the subject material were consulted for the purpose of obtaining secondary information.

3.6. Data collection instruments

In collecting data of this study, questionnaire, interview and documentation techniques were used in order to get information from respondents. Computer via internet helped to collect some information related to literature review. Smart phone used used to take pictures for further analysis during interpretation of data.

3.6.1. Questionnaire

Questionnaire is a set of questions which are asked to get information from a respondent. It is a set of questions prepared by the researcher to be distributed to a particular sample (Orodho & Kombo, 2002). A questionnaire was designed and pre-tested before the researcher submits it to the selected respondents. A questionnaire will be designed and pre-tested before the researchers submit it to the selected respondents. The questionnaires comprised both close-ended and open ended questions. The researchers will use information obtained via questionnaires in order to make an efficient analysis. In the present study, the researchers submitted the questionnaires to households of Gisozi sector in order to get the needed information on the performance level of existing materials management process on construction project sites in Gisozi sector, the roots causes of ineffective materials management in Gisozi sector and the relationship between effective construction materials management process types and project delivery in terms of cost overrun and delay in Gisozi sector..

3.6.2. Documentary review

The documentation is research tool which focuses on the systematic searching from any written documents which are relevant to the field of the research (Sekaran, 2005). With this method, various written documents containing information related to the topic under study were reviewed. Among those documents include dissertations from ULK Polytechnic Institute main library, the active construction sites, Gisozi Sector, Gasabo district and Rwanda Housing Authority reports, journals and other important documents relevant to the performance level of existing materials management process on construction project sites in Gisozi sector, the roots causes of ineffective materials management in Gisozi sector and the relationship between effective construction materials management process types and project delivery in terms of cost overrun and delay in Gisozi sector.. .

3.6.3. Interview

The interview can be defined as face-to-face conversation between an interviewer and the respondent, conducted for the purpose of obtaining information (Leedy & Omrod, 2015). The researcher made a set of questions known as interviews guide to be asked for people to the active construction sites. The interview was conducted on site by site.

3.7. Study population

The study population is a set of people, services, elements and events, group of things or households that are being investigated or that a research is concerned (Morrison, 2010). The population size for this study will be 9100 including 9,095 workers from 45 selected active construction sites in Gisozi sector, 1 engineer at sector level, 3 engineers at district level and 1 engineer at Rwanda Housing Authority.

3.8. Data collection techniques and sample size

This section highlights sampling techniques used to pick the sample from a larger population and simple size used in this study

3.8.1. Sampling technique

Sampling techniques provides a range of methods that help to reduce the amount of data to be collected by considering only data from subgroup rather than all possible case elements (Saunders, et al., 2016). Sampling technique is the methodology that is used to select the sample from a larger population (Berg, 2009). For the purpose of this study, respondents were selected using simple random sampling and purposive sampling technique. Simple random sampling technique is nonprobability sampling technique where all respondents have an equal and independent chance of being included in the sample. The population on active construction sites in Gisozi sector were selected using simple random sampling technique and purposive sampling techniques. Purposive sampling technique was used to select engineer at sector level, district level and at Rwanda housing level.

3.8.2. Sample size

Sample size is a subset of the entire population identified. This comprises of certain members selected from the total population. A sample size is a small group of cases drawn from and used to represent the large group or whole population under investigation (Sekaran, 2005). The study has only considered the population on active construction sites randomly will be selected in 45 active construction site for data variation purposes where every people in population taken, has equal chance of being selected as respondent. Each people within the sample size have been systematically surveyed where only five workers on site will be interviewed as a representative of all site workers. To collect a representative sample size of people, the researcher will use the formula Yamane, (1967) to determine sample size,

$$n = \frac{N}{1 + N(e)^2}$$

n = sample size N= total population e = Margin error rate =10%

$n = \frac{9{,}095}{1+9{,}095\ (0.1)^{\ 2}}$ = 98.91245 approximately equals to 99 respondents.

The sample was composed by 99 respondents selected from active construction sites which were selected using simple random sampling technique.

3.9. Data processing and analysis

Collected data were sorted, edited, coded and tabulated for analysis. During this process, the data collected were transformed into meaningful information for easy interpretation and understanding. Hence, the data were analyzed by arranging and organizing them properly so as to be easily interpreted. The following steps were used in data processing and analysis.

3.9.1. Data processing

Data processing is generally the collection and manipulation of items of data in order to produce meaningful information. This research project processed data through editing, coding and tabulation in order to gather quality information to be used in this research project.

