

Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise Addis ababa projects



Abeselom Yared Shiferaw

A Thesis submitted to: Department of Civil Engineering, School of Civil Engineering and Architecture

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Civil Engineering (Specialization in Construction Engineering and Management)

Office of Graduate Studies

Adama Science and Technology University

January, 2024

Adama, Ethiopia

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DECLARATION

I hereby declare that this Master Thesis entitled “Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise Addis Ababa projects “is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

Abeselom Yared Shiferaw

Name of student

Signature

Date

RECOMMENDATION

I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled “Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise Addis Ababa projects “ prepared under my guidance by Abeselom Yared Shiferaw submitted in partial fulfillment of the requirements for the degree of Master’s of science in Civil Engineering (Specialization in Construction Engineering and Management).

Therefore, I recommend the submission of revised version of the thesis to the department following the applicable procedures.

Meseret Getnet (PhD)

Major Advisor

Signature

Date

APPROVAL SHEET

I/we hereby certify that all the correction and recommendation suggested by the board of examiners are incorporated into the final thesis entitled “Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise Addis Ababa projects “by Abeselom Yared Shiferaw.

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We, the undersigned, members of the board of Examiners of the thesis by Abeselom Yared Shiferaw have read and evaluated the thesis entitled “Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for a trial fulfillment of the requirement of the degree of Master of Science in Civil Engineering (Construction Engineering and Management).

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ACKNOWLEDGEMENT

First and foremost, I am thankful to God for giving me health, wisdom, knowledge and above all strength during different challenges. I wish to express my sincere gratitude to my advisor Meseret Getnet (PhD) for the assistance provided in terms of guidance, constructive criticisms, suggestions and encouragement throughout the research process. His extensive knowledge on various relating aspects added value not only the research, but also in the perspective of my career in general.

I am so much grateful to all the questionnaire respondents and interviewees for participating and sharing knowledge while spending their precious time to make this research successful.

I would also thank all my family members especially my father Yared Shiferaw, my brother Nebyiuleul Yared, my aunt Shewaye Bihone and my girlfriend Rahel Tesfaye and my second mother Mistlal Desta for their constant moral support and prayers throughout the entire duration of my studies. Their words of encouragement, love, and inspiration, to me never failed to keep me going even through the hardest of times and it is here that I am expressing my sincerest gratitude to them.

Last but not least, I would like to express my deepest gratitude to my mom Genet Tadesse even though she isn't alive today she was the main person that made me start the course and I am forever grateful for her love and support .

ABSTRACT

Construction material management and proper utilization is an important element in project planning and control, and minimization of waste should be given adequate attention. It is also a vital process which can maximize or minimize the project performance. The purpose of this paper is to investigate the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise Addis Ababa. A comprehensive literature review was carried out to find the factors affecting construction material management process ,the effect of poor construction material management on project performance and techniques used to improve construction material management in building construction sites. To achieve the intended objectives mixed design method is used . Thus ,a total of 143 questionnaires were distributed to construction professionals like project managers , construction engineers , office engineers , site engineers and quantity surveyors working in defense construction enterprise building construction sites in and around Addis Ababa. Descriptive statistical analysis and multiple regression analysis were applied by using SPSS v-26. Under the material planning stage inadequate and incomplete design and specification is the highest ranked factor. Under the material purchasing sub factor time consuming and inefficient procurement process for construction material is the highest ranked factor. When looking into material storage and inventory control improper handling of construction materials is the highest ranked factor and finally under the material supply and distribution not enough material quantity inspection verification control is the highest ranked factor..Therefore from the above results it can be concluded that there should be a well organized material management policy and strategy So, to come up for a deep and detailed academic and practical by companies research of the improvement process in construction material management proves to be necessary in order to orient research developments on this topic.

Keywords: Material Management, Project Performance, Functions of material management, Process of material management

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LIST OF ACRONYMS

DCE:-Defense Construction Enterprise

ICT: - Information Communication Technology

RFID: - Radio Frequency Identification

MTO: Materials Takeoff

JIT: Just in Time

EOQ: Economic Order Quantity

SPSS: - Statistical Package for the Social Science

ERP: - Enterprise Resource Planning

RQs: - Research Questions

ANOVA: - Analysis of Variance

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

In construction project, construction material is main factor of cost as total cost of installed material may be more than half of the total cost of project. The goal of material management is to ensure that the materials are available at their point of use when needed hence, efficient procurement of material represents a key role in the successful completion of the work(Deepak & Mukesh, 2018).

Materials management is a process for planning, executing and controlling field and office activities in construction. The goal of materials management is to ensure that construction materials are available at their point of use when needed. The materials management system attempts to insure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost. Materials management is the system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, are obtained at a reasonable cost and most importantly are available at the point of use when required. Thus Materials management is an important element in project management. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs(Khyomesh & Chetna, 2011).

Successful completion of projects requires all resources to be effectively managed. Considering that for a typical construction project, 10% to 15% of total cost is for engineering design and 50% to 60% is for equipment and materials, it is obvious that almost half of project cost consists of materials cost. It is clearly important to manage all materials from design to construction stage in every project. Material management is a function that significantly contributes to the success of a project. As projects grow in scale and complexity, material management is required really to use them. It is also the process that coordinates planning, assessing the requirement sourcing, purchasing, transporting, receiving and inspection, storing, handling and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of materials.

One of the primary focuses of a contractor is to deliver a project safely while maximizing profit(Nann& Aye Mya, 2014).

Contractors need to survive, and this is based on the profit realized as a result of their expertise. Poor materials management can also result in substantial, but avoidable costs during construction. This could result in contractor's use of insufficient materials and eventually non-conforming to specification, stemming from inadequate quantities of material usage for production. There are grave consequences that could result from poor materials management, which could result in insufficiency of material for production on site, forcing contractors to produce non-conforming products(Olatunji& John, 2013).

As Construction projects become more competitive, new management techniques are necessary to make construction projects more productive and thus more cost effective. One area of concentration to establish projects of shorter duration and less cost is materials management. Construction professionals are recognizing the need to focus on the materials management process as a proactive identifiable entity that has a significant impact on the cost of construction(Asienga, 2005).

Construction projects involve a number of inter-related and inter-dependent activities. Present days, due to fast changing environments impose number of legal, financial, logistic, ethical and environmental constraints. They interact economically, socially and technically within the organization and systems. These projects employ huge resources, but they raised difficulties, risks and uncertainties. These explore series of problems concerning resources alike 'where they are going to arise from', 'how far they are required', 'where they should be housed', 'when they should be inducted at site', 'when to mobilize' and 'how to optimize their utilization'. Due to the nature of resource-driven in construction management, the management of resources is really a difficult task. The project manager should develop an action plan for controlling and directing resources of machines, workers and materials in timely and coordinated manner in order to deliver a project within the frame of limited time and funding(Ramajogi&Asadi, 2017).

1.2. Statement of the Problem

Current materials management practices in the contractor companies in construction industries are performed on a fragmented basis with unstructured communication and no clearly established responsibilities between the parties involved. This fragmentation creates gaps in information flow, which affects the decision making process and lead to delays in material ordering and receiving, among other problems (Fuad, 2017).

Most of the construction projects are executed with cost and time over-run due to dispute and claims. This may arise where the quantity of materials used in construction is higher than that from materials schedule preapproved from the bill of quantities. This is because the percentage allowance used for material waste in estimate is based on the estimator's experience and guesswork. This can lead to losses or decline in profitability level of the contractor (Ramajogi&Asadi, 2017).

It is common to observe in Ethiopia the scattered equipment and assets out of the warehouse and in the office compound that at risk of theft. A large number of stocks of materials are stacked in the store which is seriously exposed to dust. Sometimes, the interruption of operations is happened due to the lack of raw materials inventories and there is damage and spoilage of materials due improper placement. Without proper material management construction projects suffer delays, cost overrun, construction waste and low productivity. Among the factors that contribute to poor project performance is due to shortage of materials occur in construction projects. Meaning that, the materials are not available when needed(Kalkidan ,2021).

Construction materials management is becoming a serious problem, especially on public building construction projects in Addis Ababa and no attention is given to such basic subject. Construction managers often ignore to identify and control material in the construction process, because mostly they forget its cost implication and delay to the project delivery(Ermias ,2109).

The construction project of defense construction enterprise reflects various problems ranging from delays on project completion time on most of the enterprise's projects execution/delivery, substandard work, disputes, to cost and time overrun and decrease on expected project profitability as a result of material shortage and wastages on sites, displacement of materials on sites, as well as poor accounting and security system of the concerned sites. Lack of materials not only causes delays, but a consequent decrease in productivity and resulting to cost overruns.

Lack of effective material management is one of the major causes of this problem. Non-compliance strictly with project bill of quantities, schedule of materials, specifications and construction program in material stock control practice is another contributing factor which tends gradually to decrease profitability of a project also often leads to extension of time respectively.

Besides that, the rate at which materials are being wasted due to improper management is becoming unbearable to the defense construction enterprise projects due to its effect on profit margin and proper usage of material to achieve quality job. Therefore, the overall intention of this study is to investigate the factors affecting material management practices on the construction projects site and its effect on project performance of Defense Construction Enterprise Addis Ababa projects.

1.3. Objectives of the Study

1.3.1. General Objectives of the Study

The general objective of the study is to investigate the factors affecting construction material management practices and its effect on project performance in building construction projects: the case of defense construction enterprise Addis Ababa projects.

1.3.2. Specific Objectives of the Study

- To explore the factors that affects the construction materials management in building construction projects.
- To assess the effect of material management on project performance.
- To assess the challenges faced in the implementation of construction material management on building construction projects in Defense Construction Enterprise.

1.4. Research Questions

Based on the stated problems that have set the context of this study, general and specific research objective would be drawn to guide the data gathering and analysis of this research. This generally seeks to address the question; assessing the construction material management practices in Building construction projects? Specifically, this study addressed in the following research questions;

1. What are the factors that affect the construction material management of building construction projects of Defense Construction Enterprise?
2. What is the effect of poor material management on project performance in DCE?
3. What are the challenges faced in using construction material management in defense construction enterprise building construction sector?

1.5. Significance of the Study

A major part of professional engineer's responsibility in building production management entails the selection, purchase, testing, storing and use of construction materials. As noted earlier, materials are a major expense in construction, thus the ability of contractor to manage his team and the flow of supplies are absolutely necessary for the successful project delivery and profit maximization.

This research is significant in that it may help to determine the problems behind proper materials management in DCE's construction project sites, so as to minimize against project delay and cost overrun. This research may help create a standard method of materials management based on size of construction site and to control cost of contract and materials wastage. It is not only desirable but necessary to undertake careful study of material management.

Furthermore, since proper materials management in the enterprise will benefit the firm in terms of increased profit margin, quick execution and reduce cost of the project. In addition, this study intends to provide some framework for the development of company policies and rules in the management of construction materials.

This brings the need for an assessment of materials management in DCE's construction project sites. This research could also be used as a reference material for others who might be interested to conduct similar studies in the enterprise or other enterprises in the construction industry.

1.6. Scope and Limitations of the Study

1.6.1. Scope of the Study

Defense construction enterprise is a grade one general contractor which is operating all over the country in different type of construction projects ranging from building and roads up to dams both government and private owned. These projects are located in Bahirdar ,Mekele , Harar , DireDawa , Zeawy , Gonder , Tarmaber,Afarand so on . But due to the vast geographical location difference between the different project sites, the study was also limited to building projects located in and around AddisAbaba.