3.9.1.1. Editing

Editing refers to the process where errors in complicated answers are identified and eliminated whenever possible (Robson, 2002). Editing was used to check completeness, accuracy, uniformity and comprehensive of data collected. The major aim of editing was to discover mistakes made during the field study, to monitor accuracy and find out whether there are some unfilled spaces in questionnaire guide.

3.9.1.2. Coding

Coding is a process of summarizing data by classifying different responses, which was made into categories for easy interpretation and analysis (Kakooza, 1996). The purpose of coding in surveys is to classify questions into meaningful categories so as to bring out their essential patterns. In coding the questions numbers were used. This will be used in this study to summarize data by classifying the different respondents into categories for easy treatment.

3.9.1.3. Tabulation

Tabulation is a simple process of counting the number of observations that are classified into certain categories (Kakooza, 1996). Tabulation consisted of putting the data into some kind of statistical tables such as percentages occurrence of the responses to particular question and their calculated percentages were done by the researcher in order to present findings in a clear way.

3.9.2. Data analysis

The act of testing hypotheses stated in this research, the descriptive statistic will be used in order to find out the relationship between the impact of variables of the subject stated as independent variable and dependable variable. There is also an application of value judgments in the interpretation of a variety of responses or observations as qualitative measures in data analysis. Discussion and observations are complemented based on value given in the study as an addendum to analyzing quantitatively (Dickson, 2012). The Microsoft excel was used to determine frequencies in order to discover the degree of occurrence to each variable. The study analyzed inferential statistics using Pearson correlation to determine relationship between variables. Tables were used to present findings.

CHAPTER 4 THE RESULTS AND DISCUSSIONS

4.1. Introduction.

This chapter is all about results and findings based on the methods used in this study and those methods are necessary to accomplish and to describe all items needed to make this study. According to this chapter, all results that obtained were represented in this chapter. In gathering useful information in this research interviews and Questionnaires were used.

4.2. Identification of surveyed respondents

The surveyed respondents of this study were classified in relation to their gender, marital status, education level, and occupation.

4.2.1. Identification of surveyed respondents by gender

The surveyed respondents under this study were given equal opportunity either male or female participated actively in providing responses. There was enough freedom to the respondents in answering the research questions, except the instructions shown in the questionnaire which shows a symbol to be used to select a correct answer

Table 2: Distribution of surveyed respondents by gender

Gender	**Frequency**	**Percentage**
Male	52	53%
Female	47	47%
Total	99	100%

Thus, 53 respondents who are 53% were male, while 47 respondents who are 47% were female. The researcher found that male was willing to answer the questionnaires more than female that's why the results show that a large number were male. This is because male in Gisozi Sector are then ones who often found working on the construction sites and deals with construction material management.

4.2.2. Identification of surveyed respondents by marital status

The researcher surveyed respondents in relation to their marital status in order to investigate the different marital status among them.

Table 3**: Distribution of surveyed respondents by marital status**

Marital status	**Frequency**	**Percentage**
Single	30	30%
Married	51	52%
Divorced	18	18%
Total	99	100%

In this study, 30 respondents who are 30 % were single while 51 respondents who are 52% were married while 18 respondents who are 18% were divorced. The results show that the married people were eager to answer questionnaires because mainly married people are many in Gisozi Sector construction sites than single and divorced.

4.2.3. Identification of surveyed respondents by education level

The researcher surveyed respondents in relation to their education level in order to investigate the education level among respondents and their understandings on the impacts of construction materials management projects on the project in Gisozi Sector / Gasabo district

Table 4**: Distribution of surveyed respondents by education level**

Education level	**Frequency**	**Percentage**
Illiterate	3	3%
Primary	17	17%
Secondary	47	48%
University	32	32%
Total	99	100%

In this study, 3 respondents who are 3 % were illiterate, 17 respondents who are 17% has primary level, 47 respondents who are 48 % has secondary level while 32 respondents who are 32 % has

university level. The researcher surveyed the respondents in relation to their education levels in order to know their understandings on the impacts of construction materials management projects on the project in Gisozi Sector / Gasabo district. The results show that most of construction site workers have attended schools and they are able to read and write

4.2.4. Identification of the surveyed respondent by age

The researcher surveyed respondents in terms of age in order to know the age of respondents, the age categories were 21-30, 31-40,41-50 and 51 and above.

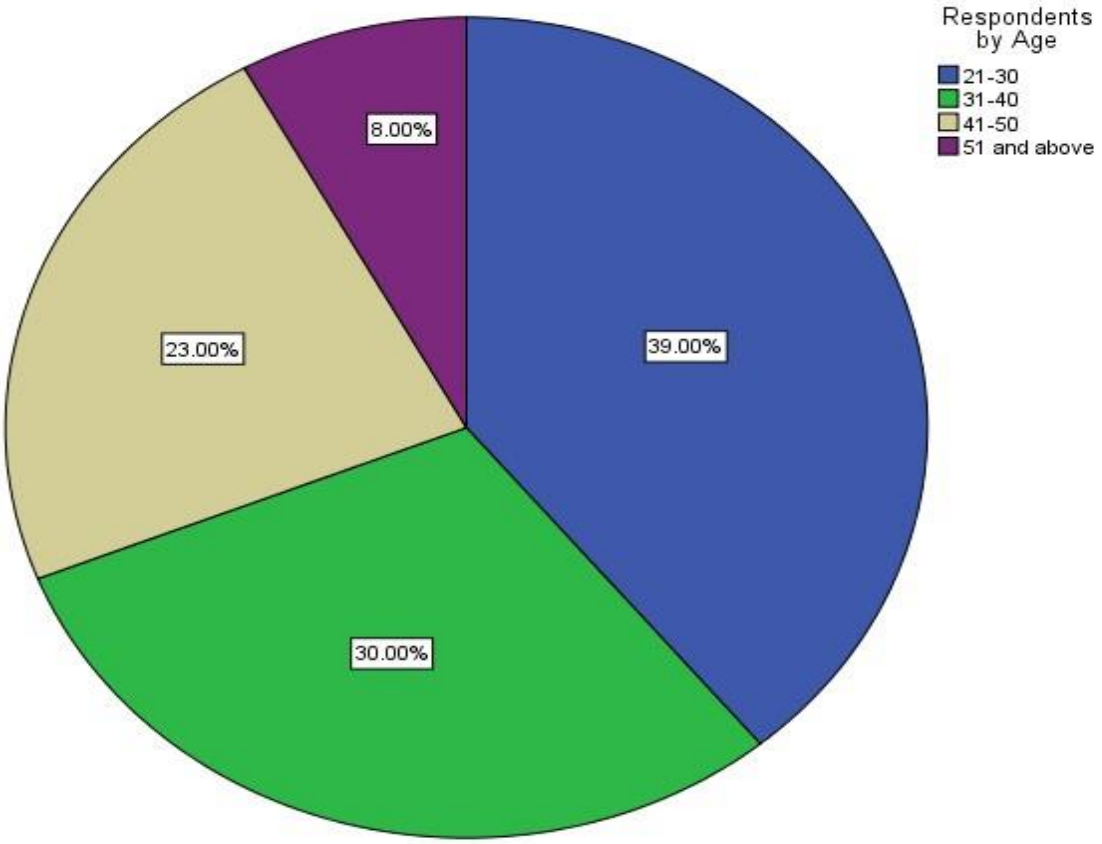


Figure 3**: Distribution of surveyed respondents in terms of age in order to know the age of respondents.**

The figure above represents the respondents by age. Whereby 38 respondents who are 39% were in the age of 21-30 secondly, the 30 who are 30% respondents were in the age of 31-40. Thirdly, the 23 respondents who are 23% were in the age of 41-50. Finally, the 8 respondents who are 8% were in the age of 50 and above. According to results the respondents with in the age of 21-30

were many since in Gisozi Sector construction sites people who mainly works on construction sites were around 21-30 ages.

4.3. **Presentation of the major findings**

This section deals with the presentation, interpretation and discussion of the real results from respondents interviewed face-to-face including the data collected through questionnaire for respondents' view related to conduct the impact of effective materials management on construction site performance in Gasabo district / Gisozi sector. After presenting the identification of respondents, the data from key informants were supplemented by literature review and this helped the researcher to interpret and discuss the data from the respondents of the study.

4.3.1. The performance level of existing materials management process on construction project sites in Gisozi Sector**.**

In this section, this study was examining the level of existing materials management process on construction projects in Gisozi Sector. According to the data collected through interviewing knowledgeable and experienced people who works in construction sites including site engineers, contractors, foreman, material keepers and many more, show that material management comprises of a group of procedures that need to be integrated, administered, managed and assembled. Below are some of those process followed on material management in this sector and their performance level.

4.3.1.1. Process of site construction materials management in Gisozi Sector.

The findings from the respondents of the study, the process of site construction materials management in Gisozi Sector is characterized by Material need generated from site, Material ordered in the store, Indent is generated, Check availability in the store, Check for the balance items, Vendor selection from the approved list of vendors from the client, Material inspection from the received stock, Rejection of the unacceptable stock and Issue of material to the concerned department.