1.6.1. Limitations of the Study

The main constraints and limitations that occurred during this study were the limitation of the number of construction projects in and around AddisAbaba which may affect the final outcome. Other limitations that happened during the study were lack of enough time to execute the study and financial limitations.

1.7. Organization of the study

Generally, the paper was organized into five chapters. The first chapter presents, introduction of the study, statement of the problem, and continued with the research questions, objective of the study, significance of the study, the scope of the study, and organization of the paper. The second chapter deals with the literature review and conceptual framework of the thesis. The third chapter contains research methods and methodology, which holds methods of data collection, data quality assurance, etc.

The fourth chapter enclosed the data presentation, analysis, and interpretation of the study. The fifth chapter summarized findings to make conclusions and recommendations.

1.8. Operational Definitions

Construction Industry: - The branch of manufacture and trade based on the building, maintaining, and repairing structures. This includes drilling and solid mineral exploration.

Construction material: - an article, material, or supply brought to the construction site by the Contractor or a subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies.

Material Management:-Material management is the process of planning, organizing, directing and controlling the flow of materials within an organization.

Material Utilization: - is the amount of a structure's capacity that is 'used up'. It can refer to the material's strength, stiffness, durability, and so on.

Project Performance:-The overall measurement of whether a project has met objectives and requirements of time, cost, quality, scope and schedule.

CHAPTER 2

2. LITERATURE REVIEW

2.1. Material Management

Material management can be defined as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material. Building materials account for 60 to 70 percent of direct cost of a project or a facility, the remaining 30 to 40 percent being the labor cost(Khyomesh&Chetna, 2011).Materials management is defined as the process to provide the right material to the right place on time and in the right quantity, in order to minimize the cost of a project .The main goal of materials management is to ensure a smooth flow of materials from the time the materials are ordered until they are used. In order to make materials management on site effective, a proper integrated materials handling process that includes the planning, identification, procuring, storage, receiving and distribution of material, should be in place (Albert et al, 2021).

Material management is a coordinating function responsible for planning and controlling materials flow, to maximize the use of the firm's resources and provide the required level of customer service. It can do much to improve a company's profit(Francis et al, 2020).Material management always related with time and cost, proper Management of materials makes the project economical along with prevention of time over run. Material management is cyclic process with common procedures such as purchase, procurement, inventory control, stock management, stock retrieval and record maintenance (Harsha&Pulidindhi, 2017).

Materials Management is a means to optimize performance in meeting up with customer service requirements at the same time increasing profitability by minimizing costs and making the best utilization of available resources. The basic goal of Materials Management as explained by and, is to make sure that the right item is purchased and made available to the manufacturing operations at the right time, at the right place and at the minimum cost.

According to, materials management is a view which brings about the responsibility for deciding the manufacturing requirement that is setting up the manufacturing processes and purchasing, storing and dispensing materials. Materials management provides an integral system approach to the proper arrangement of materials activities and the total material price. They see it as something that stand as assigning to a single operating department all main activities, which contribute to the price of materials. The goal is to enhance performance of materials systems, as opposed to sub-optimizing the performance of sub-individual operating units that are fragment of the material system(Cross ,2019).

Materials management embraces all activities concerned with designing or manufacturing the product. Information, stores and stock control, inspection of the material received in the enterprise, transportation and materials and many other functions. In the words of bethel, its responsibility end when the correct finished product in proper condition and quality passes to the consumer(Ashika, 2014).

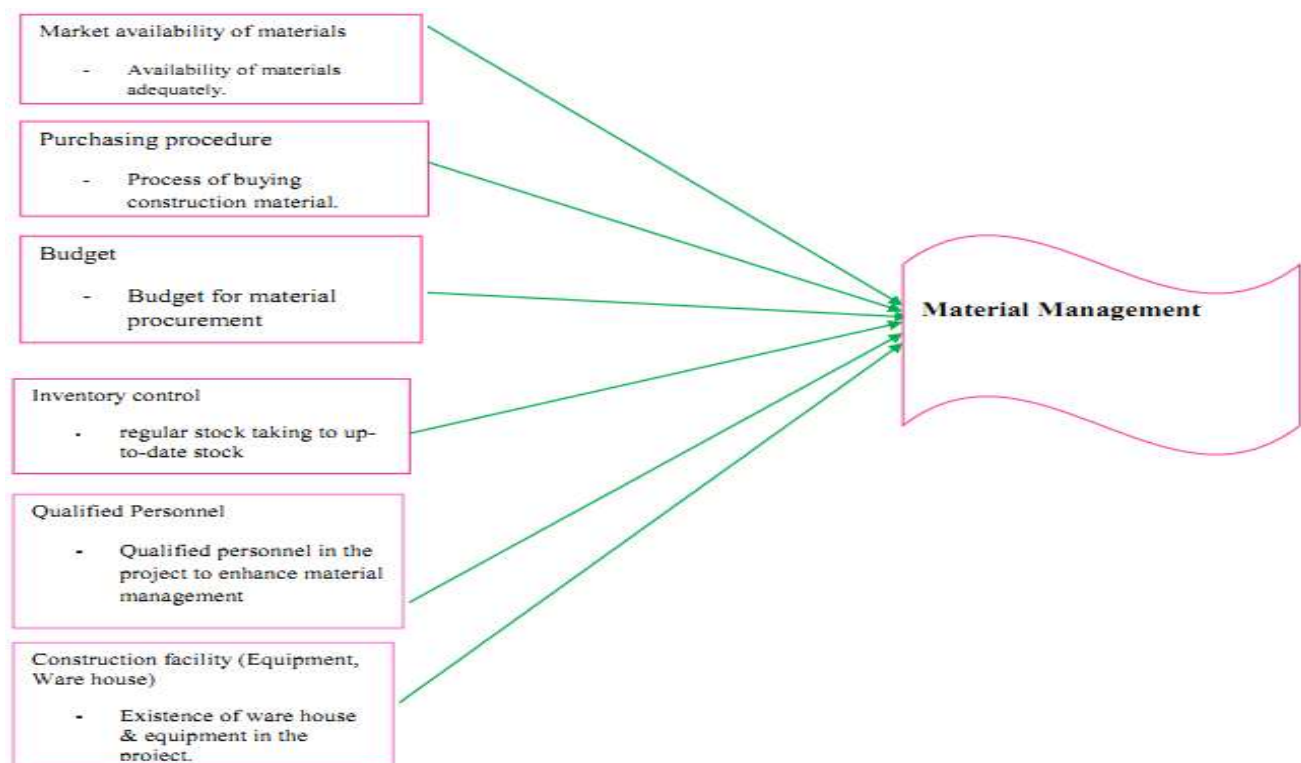


Figure 2.1Activities of material management, Source (Sufyan, 2020).

2.2. Functions and Process of Material Management

The “Functions Approach” to management considers management functions as its most fundamental. The indisputable managerial functions are planning, organizing and controlling. A fourth function is the role of the manager in starting the system and keeping it together. For some it is directing and for others it is leading. Staffing has also become a significant function in the utilization of human resources. Co-ordination, on the other hand, began as a separate function but it is now considered an integral part of the entire management process (Asienga,2005).

According to (Bamidele&Faestus ,2016) and (Asienga,2005) the functions of material management are :-

2.2.1. 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. Adequate material management may involve complex communication mechanisms, education activities and training programs that must be established early in the 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. 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(Asienga,2005).Materials requirement planning is technique used to determine the quantity and timing requirements of dependent demand “materials used in the construction operation”(Bamidele&Faestus, 2016).

2.2.2. Material Takeoff

Materials management process actually begins when a materials takeoff is performed to produce bills of materials. Before bill of quantities of the materials can be created, materials specifications must be established. 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 (Asienga, 2005).

2.2.3. Vendor Selection

Vendor selection 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(Asienga, 2005).

2.2.4. Purchasing of Materials

The objective of procurement in materials management is to provide quality materials at the right time and place, and at an agreed budget. Procurement is also about organizing the purchasing of materials and issuing delivery schedules to suppliers and following-up, to make sure that suppliers deliver on time (Bamidele&Faustus, 2016.)

2.2.5. Expediting

The purpose of expediting is to provide timely information regarding anticipated materials deliveries to all concerned project personnel. Experienced professional expeditors 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 (Asienga, 2005).

2.2.6. Quality Assurance and Quality Control

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. 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 (Asienga, 2005).

2.2.7. Transportation of Materials

The movement of equipment, materials, and personnel to the job site represents a unique and specialization element of materials management. Experienced traffic personnel can have a positive impact on the execution of the project while minimizing transportation cost (Bamidele&Faestus, 2016).

Good logistics involved the use of minimum of materials on site awaiting assembly, as well as being good for cash flow, this it easier to keep the site clean and tidy and reduces opportunities for slips trips and falls, an effective logistics team will also pay attention to the maintenance of plant and equipment.

2.2.8. Sites 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. Effective material handling as using the right method, amount, material, place, time, sequence, position, condition, and cost. This involves handling, storing, and controlling of the construction materials. Handling of is the flow component that provides for their movement and placement .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(Bamidele&Faestus, 2016).

The supplier should immediately be notified of any defects, shortfalls or failure in specifications and remedial action immediately taken to avoid delays. Once the materials have been received, any special handling and instructions should be followed to avoid damage and deterioration of materials while on site (Asienga, 2005).

2.2.9. Surplus Materials

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. 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 (Asienga, 2005).

2.2.10. Material Waste Control

Stock control is classified as a technique devised to cover and ensure all items are available when required. Stock control can include raw materials, processed materials, and components for assembly, consumable stores, general stores, maintenance materials and spares, work in progress and finished products. Meanwhile, construction activities can generate an enormous amount of waste; it has been recognized as a major problem in the construction industry. However, tighter materials planning can reduce waste and can directly contribute to profit-improvement and productivity (Bamidele&Faestus, 2016).

2.2.11. Just-in-time Method (JIT)

JIT is a systematic concept consisting of JIT purchasing, JIT transportation and JIT production. These three elements combine to create a material handling system that avoids waste and minimizes inventory investment. The technique has changed employees' belief, attitude, work habits and awareness of quality assurance. It is an operating management philosophy of continuous improvement in which non-value-adding activities (or wastes) are identified and removed for the purposes of reducing cost (Bamidele&Faestus, 2016).

2.2.12. Economic Order Quantity of Materials (EOQ)

This determines the amount of orders that minimizes total variable costs required to order and hold inventory. The economic order quantity (EOQ) refers to the order size that will result in the lowest total of ordering and carrying costs for an item of inventory. If a firm place unnecessary orders it will incur unneeded order costs. If a firm place too few order, it must maintain large stocks of goods and will have excessive carrying cost (Bamidele&Faestus, 2016).