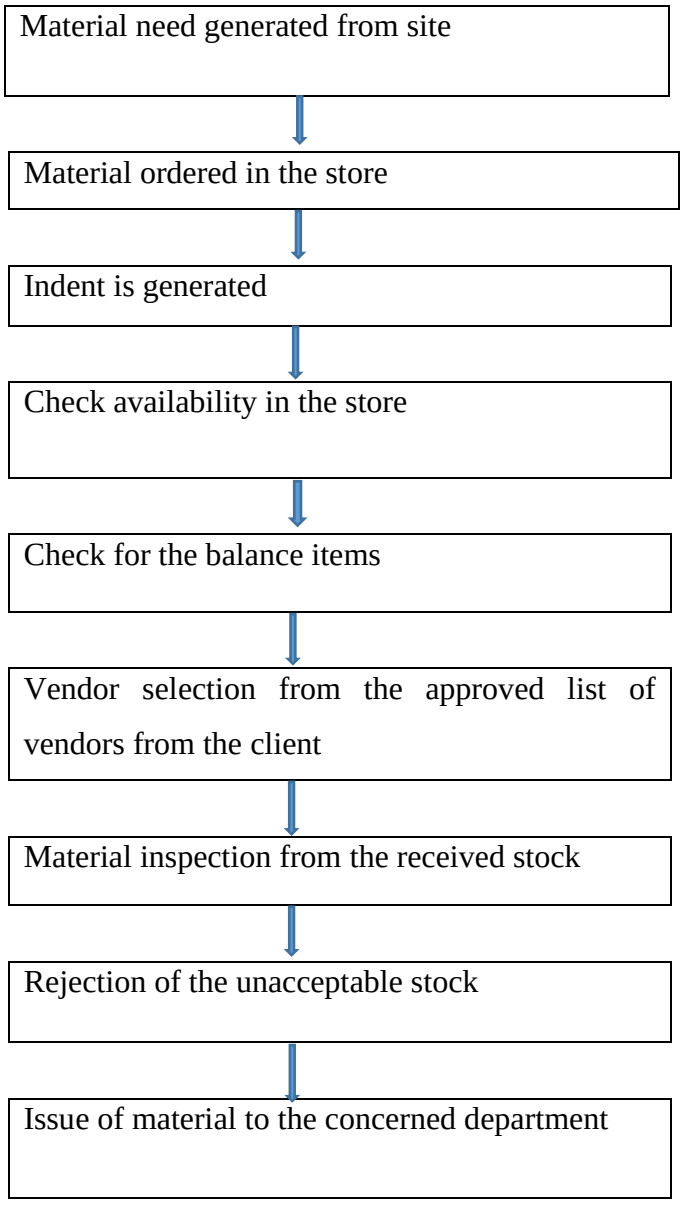


Figure 4**: Process of site material management**

4.3.1.2. Components of construction material management

The results from the respondents show that the components of construction material management in Gisozi sector are; planning and scheduling, monitoring and controlling, organization and personnel, Procurement, Delivery, Storage and Storage facilities, Usage and Surplus and Waste control, Efficient materials planning, Buying or Purchasing, Procuring and receiving, Storing and inventory control, Supply and distribution of materials, Quality assurance, Good supplier and customer relationship, Improved departmental efficiency

Table 5: Components of construction material management

Statement	Frequency	Percentage %
Planning and Scheduling	99	100
Monitoring and Controlling	99	100
Organization and Personnel	99	100
Procurement	99	100
Delivery	99	100
Storage and Storage facilities	99	100
Usage and Surplus and Waste control	99	100
Efficient materials planning	99	100
Buying or Purchasing	99	100
Procuring and receiving	99	100
Storing and inventory control	99	100
Supply and distribution of materials	99	100
Quality assurance	99	100
Good supplier and customer relationship	99	100
Improved departmental efficiency	99	100

Material planning

Some of The respondent's answers showed that material planning in theirs sites involves the quantification, ordering and scheduling of materials and activities to be carried out. In this regards, the usage of appropriate material management stimulates higher production and profitability to any construction companies and this can render them to high level of performance.

Quality of service

Contractors said that its must in their site to choose and undertake procurement adequately taking into consideration construction materials. It is always recommended to carry out a research and assessment of various material properties to see whether they are compatible with various sites of buildings they about to work on. Procurement of construction materials must be delivered after approval of knowledgeable quality surveyor.