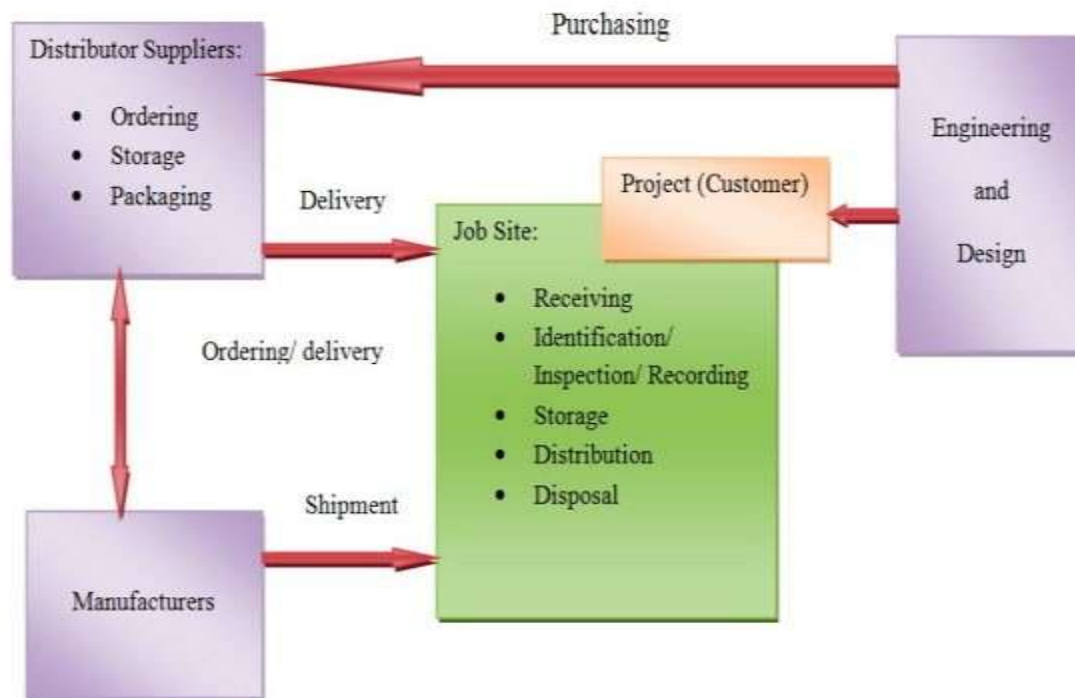


Figure 2.2 Typical material management process in construction site, Source (Ngor et al, 2019).

2.3. Impact of material management on construction project performance

Materials management is defined by Business Roundtable in Modern Management System as ‘the planning and controlling of all essential efforts to confirm that the correct quality and quantity of materials and equipment are properly stated in an appropriate manner and gotten at a sensible cost and are offered when needed’. However, some defined it in a straight line with an idea that complex adding process whereby all findings of materials are combined under one management function (Abbas& cross, 2019).

Briefly, materials management can be defined as a strategic process that entail of identifying, purchasing, delivering, handling, giving of space and reducing wastes with the purpose of positive suitability of enough quantities of material for project needs. Materials management in a construction project consists of seven combined processes and functions. They include project planning, materials take-off, supplier’s enquiry, purchasing, and materials control, warehousing, expediting and shipping (Abbas& cross, 2019).

Impacts of materials management practices that could benefit construction industry includes: reduce cost of materials, improvements in productivity, projects constructed on time , purchase saving, providing adequate storage of material on site, improvements in project schedule, effective design site layout so as to aid in the management of materials on site, installation of materials hoists on site to aid in the movement of materials, good relations with suppliers, effective handling of materials, control of materials on site, quality work, reduced materials wastage and better cash flow management (Albert, 2014 and Cross, 2019).

A good management system for materials management will lead to benefits for construction. Cash flow has become crucial for the survival of any business, if materials are purchased early, capital may be tied up and interest charges incurred on the excess inventory of material. Material may deteriorate during storage or be stolen; also delays and extra expense may be incurred if materials required for particular activities are not available(Donavan& Flanagan, 2009).

The positive impact of material management on project profitability can never be overemphasized. This is chiefly against this background that the value of materials, equipment etc. constitute at least half of the cost in most commercial, government, private and individual project. Efficient materials management therefore, becomes imperative to avoid serious over expenditure and erosion of profit, the life line of most project outfits (Francis et al., 2020).

The study conducted by (Mulu, 2021) described that improper material management can have consequence in increased costs throughout construction project. Efficient and effective management of material can result in considerable savings in project costs. Materials may deteriorate in store or get stolen if special attention is not taken. Delay and additional costs may be sustained if materials required for particular works are not available.

Material management is an important element in project management as materials contribute a major portion to project cost. It also plays a key role because of success of every construction project rely on having proper resources (Mat & Kasim et al., 2015).

Generally, the criteria of project performance are identified both from a positive and negative perspective effects. From the positive effects, effective material management has a positive impact on time optimization, cost saving, quality maximization, productivity improvement and waste minimization. On the other hand, ineffective materials have negative effects on project performance such as time delay, cost overrun, deprived quality, loss of productivity and excessive waste generation (Mulu, 2021).

Material mismanagement decrease the contractor's profit leading to huge loss, and leaving the project in big troubles, therefore, the proper management of this single largest component can improve the productivity and cost efficiency of a project and help ensure its timely completion. Generally, the criteria of project performance are identified both from a positive and negative perspective effects. From positive effects, effective material management has a positive impact on time optimization, cost saving, quality maximization, productivity improvement and waste minimization.

On the other hand, ineffective material management has negative effects on project performance such as time delay, cost overrun, poor quality, loss of productivity and excessive waste generation(Zairra&Narimah, 2017). Material management affects project performance in the below mentioned ways.

2.3.1. Time

Time is defined as a degree that general conditions promoted completions of a project within allocated duration. It is an essence of a construction contract, hence most of the contract have a similar provision about completion time and clearly stated in it. Therefore, it is important for construction project completed on time. The insufficient stock of materials lead to idling time as workers tries not to exhaust the stockpile or it is worsened by work stoppage. Due this shortage, materials need to be reordered and causes longer idling time. Consequently, the work progress will be delayed. Therefore, the availability and sufficient quantity of materials affect the time performance(Zairra&Narimah, 2017).

2.3.2. Cost

Lack of standard or poor-quality control in material management contributes to increase of construction cost. This is because the chances to loss material during handling and implementation stages are higher and it requires a material replacement. For instance, the materials with poor quality will damage due to lack of durability, strength and density(Adnan et .al , 2007).

2.3.3. Quality

Material management affects quality performance. Availability of resources such as materials and equipments planned during project duration is one of the factors contributing to quality performance. The available equipment also needs to be in good condition and in quantity. Without the proper and sufficient equipment, it will jeopardize the satisfactory quality of work done. Similarly, the materials itself also need to be in appropriate quality according to the specification. Using the appropriate quality of materials can lead to the satisfactory quality of work; subsequently will be accepted by consultant(Zairra&Narimah, 2017).

2.3.4. Productivity

Material storage also had a significant impact on labor productivity. Effective management of materials contributes a great deal for achieving business profit and productivity. This is done through effective acquisition, control, handling and movement of materials. Handling of material is one of the activities perform by materials managers and can be an effective tool for saving cost and holding up profit(Ibegbulem&Okorie ,2015).

2.3.5. Waste

The factors that contribute for physical waste in construction sites are wrong material storage and poor material handling. On the other hand, the only factor which contributes to non-physical waste is the wrong material storage. For the site condition, very obviously determine different factors contribute to two different streams of waste. The physical waste generates from Leftover materials on site factor while non-physical waste arises because of the factors related to poor site condition factor(Sasitharan et.al, 2012).

Effective practice of materials management plays a key role in the successful completion of a project. The impact of effective materials management practices on construction projects includes: -

Environmental impact:- This includes the conservation of natural resources, reduction of energy consumption, conservation of landfill space and reduction of environmental impacts across the life cycle by decreasing the demand for virgin products (Van Ewijk, &Stegemann, 2016).

Economic impact: - It includes reduction in disposal costs and may reduce transportation of material costs which leads to reducing overall project costs, reduction in purchasing costs since non-virgin materials are often less expensive than virgin resources, make contractors to be more competitive with their bids at reduced costs and it creates employment opportunities and economic activities in the reuse and recycling industries (Beamon, 2008).

Performance impact:- This includes reclamation of salvaged or reused materials which can perform as well as or better than virgin products in many applications, reduction in the overall costs of materials, better handling of materials, reduction in duplicated orders, materials will be on site when needed and in the quantities required, improvements in labor productivity, improvements in project schedule, quality control, better field material control, better relations with suppliers, reduction in materials surplus, reduced storage of materials on site, labor savings, stock reduction, purchase savings and better cash flow management (Jensen, 2014).

Other impacts of materials management practices that could benefit construction industry includes: reduce cost of materials, improvements in productivity, project will be constructed on time or than expected, purchase saving, providing adequate storage of material on site, improvements in project schedule, effective design site layout so as to aid in the management of materials on site, installation of materials hoists on site to aid in the movement of materials, good relations with suppliers, effective handling of materials, control of materials on site, quality work, reduced materials wastage and better cash flow management (Albert, 2014).

The main impacts of effective materials management practices are reduced cost of materials, good quality control, better field material control, better handling of materials, adequate storage of materials on site, improvements in productivity and completion of project on time. Based on the findings, it was concluded effective materials management practices improve the overall handling of materials for more efficiency and effectiveness on the construction site. According to purchasing of materials, material planning method and transportation of materials are the most common practices of materials management (Atanda&Muhammed, 2021).

Effective materials management techniques on construction site are important for project success and since there is a significant link between it and the recommendations thus, materials managers of construction firms should be more concerned about planning and monitoring of material schedule, establishing good business relations with suppliers, the use of security measures on site use of information communication technology, and also the use of competent workers as well as effective training of workers, to enhance their materials management and ultimately improve their project delivery success(Napoleon et.al, 2018).

2.4. Factors affecting construction material management

According (Kebede, 2016) the factors affecting materials management are:- sourcing of materials and requisition; demand estimation; transportation; receiving and verification of materials on site; storage of materials on site; issuing of materials for use; procurement or indent for materials; quality inspection and control; maintenance; time; materials handling; stock and waste control; financial ability; possession of qualified staff; possession of qualified subcontractors; possession of qualified of required equipment; competence of estimators; availability of equipment; duration of the project; type of project; type of materials; and level of awareness.

Factors affecting materials management effectiveness are varied and complex. The root cause might originate from the contractors, suppliers, transportation providers, consultants, clients and governmental interference. Previous studies have pointed out many influential factors that contributed to or adversely affect the materials management effectiveness.

They are exhaustively listed as follows: adequate planning, appropriate site management, efficient supervision, efficient handling, proper storage, efficient control of materials, adequate storage space, proper inventory control, good site accessibility, unsystematic flow of materials, fluctuation of material prices, improper sorting of materials, poor layout for material handling, improper material deliveries, unavailability of up-to-date inventory status, delay in materials deliveries, excessive paperwork, excessive handling, equipment breakdown, shortage of equipment, poor coordination, inefficient communication, delay in procuring of materials, errors in ordering, lack of material storage, poor material planning and others (Zairra et.al, 2021). Factors affecting effective material management are Plan and design complexity, Fund availability for payment, Price fluctuations, Lack of storage, Poor communication, Site conditions, Wrong handling of materials, Weather condition, Wastage and existence of unnecessary materials on site (Sufiyan, 2020).

Factors such as waste, transport difficulties, improper handling on site, misuse of the specifications, and lack of proper work plan, inappropriate material delivery and excessive paperwork all adversely affect material management (Nann & Aye Mya, 2014).

The factors that affect the material management strategies in a construction work consists of sequence of materials delivery, availability of material in the local market, material changes in type and specification during construction, damage of material in storage, delay in the especial manufacture of building materials, unreliable supply from material suppliers, poor planning and co-ordination, poor communication between sites, inadequate waste management plan, transportation for large quantities, inadequate knowledge of it solution on materials management, improper handling on site/manual materials handling, workers'' mistakes/misuse of specification and excessive paperwork, Management of surplus materials, dispute resolution strategies and lack of skilled negotiating procedures(Olanrewaju et.al ,2021) .