Logistic

Site engineers said that another important procedure of material management used on their site refers to the movement and comprises of planning, execution and follow up and storage of all materials from raw to the finished ones to attain the expectation of client. This is helpful to the formulation of an effective construction site layout that may afford easy accessibility and transmitting materials in the site.

Storage and inventory management

Respondent's answers showed that its activities related to holding material and the process of counting as its moves on the site so as to ensure how materials are being used and keep track of it. Adequate guarantee during storage is sometimes not considered and this lead to low quality of materials or its decline and worsening. It was proposed that the storage are necessitates for enclosing, cleaning and drying adequate air condition and for some material had to be stacked on pallets and without humidity.

On site transportation

In Gisozi sector, construction site on site transportation hold important role for achieving effective material management and planning of access and transmission of material on the construction site are elements that necessitate to be the focus for adequate material management.

Waste management

Further, the control of material wastage is very important in controlling the construction cost. Contractors specifies that material waste is estimated to nine percent by weight in construction sector and between 20 and 30 percent of purchased materials in Gisozi sites. Material waste emanates from planning, procurement, material handling and operation procedures. The construction materials wastage is not the same with the value of material provided and approved on the construction site. Material waste was seen as a main and growing issue in construction project in this sector and it may lead to ineffectiveness of construction project delivery. Appropriate control will be helpful to the enhancement of production and can ameliorate waste control in the construction.

Project performance is related to the end product objective in terms of success and realization the prerequisites as well as satisfaction of clients. Therefore, project success lead to its sustainability and durability in terms of obtaining a competitive advantage, improvement of reputation for a firm, enhancing market share and attaining certain level of profitability. Project manager whose individual profile was to the ideal project manager for a specific project type was performance in effect on customer. In Gisozi Sector construction site the performance level is achieved when the mentioned above procedure of material management are executed.

4.3.2. The roots cause of ineffective materials management in Gisozi Sector.

According to the results obtained from the questionnaires transport complexities 12 %, waste 7%, Inadequate material handling on site 10%, Improper working design 22 % and Inadequate material delivery 20% all lead to the ineffective material management in most of Gisozi Sector. After obtaining the results from Questionnaires we conducted the site visit to get more visible picture on the issue. In brief discussion regarding the site visits the general pertaining issues in material management is inability for ordering on time which lead to the delay in project implementation, wrong direction of delivering, over ordering, inadequate materials or stealing materials and double handling of material due to inadequate.

Moreover, site visits conducted in Gisozi Sector showed that the problems could emerge owing to error, particularly due to some construction firm still focus on manual methods for management

that comprise paper based methods. Findings under this research revealed the greatest impediment to the material management are associated with challenges site and site logistics concerning the material handling and allocation and order and provision of construction materials on the most of Gisozi site. Another evidence from site visits shows that the planning, procurement, vender choice and execution steps if not done in appropriate ways, they can bring huge problems to the material management. In light with the above information, the correlation between those problems and ineffective material management has been revealed in the below bar chart.

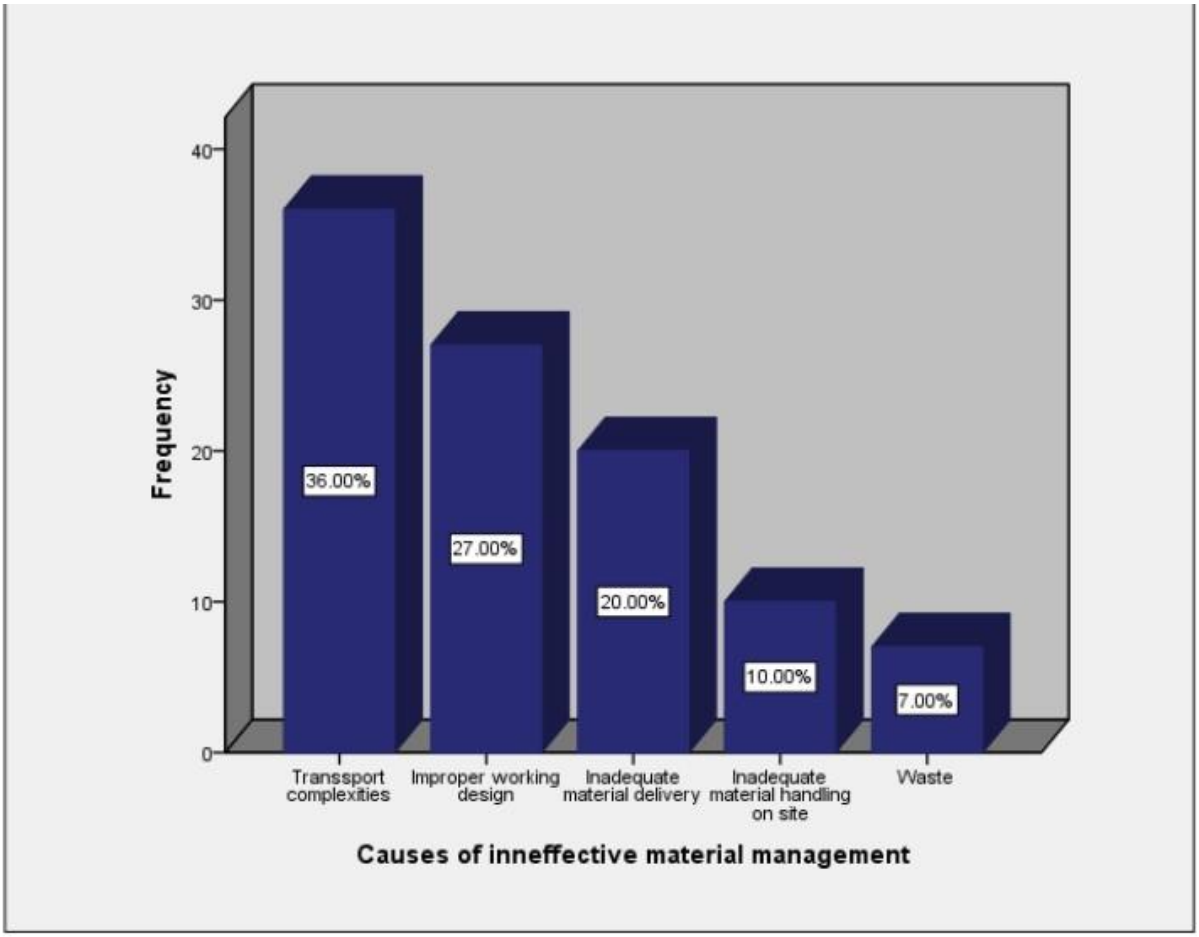


Figure 5: The chart showing the causes of ineffective material management

4.3.3. The relationship between construction materials management process and project delivery in terms of cost overrun and delay in Gisozi Sector

From the Questionnaires answered by the respondents who works in construction sites in Gisozi Sector. It has been proven that when the construction materials are not well managed the cost

overrun may occur. Cost overrun occurs when any unexpected incurred cost that causes a project to exceed the overall budget you have agreed with your client. This is because improper construction materials management may lead to excessive use or over use of some materials which on other hands cause to buy new ones. All of this led at the end of project to cost overrun.

On the other hand, construction project delay has a big connection with construction materials management because from the Questionnaires Most Site engineers confirmed that there are improper construction materials there may be late in materials procurement, purchase and delivery as matter of fact when the ones in charge are careless and report they need materials when there are none lest on the site which result in long time procurement, purchase and delivery of those materials. All of those results in Delay of the construction project. The delay in construction project occurs when there is extra time required or incurred either beyond the stipulated completion date or beyond the date that the project stakeholders agreed upon for the completion of the project.

It is of great importance to make sure that the construction materials are well managed otherwise it may lead to cost overrun or delay, which is both bad for the construction firm executing the project as it may lead to total loss of that firm and unsatisfied the client. 70% of respondents agreed that construction material management may influence cost overrun or delay while 30 % disagree that construction material management influence project cost overrun or delay.

CHAPTER V: CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011). According to Mahavidyalaya et al. (2011), material management is an important aspect of project management. This research examines the implications of building materials management, job quality, and project profitability in the Gisozi construction industry. The study's findings, which include the following claims, proved the significant impact that good construction materials management has on minimizing the output of material waste on any construction project site: Effective construction materials management simplifies the implementation of a construction materials waste management policy and the accounting for material waste; managing site waste management plan cost data; managing waste-related KPIs; positively impacts the waste management plan and reduces waste quantities.

Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011). Based on these data, it can be stated that proper material management in construction projects would reduce waste generation, improve building quality, and result in maximum profitability for construction contractors. According to the study, effective construction materials management has a moderate effect on the quality of building projects in the Gisozi Sector, as stated below: Effective construction materials management has a favorable impact on the quality of some of the materials on site; it establishes the quality standards set by management and makes it easy to conduct materials quality audits. Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011). Thus, material management is an essential part of project management, as stated by Mahavidyalaya et al. (2011).