Construction material creates a most important cost factor in any construction project. The total cost of material may be 60% of total cost; so that it is important for contractor to consider that timely readiness of material is possible cause of successful completion of project. According to(Amar &Milind, 2018) the different factors affecting material management are: - inadequate staff of contractor is main reason for increase the material cost in execution, lack of experience of material management team .material Planning not being done before execution stage but it affects material cost, irregular geographical conditions in case soling extra depth of excavation to be considered, inaccessibility to the site area during harsh weather conditions. (Rainy season) and concrete cycle not being done as per the planned schedule.

According to(Vipin&Rahima, 2019) cited in (Yinchachu, 2021) study, the factors affecting material management under the category of material planning, vendor analysis, material purchasing, storage and inventory and supply distribution and on-site were identified and categorized into a group in the following table.

Table 2.1 Factors affecting construction material management (Vipin & Rahima, 2019) cited in (Yinchachu, 2021)

Stages	Construction material management factors
Material planning	Poorly defined roles and responsibilities
	Storing materials in faraway stores
	Poor store layout
	Forecasting materials price in the market
	Unclear and inadequate details in material specification
	Waste from the uneconomical shape of a material
	Insufficient instructions about handling materials at the site
	Locating the source of procurement
	Misunderstanding of owner's requirements by a design engineer
	Impossibility to order small quantities
	Severe weather conditions
	Poor use of advanced software
Vendor Analysis	Poor coordination and communication among the contractor and material supplier
	Rework due to poor material quality used before
	Timeliness of delivery
	The financial condition of the company
	Time-lapse in testing and inspection
	Manufacturing defects on materials
	Competitiveness of price
Storage and Inventory	Insecure and unsafe material storage.
	Habit of storing and collecting construction materials in stores for long time.
	Habit of theft, burglary and vandalism of construction materials on site.
	Unqualified professionals regarding material management and stock control.
	Improper handling of construction materials.
	Weak and disorganized inventory and recording mechanism.
	No proper store arrangement and placement .

Material Purchasing	Time consuming and inefficient procurement process for construction materials
	Not delivering construction material on the right time.
	Insufficient capacity of suppliers.
	Appropriate amount of the material isn't available in the market.
	Price variation on the material during the project cycles.
Supply, Distribution, and On-site	Unavailability of both local and industry produced materials near the site.
	Unsafe and negligent transportation and delivery of construction materials.
	Not enough material quantity inspection verification and control.
	Using damaged and expired construction materials.
	Use of incorrect material

According to (Zairra & Narimah, 2017) the identified influential factors affecting material management are categorized into 8 groups: site condition, planning and handling on site, management, material, transportation, supplier or manufacturer default, contractual and governmental interferences.

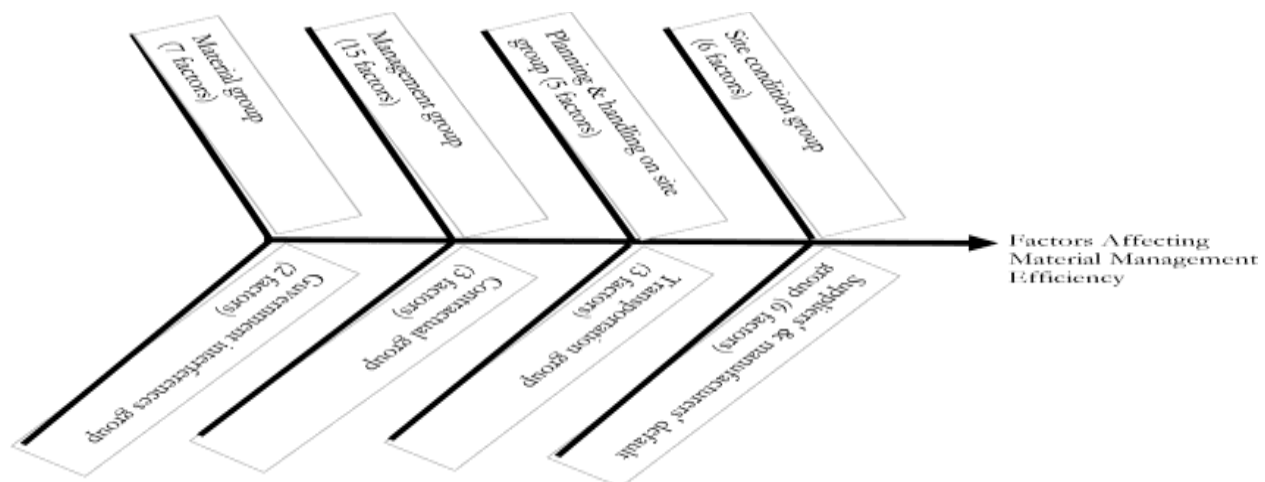


Figure2.3 Fishbone diagrams of group factors of construction material management (Jusoh&Kasim, 2017).

2.5. Challenges in Implementation of Construction Material Management

According to (Mehr & Omran, 2013) explanation, an effective construction material management process is a key to the accomplishment of a construction project in the best way. Currently, successful management of construction materials has to be based on thorough and updated information and procedure of using well-designed construction material management software. There are many challenges during material management. These challenges are divided into three categories: -

2.5.1. Challenges related to information technology:-The success of material management highly depends on accurate and correct generation and convey of information. In this case, computerize and network information offer fast, accurate, and maintenance of information. In a large company, a person who is in charge of material purchasing needs to ensure an accurate quantity of construction material is ordered while make ensure which construction materials are needed, where and when the supplier must deliver them. During the construction and post-construction, one of the most challenges is tracking of materials. Automated systems like bar codes, radio frequency identification (RFID) technology, information, and Communication Technology (ICT), improve tracking and inventory control and loss and misplacement of materials.

2.5.2. Challenges related to decision modeling:-It is the role of the contractor to decide on qualified suppliers who can meet the construction materials requirements effectively. During the procurement phase, it is necessary to decide how much construction materials are required, and when construction materials should be delivered to the site. It is important to make sure the number of construction materials which is required is available and there is no shortage.

2.5.3. Challenges related to implementation management:- Change in setting up, process, and methods, using new information technology where decision models are in use have been identified as stressful for organizations that follow improvements. In this situation, better material management practice and decision-making models increase the efficiency and effectiveness of the process and reduce the overall cost. Also, this study (Mehr & Omran, 2013) analysis detaining the following Challenges in construction material during construction are:

Lack of user-friendly construction materials software packages and lack of capable personnel in using computer-based materials management systems are considered the main difficulty in using a computer in construction materials management. Manual materials management and supervise processes are inadequate as they are labor concentrated, imprecise, and fault-prone.

Insufficient and poor production of raw material by the country: the reason for the shortage of material during construction included the incomplete supply of material coupled with a general shortage in the industry, poor communication between the site and head office, poor purchasing planning, and material management.

Cost of materials: the price of material highly depends on supply and demand and is affected by many other things such as quality, quantity, time, and place. It also depends on currency exchange, low or high demand, material specification, inflation, and availability of new materials and fluctuation in the price of materials. However poor construction material management of interrupts the whole construction project in terms of time, cost, value and output. These are due to different factors affecting construction material management in construction projects.

Rivas (2011), as cited in Bamidele & Faestus (2016) Informed that late delivery of construction materials, unavailability of materials before commencement of construction work, and the long distance of materials from the work location is the principal causes of materials-related problems on construction sites. Kazak (2008) as cited in Bamidele & Faestus (2016) found that poor planning for construction materials and difficulties associated with site transportation as factors leading to a lack of construction materials on sites. Pauline (2014) as cited in Bamidele & Faestus (2016) also informed that difficulty to store materials on site due to limited space is another problem in connection with material management; sometime machineries cannot be adjusted on site due to acute space or mismanagement of site activities. Other problems identified in literature include: conflict among sub-contractors and difficulty to coordinate their materials, late delivery of ordered materials, cash flow problem to contractor due to delayed payments, rejection of materials due to non-compliance to specification and improper health and safety procedure should injuries occurred.

2.6. Conceptual Framework diagram of material management flow

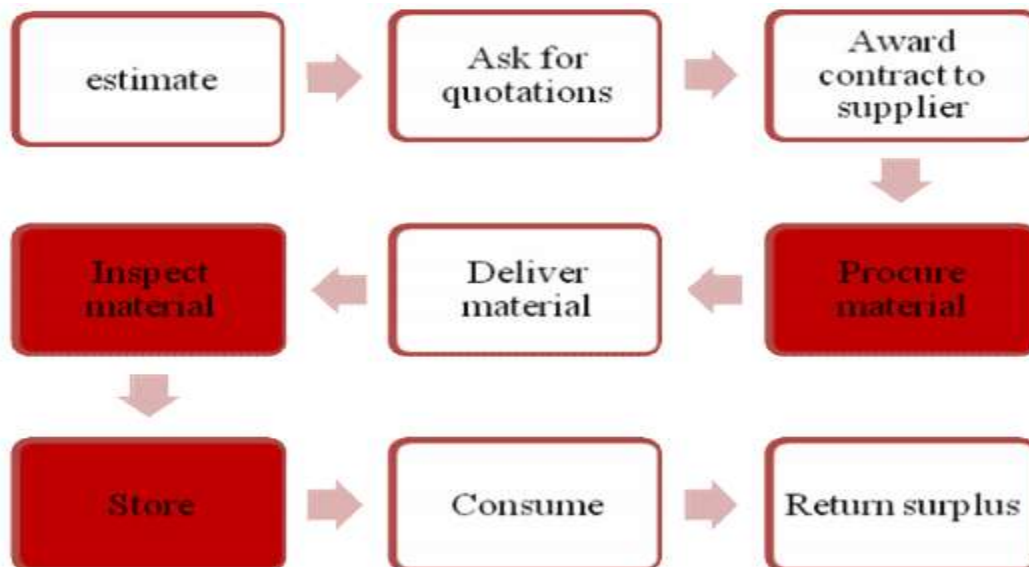


Figure 2.4 Construction material flow at DCE (Tibebu ,2016)

When looking into the material management process in DCE it starts from purchasing issue or order from the office engineering team depending on the design and the specification of the work. The purchasing order will be issued to the purchasing department, depending on the type of the material to be purchased and its quantity the purchasing department will go into the market with petty cash purchase, Performa purchase or bidding. From the above three purchasing types the material will be delivered to the site after its quality is inspected and gets the supervisor's approval. After the material passes the purchasing and approval stages it will be store in the warehouse or on the site depending on the material type. Finally, the construction team will issue the material and after the approval by the project manager the material will be delivered to the site and consumed. But there will usually be shortage or overage of material delivered to the site and there is no proper mechanism checking the material is being used and utilized properly and most of the time no one will be held accountable for the material shortage or overage. This material overage is resulting in material wastage. Therefore, the study will try to assess where this material shortage and overage is occurring in the company and what must be done in order to avoid such problems of material management and utilization.

2.8. Research gap

According to Tibebu (2016) the material management problems that are currently happening in Ethiopia are late purchase ,late delivery , weak transport system and stringent public procurement processes are some of the material management problems however the study fails to address the effect of incomplete design and specification ,the role of suppliers , and other stakeholders like banks that related with foreign currency issues , price fluctuation and escalation and the role of peace , security and political stability of material management . In addition the study fails to address the effect of material management on project performance like quality, time and cost.