Effective building materials management was discovered to offer both high and moderate impacts on profitability in the Gisozi Sector's construction industry. These statements were: Effective construction materials management reduces waste, increasing profitability; and Effective construction materials management on project sites leads to improved productivity in construction projects and sustainable material accounting, increasing profitability.

5.2. Recommendation

As to achieve maximum benefits in conduct the impacts of construction materials management projects on the project in Gisozi Sector, we can recommend the following:

- We recommend our fellow students who are going to make dissertation right after us, to elaborate this topic of conducting the impacts of construction materials management projects on the project sites in Gisozi Sector because I don't get enough time to go in deeply.
- We recommend all people who are in charge of construction material management, to elaborate this project in the process of improving the management of construction materials on site or creating new one.
- It is, therefore, recommended that the construction industry in Gisozi Sector should collaborate with government agencies to develop guidelines for preparing a waste management plan for the construction industry and ensure that top management adopts the culture of training and developing their staff about new managerial tools and techniques for site materials management.

- For construction materials management characteristics to achieve on site materials managers should be encouraged to use construction materials management systems to save effort, time and cost, and to achieve more accurate results

- Materials managers should acquire the requisite knowledge, skills and ability to implement effective materials management techniques on sites, top management of contracting firms can put in incentives for their staff members to attend training courses or in-service training in construction materials management and its applications.

REFERENCE

Albert, I., Shakantu, W., & Ibrahim, S. (2021). *THE EFFECT OF POOR MATERIALS MANAGEMENT IN THE CONSTRUCTION INDUSTRY : A CASE STUDY OF ABUJA , NIGERIA*. *28*(1), 142–167.

Baiburin, A. K., & Baiburin, A. K. (2019). Errors , Defects and Safety Control at Construction Stage ScienceDirect ScienceDirect ScienceDirect Errors , Defects and Safety Control at Construction Stage Errors , Defects and Safety Control at Construction Stage. *Procedia Engineering*, *206*(November), 807–813. https://doi.org/10.1016/j.proeng.2017.10.555

Bolden, J., Abu-lebdeh, T., & Fini, E. (2013). *UTILIZATION OF RECYCLED AND WASTE MATERIALS IN VARIOUS CONSTRUCTION APPLICATIONS*. *9*(1), 14–24. https://doi.org/10.3844/ajessp.2013.14.24

Chitte, C. J. (2018). Study on Causes and Prevention of Cracks in Building. *International Journal for Research in Applied Science and Engineering Technology*, *6*(3), 453–461. https://doi.org/10.22214/ijraset.2018.3073

Environmental Impact Of Construction Materials And Practices. (2016). *January*. https://doi.org/10.13140/RG.2.1.2581.0001

Eze, E. C. (2020). *Assessment of materials waste in the construction industry : A view of Construction Operatives , Tradesmen and Artisans in Nigeria Assessment of materials waste in the construction industry : A view of Construction Operatives , Tradesmen and Artisans in*. *September*. https://doi.org/10.9790/1813-0604013247

Gutti, M. B. (2018). *A Feasibility Study on Waste Utilization in Construction and Review of Waste Generation*.

Journals, I. R. E. (2019). *A Material Management in Construction Project Using Inventory*

Management System. *3*(5), 52–58.

Mahavidyalaya, B. V., Vidhyanagar, V., & Vidhyanagar, N. V. (2011). *CONSTRUCTION MATERIALS MANAGEMENT*. *May*.

Nairobi, O. (2005). *MATERIALS MANAGEMENT ON CONSTRUCTION PROJECTS : A CASE STUDY OF CONCRETING WORKS ON SITES IN NAIROBI*.

Nama, P., Jain, A., Srivastava, R., & Bhatia, Y. (2015). Study on Causes of Cracks & its Preventive Measures in Concrete Structures. *Journal of Engineering Research and Applications Www.Ijera.Com*, *5*(2), 119–123. www.ijera.com

Oladinrin, T., Ogunsemi, D., & Aje, I. (2012). Role of Construction Sector in Economic Growth: Empirical Evidence from Nigeria. *FUTY Journal of the Environment*, *7*(1), 50–60. https://doi.org/10.4314/fje.v7i1.4

Olanrewaju, R. A., & Awodele, O. A. (2020). Effects Of Building Maintenance And Infrastructural Facilities On National Economy: Case Study Of Harmony Housing Estate, Ilorin, Kwara State. *Researchgate*, *February*.