Even though most of the problems related to material management are mentioned by (Navon & Berkovich ,2006) and (Kasim ,et al 2005) other factors such as instability and inconsistency in the market, the impact of lack of peace and security, negligence by the construction crew, lack of proper code of conduct and penalties about material wastage and continuous work orders and variations aren't addressed properly. Therefore, further research needs to be conducted to address this knowledge gap and their relationship with material management and utilization.

The use of technology in construction material management is a relatively new area of research in Ethiopia. Most studies have focused on the use of technology for specific tasks, such as inventory management or tracking materials. There is a need for more research on the overall impact of technology on construction material management in Ethiopia.

In addition to the above mentioned solutions related to material management by (Faniran et al,1998) and (Argaw, 2020) some other measures can improve the material management practices on construction sites such as :- strict code of conduct and guidelines about material management on construction sites , awareness creation about material management and its impact on the construction industry and the national economy as a whole aren't properly addressed in previous studies , therefore this research tried to address these knowledge gap in material management process like the use of technology , applying systems and software , strict code of conduct about negligence and wastage of materials by the construction crew.

CHAPTER 3

3. RESEARCH METHODOLOGY

This chapter provides the research methodology employed to conduct the study. This chapter presents site selection and description of the area; research design approach; sample design; source of data primary and secondary data collection; population of the study sampling frame, sampling unit, and sample size and sampling design technique; method of data collection; method of data analysis; and ethical issues.

3.1. Description of the study area

Defense Construction Enterprise was established in 2010 G.C by Ethiopian ministry of council regulation NO 185/2010 as public enterprise and national defense as supervising authority of the enterprise. The authorized capital of the Enterprise is Birr800, 000,000.00 /Eight hundred million Birr /of which birr 276,438,724.00/ Two hundred seventy six million four hundred thirty eight thousand seven hundred twenty four Birr is paid up in cash and in kind. Prior to its establishment as an Enterprise, it was structured as an Engineering Department under the Ministry of National Defense responsible for the construction of Army Hospitals, Depot, Camps, access roads and other infrastructure activities owned by the Ministry of National Defense. Henceforth it establishment, the enterprise has mainly been undertaking various infrastructural projects to satisfy of national defense infrastructural needs. In parallel, it has also been engaged in the construction of mega road, dams, irrigation infrastructures and buildings projects that have been undertaking in different part of the country.

The purposes for which the enterprise is established are:-

- To engage in any construction activity mainly to satisfy the national defense construction needs.
- In parallel, to engage in the construction of roads, dams, irrigation infrastructure, buildings and other construction works in the country.
- To engage in any other related activities necessary to the attainment of its purposes.

Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case DCE, 2024

Defense construction enterprise has mainly two departments the first is the building and real estate development department and the second is road and irrigation works department. Under the building and real estate department which is our research scope there around 15 building construction projects in and around Addis Ababa which where our study mainly focuses. The detailed description of the different building projects in and around Addis Ababa is stated in the appendices part in a tabular form.

Table 3.2 The number of DCE Projects in and around Addis Ababa

No	Project Name	Contract Amount	Number of Construction professional in the project
1	Bishoftu Engineering College Expansion	580,000,000.00	19
2	Bishoftu Defense High-tech Hospital	27,141,602.00	13
3	Bishoftu Airforce Site Work	8,860,379.00	20
4	Janmeda Peacekeeping project	192,089,956.90	18
5	Janmeda Staff College Project	31,066,694.50	21
6	MOND Headquarter Project	1,102,727,382.36	22
7	INSA Headquarter Project	928,569,468.38	23
8	Semit Army Foundation Project	47,310,573.39	22
9	Kaility Army Foundation Apartment Project	361,115,122.00	18
10	Goffa Apartment Project	149,565,833.36	24
11	Quore War College Phase	311,124,173.00	16
12	Calibration Center Project	178,261,350.00	14
13	Children and Youth Theater Project	304,503,474.76	22
14	Shegole apartment project	756,872,234.56	20
15	RasHailu Swimming pool project	485.264,675.80	18

Source: DCE Building Engineering Department

3.2. Research Design

The first phase of the research thesis included identifying and defining the problems, establishing the objectives of the study and developing the research plan. The second phase included an exhausted summary of the comprehensive literature review. The third phase included a field survey which was conducted from the viewpoint of contracting companies specifically in the building construction sector. The fourth phase focused on the careful selection of variables and questionnaire design. The fifth phase was dissemination of the questionnaire.

The research employed descriptive method because the study intended to find out the material management practice on construction projects sites. Kothari (2004) defines descriptive research study as those studies which are concerned with describing the characteristics of a particular individual, or of a group. According to Saunders et al (2009), there are seven research strategies (experiment; survey; case study; action research; grounded theory; ethnography and archival research). In this research the researcher used survey research.

Survey research is a popular and common strategy in business and management research and is most frequently used to answer who, what, where, how much and how many questions. And used for exploratory and descriptive research. Surveys research allows the collection of a large amount of data from a sizeable population in a highly economical way. Often obtained by using a questionnaire administered to a sample, these data are standardized, allowing easy comparison. In addition, the survey strategy is perceived as authoritative by people in general and is both comparatively easy to explain and to understand.

Saunders et al (2009) also divide research design in to longitudinal and cross-sectional, based on time horizon. Cross-sectional studies are the study of a particular phenomenon at a particular time. It includes research projects undertaken for academic courses. Cross-sectional studies often employ the survey strategy. Longitudinal research has capacity to study change and development over time the researcher is able to exercise a measure of control over variables being studied. In this study, the researcher had used a cross-sectional study because data were collected from a cross-section of professional engineers of the enterprise, once.

3.3. Research Approaches

According to (Kothari, 2004) a research design is the arrangement of conditions for the collection of data and its analysis. Function of research design is to serve as a frame to collect relevant evidence with minimal costs with respect to time and money. It constitutes the blueprint for collection, measurement and analysis of data. The purpose of this research is to identify factors affecting construction material management practices and its effect on project performance in building construction projects by using mixed research approach of both quantitative and qualitative data. In other words, the researcher was able to simultaneously collect both quantitative and qualitative data, analyze the data in multidimensional and use the results to seek answers for the research problem. In this study, since the focus of the study is the description of the situation as it exists at present, a descriptive research design was employed and both qualitative and quantitative data were used. Therefore, this research used descriptive survey method, allow the collection of a large amount of data by using questionnaires in an economical way and it is comparatively easy to explain and understand.

3.4. Data sources and instruments of data collection

There are two types of data, namely primary and secondary data. According to them, a study might use either both or one of the types of data depending on the research type and data collected by the researcher. For the purpose of this research primary data was collected through standardized structured and semi-structure questionnaire (Saunders et.al, 2007). Primary data are originated by a researcher for the specific purpose of addressing the problem at hand (Malhotra and Birks, 2006). Primary data of this research are both quantitative and qualitative types.

As the research was intended to investigate the factors affecting construction material management practices and its effect on project performance of the building construction projects site in DCE, a set of questionnaire was distributed to professional engineers of the enterprise. The research was developed by 51 Likert-scales and 5 additional open-ended questionnaires. The questionnaire statements were evaluated on a 1-5 Likert scale , where 1 indicates strongly disagree with the statement, 2 disagree, 3 neutral, 4 agree and 5 refers to strongly agree with the statement.

3.5. Study population

The target populations for this research were the 15 building construction projects in and around Addis Ababa .The selection of target populations for the study was based on the representativeness and resourcefulness of the people.

3.6 .Sampling size and technique

According to the human resource department of the company which is shown in Appendix 1A table there are around 280 permanent and contract employees in the 15 building construction projects in and around Addis Ababa .Out of the 280 workers 143 are construction engineering professionals like project manager, construction engineer, office engineer and site engineer while the rest 137 are supporting stuff like finance, human resource and supply. So the sample size considered for this study is 143 which are all construction engineering professionals which are project managers, construction engineers, office engineers, site engineers, quantity surveyors and construction formans.

The sampling design for the population is population census since the number of construction professionals working in and around Addis Ababa is limited. Census is defined as the overall process of collecting, processing, tabulating, analyzing and publishing the demographic, economic and social data of the population and housing units in a specific country or part of it without dropping or repetition and assessing, classifying. Therefore out of the entire population of the study all the 143 construction engineering professionals are selected using a population census based on the resourcefulness and knowledge of the respondents to the study. The researcher distributed the questionnaire for all the 143 population size and collected the response.

3.7. Methods of data collection

Muhammad & Kabir (2018), stated as data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. For this study questionnaire and interview were used as the method of data collection.

3.7.1. Questionnaire

According to Abawi (2013), a data collection instrument consisted of a series of questions and other prompts to gather information from respondents. For the collection of the quantitative data, 59 questionnaires were developed. The questionnaire consisted of closed-ended items developed in line with the objectives of the research. The questionnaire has 2 sections. The first section covers general information about the respondent. The 2nd section has 3 subsections under it the first one covers factors affecting the material management practices in building construction sites of DCE. The 2nd sub-section covers the effect of material management on project performances which are time, cost, quality, productivity and waste control and the 3rd sub-section states the challenges in implementation of construction material management. Finally, the aim to address the quantitative approach instrument of data collection method was a fast and easy method of collecting data and were more accurate when starting, processing, and analyzing these data.

3.7.2. Personal observation

This method allowed the researcher to cross check and prove that the information gathered via questionnaire as well as from secondary data. It was also used to realize the exact conditions which exist in the study area such as construction sites of DCE, stores and offices.

3.8. Methods of data analysis

The methods of analysis used in this research were selected due to the type of data available for the analysis and the objectives of the research. The questions in the questionnaire were qualitative; hence the descriptive method of analysis is best suited for the analysis. Such method was applied for the presentation, interpretation and discussion parts on various dimensions of the appropriate to analyze, interpret, tabulate and present the result of the study. The data gathered through questionnaires was coded, entered into computer and analyzed and presented in the form of charts, diagrams, and tables by using SPSS Statics version 26 software. Finally, conclusions were made based on the results/findings of the study and recommendations were forwarded on the basis of the data analyzed.

3.8.1. Descriptive data analysis

Frequency, mean, standard deviation, and maximum and lowest data were all used in the descriptive analysis. Using the proper methodologies for analysis, the qualitative and quantitative data gathered from the data-gathering method were examined. Through interpretations and conceptual generalization, qualitative data were analyzed.

3.9. Validity and reliability

Reliability and validity are terms that refer to the quality of the measures used in a research study. Reliability refers to the internal consistency and validity refers to the accuracy of the measure.

3.9.1. Validity

Validity of research can be explained as an extent at which requirements of scientific research method have been followed during the process of generating research findings. According to (Pallant, 2011) states that it is the degree to which the results are truthful. So that it requires research instrument (questionnaire) to correctly measure the concepts under the study. One of the methods to know the validity of the research is pilot test.

Therefore a pilot test was applied by distributing questionnaires for the respondents. A total of 20 questionnaires were distributed to some of the respondents randomly check truthfulness of the questionnaire and comments like spelling and grammatical errors , missing addresses and redundant questionnaires were found which were letter corrected.

3.9.2. Reliability

The reliability of the questionnaire is tested by using Cronbach's alpha or called the alpha coefficient to show the internal consistency of questionnaires as stated by (Gliem & Gliem, 2003). And, again Gliem & Gliem (2003), stated the closer the reliability coefficient of 1.0 is the better. In general, they conducted reliabilities less than 0.60 are considered as poor; those in the range of 0.60 to 0.80 are considered good and acceptable. Similarly, Drost (2004) stated that internal consistency measures consistency within the instrument and questions how well a set of items measures a particular behavior or characteristic within the test.