Ronald, K., Mongute Nathan, N., & Jaya, D. S. (2020). Effects of Materials Management on Performance of Selected Construction Projects in Rwanda.

Tuma, M. Al, & Ghasemlounia, R. (2021). *Effects of Construction Materials to Achieve Sustainable Buildings*. *September*. https://doi.org/10.31033/ijemr.11.1.4

Veraart, F. (2018). *Building Materials and Construction : Constructing a Quality of Life*. https://doi.org/10.1007/978-3-319-76696-6

Appendix 1**: Questionnaire survey addressed to the respondents.**

IMPACTS OF EFFECTIVE CONSTRUCTION MATERIALS MANAGEMENT ON PROJECT SITES.

Dear respondent, we are the student of ULK Polytechnic Institute, Option of construction technology, department of civil engineering. As part of our academic requirements, we are undertaking a research on impacts of construction materials management on project sites and we would like to request you to provide the answers to the proposed question and all your views will be used strictly for research purpose.

Section A: Biographical information of participants

Answering each question please put a tick on the right answer.

1) Kindly indicate your gender.

- ○ Female
- ○ Male

3) Kindly indicate your age group.

- ○ 18-30 Years
- ○ 31 -40 Years
- ○ 41-50 Years
- ○ 51-60 Years
- ○ Above 60 Years

4) Indicate your Level of Education

- ○ Secondary school
- ○ University level
- ○ Masters

5) Indicate your job position

- ○ Project manager

- ○ Project engineer
- ○ Quantity surveyor
- ○ Construction inspector
- ○ Land surveyor

Section B: Open questions

Please tick the most appropriate

1) How was the supplier for each of the materials identified?

Identification of supplier	Ballast	Sand	Cement	Steel	Ready mix Cone.
Open tendering					
Introduction by third party					
Marketing by sales men suppliers					
Contractor same supplieras (own supply)					
Others (specify)					

2) For each of the materials, how many suppliers were identified?

Material	No. of Vendors
Ballast	
Sand	
Cement	
Steel	
Ready mix concrete	

3) Which of the following was used in the selection of vendor/supplier for the materials?

Criteria for selection of supplier	Ballast	Sand	Cement	Steel	Ready mix concrete
Past Success with supplier					
Good Price					
Geographical location					
Credit offer					
Quality assurance programme					
Bargaining agreement					
Schedule adherence					

4) For each of the materials, how are the orders placed?

Placement of orders	Ballast	Sand	Cement	Steel	Ready mix cone.
1 Telephone					
Written order					
Verbally through agents					
Others (specify)					

5) Is there any physical measurement/counting of quantities of material at purchasing and delivery on site?

Physical measurement	Ballast	Sand	Cement	Steel	Ready mix cone.
Yes					
No					

6) If no, how do you ensure that the right quantity and quality of materials are supplied at the right time and place? .....

7) Are there any disagreements with the suppliers from any of the sources outlined below for the respective materials?

Source of disagreement	Ballast	Sand	Cement	Steel	Ready mix cone.
Price					
Quality					
Quantity					
Time delivery of					
Damage of materials					
Others (specify)					

8) How are the materials delivered and transported on site?

Method of delivery	Ballast	Sand	Cement	Steel	Ready made concrete
Pick up loads					
7 ton lorries and above					
14 ton lorries and above					
24 ton lorries and above					
Trans mixers					
Others (specify)					

9) How are the materials stored?

Storage	Ballast	Sand	Cement	Steel
Silos				
Stores				
Yards on site				
Central yard off site				
Others (specify)				

10) What are the causes of material shortages on site?

	Theft

☐	
☐	Poor workmanship
☐	Underestimation
☐	Late ordering and/or delayed delivery
☐	Lack of finance
☐	Others (specify).....

11) How are the shortages dealt with?

……

……

……

12) During and prior to the concreting, was there any wastage of materials due to any of the following?

Source of Wastage	Ballast	Sand	Cement	Steel	Ready cone.
Discrepancy in specifications					
Wrongful purchase					
Wastage in transportation					
Damage on site					
Deterioration					

Poor workmanship leading to repeat of works					
Others (specify)					

13) What measures were taken prior to and during concreting to minimize wastage?

……

……

……

14) What is the performance level of existing materials management process on construction project sites in Gisozi sector)?

……

……

……

15) What are the roots causes of ineffective materials management in Gisozi sector?.

……

……

……

16) What is the relationship between effective construction materials management process types and project delivery in terms of cost overrun and delay in Gisozi sector)?

……

……

……

Thank you!