Table 3.2: Represent questionnaire analysis Cronbach's Alpha coefficient test result.

Reliability Statistics		
Variables	Cronbach's Alpha	N of Items
Material Planning	0.815	4
Material Purchasing	0.764	5
Material Storage and inventory control	0.943	5
Material supply and distribution	0.824	4
The effect of poor material management on project performance	0.725	26
Mechanisms and techniques of improving material management	0.626	15
Entire Scale(Average)	0.782	59

Source: own survey data, (2023)

All items which are 59 in number included in the questionnaire were statistically analyzed to measure the internal consistency of the instrument using Cronbach's alpha. Based on the above reliability statistical analysis, it is interpreted consistency among the measurement items Alpha value .0.782 and it is between 0.6 and 0.8. So, the selected instrument can accurately measure the variables of the study.

3.10. Ethical considerations

Ethics is becoming an increasingly prominent issue for all researchers. Researchers are encouraged to employ knowledge of research ethics in practice. Ethical issues were prominent throughout this research process, including during the data collection, during the analysis and writing up of the final report. The researcher clarified to the respondents about the objectives of the study and explains that the information was used only for research and academic purposes. During conducting data collection, both honesty and respect for the rights of the respondents were in place.

CHAPTER 4

4. RESULTS AND DISCUSSION

4.1. Introduction

This chapter presents the analysis of the data collection from respondent. The chapter intends to address the research questions using the data collected from respondents at different projects. The result of the survey was discussed by using questionnaire results. The study attempts to accomplish the objectives of the study and answer the research question.

A total of 143 questionnaires to fifteen project sites which dealt with survey to assess the construction material management and utilization practices on construction sites in Defense Construction Enterprise . Out of the 143 questionnaires distributed all the 143 questionnaires were collected and practical responses (100% response rate). The questionnaires contain variables which include issues such as construction material problems currently occurring in construction sites and evaluate the effect of construction material management of project performance. All items in questionnaire are arranged in the form of Likert items to capture the feelings of respondents in scale range from 1 to 5; 1) strongly disagree,2) disagree,3) neutral,4) agree and 5) strongly agree. All the data has been analyzed in SPSS so that the accuracy of the information is maintained.

4.2. Demographic characteristics of the respondents

Specific facets of a population are referred to as demographics. The word is a combination of the Greek words for people and images, demos and graph. Age, race, gender, ethnicity, religion, income, education, house ownership, sexual orientation, marriage status, family size, health and disability status, and psychiatric diagnosis are a few examples of demographic factors.

The information generated to address the stated research objectives from the respondents with diver's demographic characteristics. The first section of the questionnaires consists of the demographic information of the participants. The demographic variables about the respondents were summarized and described in different figures and tables. These variables included: gender, age, profession, experience and educational qualification.

Questionnaires were used to obtain primary data for this research work. The result of the returned questionnaire is presented in the table 4.1. From the table, it gives the breakdown of the administered questionnaires based on the number of responses obtained. Based on the level of homogeneity of the returned questionnaires, 100 % response rate is considered adequate for analysis and conclusions of this type of research.

Table 4.1 Response rate of the study

Questionnaire	Frequency	Percentage %
Number of distributed	143	100%
Accepted responses	143	100%

Source: own survey data, (2023)

Table 4.2 Gender of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	57	39.9	39.9	39.9
	Male	86	60.1	60.1	100.0
	Total	143	100.0	100.0	

Source: own survey data, (2023)

Figure 4.1 and table 4.2 shows from the 143 respondents 39.9% which is 57 are female and 60.1% which is 86 are male. These indicate that there is a larger number of male work forces in the enterprise.

Table 4.3 Age of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21-30	64	44.8	44.8	44.8
	31-40	73	51.0	51.0	95.8
	41-50	6	4.2	4.2	100.0
	Total	143	100.0	100.0	

Source: own survey data, (2023)

Figure 4.2 and table 4. 3 shows the age of the respondents from the 143 respondents 44.8% which is 64 of the respondents are from the age of 21-30, 51% of the respondents which is 73 are from the age of 31-40 and 4.2% of the respondents which is 6 are from the age of 41-50. The result most of the enterprises work force is very young and productive.

Table 4.4No of employees in the project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-9	39	27.3	27.3	27.3
	10-99	81	56.6	56.6	83.9
	100-299	13	9.1	9.1	93.0
	above 300	10	7.0	7.0	100.0
	Total	143	100.0	100.0	

Source: own survey data, (2023)

Figure 4.3 and table 4. 4 shows the number of employees in the project from the 143 respondents 27.3% which is 39 of the respondents are from 0-9, 56.6% of the respondents which is 81 are from range of 10-99 and 9.1% of the respondents which is 13 are from the range of 100-299 and 7 % of the respondents which is 10 are from the range of above 300.

Table 4.5Profession of employees in the project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Project Manager	14	9.8	9.8	9.8
	Construction Engineer	15	10.5	10.5	20.3
	Office Engineer	14	9.8	9.8	30.1
	Civil Engineer	37	25.9	25.9	55.9
	Quantity Surveyor	16	11.2	11.2	67.1
	Electrical Engineer	6	4.2	4.2	71.3
	Sanitary Engineer	11	7.7	7.7	79.0
	Construction Forman	21	14.7	14.7	93.7
	Others	9	6.3	6.3	100.0
	Total	143	100.0	100.0	

Source: own survey data, (2023)

Figure 4.4 and table 4. 5 shows the profession of employees in the project from the 143 respondents 9.8% which is 14 of the respondents are project managers, 10.5 % of the respondents which is 15 are construction engineers , 9.8 % of the respondents which is 14 are office engineers ,25.9 % of the respondents which is 37 are civil engineers ,11.2% of the respondents which is 16 are quantity surveyors ,4.2% of the respondents which is 6 are electrical engineers , 7.7% of the respondents which is 11 are sanitary engineers , 14.7% of the respondents which is 21 are construction Forman and 6.3 % of the respondents which is 9 are from other professions .

Table 4.6 Work Experience of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 5 years	4	2.8	2.8	2.8
	0-5 years	32	22.4	22.4	25.2
	6-10 years	77	53.8	53.8	79.0
	11-15 years	23	16.1	16.1	95.1
	16-20 years	7	4.9	4.9	100.0
	Total	143	100.0	100.0	

Source: own survey data, (2023)

Figure 4.5 and table 4.6 shows the work experience of the respondents in the project from the 143 respondents 2.8% which is 4 of the respondents are under 5 years, 22.4 % of the respondents which is 32 are from 0-5 years, 53.8 % of the respondents which is 77 are from 6-10 years, 16.1 % of the respondents which is 23 are from 11-15 years, 4.9% of the respondents which is 7 are from 16-20 years.

Table 4.7 Educational qualifications of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Certificate	1	.7	.7	.7
	Diploma	1	.7	.7	1.4
	Advanced Diploma	5	3.5	3.5	4.9
	BSC	123	86.0	86.0	90.9
	MSC	13	9.1	9.1	100.0
	Total	143	100.0	100.0	

Source: own survey data, (2023)

Figure 4.6 and table 4.7 shows the educational level of the respondents from the 143 respondents 0.7% which is 1 of the respondents have certificate, 0.7% which is 1 of the respondents have diploma, 3.5 % of the respondents which is 5 have advanced diploma, 86% of the respondents which 123 have a BSC degree and 9.1% of the respondents which is 13 have a MSC degree

4.3. Factors affecting the material management in building construction sites

The result of the descriptive statistical analysis on the factors affecting construction material management practices in building construction sites provides an indication of which of the below mentioned factors have the most effect on construction material management practices in building construction sites .

A total of eighteen different variable factors with four different subsections which are material planning ,material purchasing , material storage and inventory control and material supply and distribution are used to measure the factors affecting construction material management practices in building construction sites and the total Cronbach's alpha coefficient of the four sub sections are for the material planning 0.815 , for material purchasing 0.764 , for material storage and inventory control 0.943 and finally for material supply and distribution 0.824 which indicates that all the variables are acceptable for the analysis .

To identify factors affecting construction material management practices in building construction sites the five likert scale ranges are used to analyze the output of the respondents. The result of the likert scale is being analyzed by descriptive statistical analysis of mean, median and standard deviation.

Table 4.8 Factors affecting material management in construction sites

	N	Min	Max	Mean	Std. Deviation	Rank
Material Planning						
Inadequate and incomplete design and specification.	143	1	5	4.10	.929	1
Existence of continuous work orders and variations	143	1	5	4.02	.826	2
Habit of estimation and guess work.	143	1	5	3.18	1.485	4
Lack of awareness and knowledge regarding material management.	143	1	5	3.52	1.255	3
Material Purchasing						
Not delivering construction material on the right time.	143	1	5	4.26	1.151	2
Time consuming and inefficient procurement process for construction materials.	143	1	5	4.38	1.009	1
Insufficient capacity of suppliers.	143	1	5	4.13	1.111	3
Appropriate amount of the material isn't available in the market.	143	1	5	3.99	1.345	4
Price variation on the material during the project cycles.	143	1	5	3.84	1.228	5
Material Storage and Inventory Control						
No policy of materials management and waste control.	143	1	5	4.31	1.321	3
Improper handling of construction materials.	143	1	5	4.57	1.212	1

Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case DCE, 2024

Lack of proper warehouse management practices for construction materials like FIFO , LILO ,Kaizen and BPR	143	1	5	4.27	1.308	4
Unqualified professionals regarding material management and stock control.	143	1	5	4.38	1.297	2
Habit of storing and collecting construction materials in stores for long time before using.	143	1	5	4.09	1.299	6
Weak inventory and stock control to update the projects current stock balance.	143	1	5	4.16	1.322	5
Insecure and unsafe material storage.	143	1	5	3.85	1.411	8
Habit of theft, burglary and vandalism of construction materials on the site.	143	1	5	3.99	1.451	7
Material Supply and distribution						
Unavailability of both local and industry produced construction materials near the project site.	143	1	5	3.69	1.350	3
Using damaged and expired construction materials.	143	1	5	3.57	1.276	4
Unsafe and negligent transportation and delivery of construction materials.	143	1	5	3.87	1.388	2
Not enough material quantity inspection, verification and control.	143	1	5	3.96	1.363	1

Source: own survey data, (2023)

Table 4.8 shows the different factors affecting material management in construction sites. Under the table there are four sub sections of the factors affecting material management in construction sites which are material planning, material purchasing, material storage and inventory control and material supply and distribution. Under the material planning stage inadequate design and specification has the highest mean value of 4.10 and existence of continuous work orders and variations has the second highest mean value of 4.02.

Under the material planning stage of material management the factors which have the highest impact on material management are inadequate design and specification and existence of continuous work orders and variations. Based on the analysis of the sub factor the result is explained as follows:-

When we look into inadequate design and specification it has a major impact on construction material management. In order to completely estimate the amount of construction material needed for the construction projects complete design and specification must be presented. If the design and specification is complete as much possible appropriate amount of material will be delivered to the site and it will make the material management process easy and effective.

In addition to the design and specification existence of continuous work orders and variations have the same impact on material management process. If work orders and variations have no time frame it will make the material management process very difficult and unmanageable. That is because a full amount of material will not be supplied to the site due to the work orders and variations and that will in turn result in material shortage or overage in the site.

To support these thought (Ayegba,2013) states that factors of effective construction material management on construction sites are: design changes, lack of proper work planning and scheduling, inefficient workforce, fraudulent practices /negligence and corrupt practices, lack of security personnel, waste on construction site and lack of or inadequate storage facility. Ogunlana, Promkuntong, Jeark (1996) suggested that the main reasons for project delays on housing projects in Thailand were incomplete drawings and specification, material management problems, organization deficiencies, shortage of construction materials, and inefficiencies in site workers.

When we look into material purchasing stage of material planning we can see that there are a number of factors that will affect the material management process. From the sub factors mentioned in the study time consuming and inefficient procurement process for construction materials has the highest mean value of 4.15 and unqualified professionals regarding material management and stock control has the second highest mean value of 3.64.

Time consuming and inefficient procurement process is a very critical factor in many construction sites in the country. Most procurement processes don't start on the scheduled time or they don't have a lead time. The lack of lead time in material procurement and delivery will make the material management process very difficult because if materials aren't delivered on the scheduled time it makes the material utilization schedule very hard to execute.

In addition if materials are not delivered to the construction sites efficiently the overall construction work will take longer time to complete. A number of factors may contribute to the above mentioned factors such as instability of the market, lack of diversity in the construction suppliers market, hesitation of suppliers to meet the legal requirements set by government owned construction firms like third party quality assurance certificate, authorization letter and so on.

Purchasing materials from the best source, at the right price and with timely delivery are challenges of many construction companies. Therefore, a control strategy is needed during materials procurement to achieve the targeted objectives. All requests for quotations and purchases must be initiated through a properly authorized requisitioning procedure normally controlled by the Project Manager. The Project Manager must ensure that the purchasing of materials follows the standard requirement, time and quality (Tibebeu, 2016).

The other sub factor to be explained under material purchasing stage of material management is unqualified professionals regarding material management and stock control. From the transportation stage up to the actual utilization stage on the construction site the material management process should be lead by qualified professionals who have the knowledge of the different material management stages like transporting, storing, recording proper delivery and so on.

Also, Kasim(2008) highlighted that problems could emerge due to human error, especially because some construction firms still rely on manual methods and unqualified professionals for material management which involves paper-based techniques. Besides study states that problematic use of paper-based reports for exchanging information relating to construction materials components with the supply chain can result from misunderstanding and poor coordination.

During the material storage and inventory control stage of material management there are a number of factors which may affect the material management process. Among them and based on the study analysis improper handling of construction materials has the highest mean value of 3.94 and not delivering construction materials on the right time has the second highest mean value of 3.92.

Improper handling of construction materials in construction sites on other major factor the affects the material management process. When materials are delivered to the construction site most of the time they will not be stored and placed appropriately which will cause the materials to be damaged . In addition to the storing and placing materials will not be placed according to the date of submission to the site and aren't easily accessible.

These will cause the materials to be expired and be rejected. The above mentioned material handling problem will incur additional cost to the project and affects the material management problems.

Handling of materials is the flow component that provides for their movement and placement. The importance of appropriate handling of materials is highlighted by the fact that they are expensive and engage critical decisions. Most common problems associated with materials supply is inadequate unloading and handling facilities, which attribute a high proportion of wastage (Canter, 1993). Therefore, handling with safety during movement of materials at site, which reduce the percentage of materials wastage and finally foster significant improvement can often the total system productivity.

Another major factors related material storage and inventory control is not delivering construction materials on the right time. For every construction site to be completed with required quality level and time every construction material must be delivered to the site on the right time.

The systematic inventory control and documentation reduce time consumption for labor to retrieve construction materials. Other effects are on-time delivery of construction material increases work progress, used appropriate quality construction material speed up finishing time, on-time material procurement reduces idling time and reasonable changes reduce an extra time for adjustment of resources (Yinchachu, 2021).

When we look into the material supply and distribution stage of material management there are number of factors that may affect the material management practices in the construction sites among them not enough material quantity inspection verification and control has the highest mean value of 3.96 and unsafe and negligent transportation delivery of construction materials has the second highest mean value of 3.87.

When materials are delivered to the site detailed and thorough material quantity inspection verification and control must be done to avoid excessive use of materials and also the usage of damaged materials. Since the construction activity is a complex and long line of activity each material delivered to the site must be carefully inspected and verified.

In addition when construction materials are delivered to the site a careful inspection must be done about the expiring date, the quality of the material and the content of it.

After all the planning ordering and buying process have been working to effect a tight control over the materials situations, the site can negate the whole system if it does not carry out its functions (to supervise the utilization of materials on the site). Stock control ensure all items such as raw materials, processed materials , and components for assembly ,consumables stores , general stores, maintenance materials and spares work in progress and finished products are available when required (Harris &Cofferm 2013).

The second sub factor under the material supply and distribution is unsafe and negligent transportation and delivery of construction materials. When transporting construction materials from the supplier to the site careful consideration must be given for the transportation of it because a negligent and unsafe transportation of the material may cause severe damage to the material which will incur additional cost to the project and affect the material management.

An efficient transportation of construction materials from storage to point of use reduces project cost. Therefore proper transportation planning system should be planned, the route and the best suited for the conveyance of each material should be used. And all fragile material must be tied to the transporting plan to prevent breakage (Tibebu, 2016).

4.4. Effect material management on project performance

Table 4.9 Effect of material management on time in construction projects

	N	Min	Max	Mean	Std. Deviation	Rank
Incompletion of project on time.	143	2	5	4.46	.648	1
Late arrival of construction materials.	143	1	5	4.26	.917	3
Not delivering the right material on the right time.	143	1	5	4.01	1.154	5
Idle working time due to insufficient stock of materials.	143	1	5	4.15	1.037	4
Late and time consuming procurement process will delay the project completion time.	143	1	5	4.29	.887	2

Source: own survey data, (2023)

Table 4.9 shows the impact of material management on time in construction projects. The respondents strongly agree that material management have an impact on project performance in terms of time in defense construction enterprise construction project sites, since all have the mean value above 4.

From the above table we can see that incompleteness of project on time has the mean value of 4.46. Incompletion of projects on time is the major problem in most construction projects in the country. These late completions of projects will incur additional cost to the project and decrease its overall performance. Most DCE projects in the country are being finished way over their scheduled time.

The insufficient stock of construction materials led to idling time as workers try not to exhaust the stockpile or it is worsened by a work stoppage. Due to this shortage, construction materials need to be reordered and causes longer idling time which in turn increases the project completion time. Consequently, the work progress will be delayed. As a result, the availability and sufficient quantity of construction materials affect the time performance (Jusoh & Kasim, 2017).

Construction Material inventory affects the construction time. The systematic inventory control and documentation reduce time consumption for labor to retrieve construction materials. Other effects are on-time delivery of construction material increases work progress, used appropriate quality construction material speed up finishing time, on-time material procurement reduces idling time and reasonable changes reduce an extra time for adjustment of resources. Other scholars such as Venkatalakshmi (2019) which investigated on construction material related factor impact on building construction time were suggested, the primary impact for the time delay is lack of material resources and on-time delivery systems in the project site.

Table 4.10 Effect of material management on cost in construction projects

	N	Min	Max	Mean	Std. Deviation	Rank
Increase in project cost due to poor material management.	143	1	5	3.76	1.28	3
Extra cost incurred to your project due to material storage and waste control.	143	1	5	3.17	1.453	5
Improper handling of materials will result in additional cost to the project.	143	1	5	4.21	.926	1
Extra cost on the project due to overstocking and misplacement of materials.	143	1	5	3.64	1.360	4
Lack of standard quality control and inspection increases the project cost.	143	1	5	4.07	1.066	2

Source: own survey data, (2023)

Table 4.10 shows the impact of material management on cost in construction projects. The respondents agree that material management have an impact on project performance in terms of costing defense construction enterprise construction project sites, since all have the mean value above. From the above table we can see that improper handling of materials will result in additional cost to the project has the highest mean value of 4.21.

From the data survey we can see that due to mishandling, misplacing and misusing of construction materials the enterprise's project cost is increasing very rapidly. That is mainly because of when construction material delivered to the site isn't properly stored and handled the material will be damaged and eventually will be rejected and replaced with another material. The additional purchase of the same material due to mishandling and misplacing will increase the project cost.

Rahman, et al (2013) stated that construction materials are the essence in the construction industry which represents a substantial proportion of the total value of the project. Construction material related issue contributes to cost overrun. Hence, efficient construction material management is an important criterion for the success of any project. A construction material management system includes the fundamental functions required in any construction project such as identifying, acquiring, storing, distributing, and disposing of materials. A regular and adequate supply of the materials is a very critical task as late or irregular delivery or wrong types of material delivered during construction affect the utilization of other resources like manpower and machinery. This leads to poor productivity, time delay, and cost overrun.

Patil&Pataskar (2013) argue that effective construction material management in construction projects can reduce the overall cost of the material. For example, in the purchasing process, discounts and bulk orders may be economical as they reduced transportation and ordering costs (Aziz, 2013). It has been estimated that a saving of 2% material cost possibly will increase profits by 14.6% (Jusoh&Kasim, 2017). Thus, by minimizing the procurement cost of construction materials, the higher chances for reducing the overall project cost and concurrently increasing company profit.

Also Rajaprabha, et al. (2016) state that, the factors that cause the cost overruns in building projects related to construction material management are classified into 8 categories based on the following issues: those are: - design-related issues, client-related issues, contractor related issues, site-related issues, labor and equipment related issues and external factors and market condition factors.

Planning and procurement are claimed as an equally important process that controls total project cost (Gulghane&Khandve, 2015). However, construction material control and expediting also important as the former process is to avoid shortage and surplus of construction materials occurred on site.

Table 4. 11Effect of material management on quality in construction projects

	N	Min	Max	Mean	Std. Deviation	Rank
Due to improper material handling and management quality of construction material will be affected.	143	1	5	3.50	1.337	1
As a result of poor material storage, handling and waste control quality of construction materials will be compromised.	143	1	5	2.98	1.436	3
Poor quality control and inspection mechanism in the project.	143	1	5	2.83	1.414	4
No material quality control systems like sampling and testing	143	1	5	2.69	1.416	5
Due to unavailability of the right kind of material quality of the work will be impacted.	143	1	5	3.01	1.399	2

Source: own survey data, (2023)

Table 4.11 shows the impact of material management on quality in construction projects; improper material handling and management have a mean value of 3.5, poor material storage, handling and waste control have a mean value of 2.98, poor quality control and inspection mechanism have a mean value of 2.83, material quality control systems like sampling and testing have a mean value of 2.69 and unavailability of the right kind of material quality have a mean value of 3.01. From the above result we can see that majority of the respondents with a mean value of 3.5 think that due to improper material handling and management quality of construction material will be affected.

When construction materials aren't properly handled which means when the right amount of material with the right quality isn't delivered to the project site at the right time the quality of the work will be compromised which in turn decreases the project performance in DCE project sites construction materials most of the time aren't delivered on the right amount, quality and time which will cause the projects to incur additional cost and decrease their efficiency and performance.

Tompkins and White (1984) define Effective material handling as using the right method in providing the right amount of the right material, at the right place, time, quality, sequence, position, condition, and cost.

Due to the frequency of handling materials there are quality considerations when designing a materials handling system. The selection of the material handling equipment is an important function as it can enhance the production process, provide effective utilization of manpower, increase production and improve system flexibility. The importance of appropriate handling of materials is highlighted by the fact that there are expensive and engages critical decisions. The materials handling equipment selection is an important function in the design of a material handling system in order to enhance the production process, provide effective utilization of manpower, increase production, and improve system flexibility (Chan, 2002).

Materials must be delivered to site undamaged and without any wastage. Most common problems associated with materials supply is inadequate unloading and handling facilities, which attribute a high proportion of wastage (Canter, 1993). Therefore, handling with safety during movement of materials at site, which reduce the percentage of material wastage and finally foster significant improve the total system productivity and performance.

Table 4. 12 Effect of material management on productivity and waste control in construction projects

	N	Min	Max	Mean	Std. Deviation	Rank
Decrease in productivity due to late delivery of construction materials.	143	1	5	3.97	1.084	1
Decrease in productivity due to improper handling and storage of materials.	143	1	5	3.52	1.373	5
Inefficient site layout for material movement which decreases productivity by increasing material travel time.	143	1	5	3.17	1.479	6
Material wastage and mishandling on your project by the construction crew.	143	1	5	3.76	1.301	4
Material waste on site due to inappropriate material storage.	143	1	5	3.96	1.198	2
Very poor waste control and minimization the project.	143	1	5	3.93	1.111	3

Source: own survey data, (2023)

Table 4.12 shows the impact of material management on productivity and waste control in construction projects. The respondents agree that material management have an impact on project performance in terms of productivity and waste controlling defense construction enterprise construction project sites, since all have the mean value above 3.

When we look into productivity and waste control it directly relates with project performance . Decrease in productivity due to late delivery of construction materials has the highest mean value of 3.97 from the result it can be seen that when the procurement process is very slow and time consuming it has direct impact on the project productivity.

Material waste on site due to inappropriate material storage has the second highest mean value of 3.96. From these it can be seen that when materials aren't properly stored and stored on the construction sites wastage will increase and the amount of material needed work will decrease which in turn decreases the productivity and efficiency of the work. Very poor Waste control and minimization has the third highest mean value of 3.93. From these it can be seen that in order to increase the productivity and efficiency of the construction site construction waste must be minimized as much as possible.

Mahamid (2020) found a strong relationship between labor productivity and rework in construction projects. He concluded that lack of manpower experience causes mistakes and misuse of resources that negatively affect productivity. Overall, he indicated that the main factors affecting labor productivity in building projects are: lack of experience, late delivery of materials rework, delay in payments, mistakes, and material shortages.

Materials waste in construction projects has significant impacts on various aspects. It leads to cost overruns, increases the burden on the project, and extends the completion time. Construction waste, especially material waste, negatively affects the environment and puts pressure on landfills. Improper disposal methods of construction waste can create considerable environmental impacts. Waste material affects project implementation, productivity, costs, and time. On the other hand, utilizing construction waste in making effective concrete bricks can be a workable solution in combating the waste problem. Overall, materials waste in construction projects has socioeconomic, environmental, and financial implications, highlighting the need for proper waste management and reduction strategies.

4.5. Challenges Faced in Implementation of Construction Material Management.

Table 4. 13Challenges Faced in Implementation of Construction Material Management.

	N	Min	Max	Mean	Std. Deviation	Rank
Lack of user-friendly construction materials software packages.	143	1	5	4.33	1.367	6
Lack of capable personnel in using computer-based materials management systems.	143	1	5	4.11	1.452	9
A lack of a systematic method to record and control materials during the construction phase with the manual method being preferred in projects.	143	1	5	4.38	1.019	5
Lack of understanding of construction materials management system	143	1	5	4.29	1.271	7
Insufficient and poor production of raw material by the country.	143	1	5	4.17	1.133	8
Fluctuation in the price of materials	143	1	5	4.89	1.006	1
Material monopoly by supply.	143	1	5	4.58	1.043	3
Material demand fluctuation.	143	1	5	4.63	1.347	2
Overall suspensions can incidentally due to the peace of a country or town.	143	1	5	4.51	1.145	4
Unpredictable weather conditions	143	1	5	3.96	1.059	10
Unstable government policies	143	1	5	3.87	1.224	11
Using new information technology.	143	1	5	3.76	1.447	12

Source: own survey data, (2023)

One of the objectives of this research is to assess the challenge facing contractors when implementation construction material management on building construction projects in Defense Construction Enterprise. Therefore, in this section, the challenge facing contractors when implementation construction material management on building construction projects was rated by respondents to the level of their agreement on the five-point Likert scale item questionnaires range from strongly agree (5) to strongly disagree (1).

Based on the survey data, overall challenges facing contractors in implementing construction material management in building construction projects have average mean value of above 4. As it is illustrated in figure 4.5, the challenges facing contractors in implicating construction material management are fluctuation in the price of materials 1st with a mean value of 4.89, material demand fluctuation 2nd with a mean value of 4.63, material monopoly by suppliers 3rd with a mean value of 4.58, overall suspensions that can incidentally due to peace of a country or town 4th with a mean value of 4.51, a lack of a systematic method to record and control materials during the construction phase with the manual method being preferred in projects with a mean value of 4.38, lack of user-friendly construction materials software packages with a mean value of 4.33, lack of understanding of construction materials management system with a mean value of 4.29, lack of capable personnel in using computer-based materials management systems with a mean value of 4.11, insufficient and poor production of raw material by the country with a mean value of 4.17, using new information technology with a mean value of 3.76, unpredictable weather conditions with a mean value of 3.96 and unstable government policies with a mean value of 3.87 are challenges facing contractors to implement construction material management.

However defense construction enterprise projects are facing high challenges to implementing construction material management systems due to fluctuation in the price of materials, material demand fluctuation, material monopoly by supply, overall suspensions that can incidentally due to peace of a country or town and a lack of a systematic method to record and control materials during the construction phase as obtained from survey data and also agree with interviews. Especially materials price fluctuation is highly challenged on-site because construction material price usually fluctuates every day.

CHAPTER FIVE

5. CONCLUSION AND RECOMMEDATIONS

5.1. Conclusion

From the descriptive statistical analysis on factors affecting material management which are: - material planning, material purchasing, material storage and inventory and material supply and distribution a different mean value was obtained. Under the material planning phase inadequate and incomplete design and specification has the highest mean value of 4.10, from the result we can conclude that in most DCE projects there is inadequate design and specification which leads to problems regarding material management that is because with inadequate design and specification it will be difficult to properly quantify the materials needed for the project on the right time which leads to shortage or overage of material demand. From material purchasing stage of material management time consuming and inefficient procurement process for construction materials has the highest mean value of 4.15 from these it is clearly evident that the enterprise material purchasing and bidding process is very long and tiresome these is mainly because of the instability of the construction material, lack of qualified material suppliers who met the company's material purchasing standard like quality assurance certificate , third party certificate , authorization letter , sample approval and test report , refusal of suppliers to do business with government owned construction company because of the legal requirements for the purchasing like vat registration , renewed trade license and tax clearance .

These long and tiresome bidding and purchasing process is extremely affecting the enterprises material management process because it will take a very long time to deliver construction materials to the site.

When we look into material storage and inventory control stage improper handling of construction materials has the highest mean value of 3.94. From the result we can conclude the enterprise has a very poor truck record of material handling and utilization process.

These result is clearly evident in the different construction sites where the thesis was based, in those specified projects there is very poor material management strategy like wasting construction materials, using excess material over than the allowed standard, not reusing construction materials like nail and formwork. These mishandling of construction material is the result of negligence by the construction crew and no proper material utilization and controlling mechanism on the sites.

Under the material supply and distribution phase of material management unsafe and negligent transportation and delivery of construction materials has the highest mean value. From the result we can conclude that there is a poor habit of delivering and transporting of construction materials to the site by drivers mainly HCB due to negligence of drivers. These will cause the construction materials to be broken or damaged which in turn will affect material management.

When we look into effect of material management on project performance we can conclude that regarding its effect on time most projects on DCE are completed way over their competition time and due to improper handling of construction materials on site the project's cost will significantly increase and the quality will be affected and finally regarding productivity and waste control we can conclude that due to late delivery of construction materials to the construction site productivity and efficiency significantly decreases .

Regarding challenges faced in implementation of construction material management fluctuation in the price of materials has the highest mean value and from the result we can conclude that due to the uncertainty of the construction market and price fluctuations it is increasingly difficult for managing the construction materials on site. The second ranked challenge regarding material management is material demand fluctuation form the result we can conclude that due to estimation, guess work and negligence by the construction crew the material actual demand and the one supplied to the site will vary. This material demand fluctuation will decrease the project productivity since material shortage on the construction site due to material demand fluctuation

5.2. Recommendation

Based on the results of this study, the following recommendations are made to foster effective materials management practice of construction projects in DCE:

- Thorough and detailed design and specification review should be made in order to make the design and specification complete as much as possible and avoid problems that may happen related to material management.
- Material purchasing and procurement process very fast and efficient. The material procurement should have a lead time before the specific construction activity starts.
- Material handling in the construction sites should be a priority by setting strict rules, penalties and code of conduct from storing, transporting up to the actual utilization stages.
- Safe and efficient way of transporting and delivering construction materials to the site should be made by avoiding damages that may happen during the transporting and delivering stage.
- Construction projects should be completed on time in order to avoid problems that may happen in relation to material management.
- Construction materials should be utilized effectively in order to avoid extra costs that may occur to purchase additional materials.
- Maximum priority should be given to quality of construction materials to avoid rework and waste.
- Construction materials should be delivered on the right time to increase the productivity of the manpower.
- System, applications and software should be applied in the projects sites in order to improve material management process from the procurement up to utilization stages like ERP .

5.3. Recommendations for Future Research

This study has scope limitations as it is considered only the enterprises building construction projects in and around Addis Ababa. Further study of ranking the survey responses by profession and by sector would result interesting findings. Study based on project size and duration would result interesting findings.

Moreover, it is recommended to study and evaluate other types of construction projects like roads, water and building construction projects which differs from the population used in this research. Finally, based on the findings of this study in addition research can be done in other study areas on: factors affecting construction material management practices and its effect on project performance in the Building Sector in order to generalize findings. Also, it is possible to study and confirm the performance improvement mechanisms in order to validate the findings of the present research.

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7. APPENDICES

Appendix -A

Adama Science and Technology University

School of Civil Engineering and Architecture

Department of Civil Engineering

Msc in Construction Engineering and Management (CEM)

Questionnaire for data collection

Dear respondents

I am undertaking a research survey to **assess the material management practices in the construction projects site of Defense Construction Enterprise.**

The research is an individual research project as part of my study for MSC Degree dissertation at Adama Science and Technology University. The main purpose of this research questionnaire is to assess materials management practices in defense construction enterprise building construction project sites in and around AdisAbeba with a view to proffering solutions to the problems of excessive waste leading to cost overrun, project delay and loss of profit. As a key staff of the company you are invited to participate in this survey. The information you provide in response to the items in the questionnaire will be used as part of the data needed for the study. All the information you provide will kept in strict confidentiality and it will be used only for academic research Please answer each question carefully. There is no right or wrong answer. If you are unsure of an answer, please respond with your best estimate. I value your participation and thank you for the commitment of time, energy and effort.

Sincerely

AbeselomYaredShiferaw

Email addresses: - **143myloxylo@gmail.com**

Cell phone No. 0912-006877/0973-000297

Thank you very much

General Instructions

- There is no need of writing your name
- In all cases where answers options are available please tick (✓) in the appropriate box.
- Tick in the appropriate space provided under each question;
- If you cannot get any satisfying choice among the given alternatives, you can write your answer, in the space provided for the option
- For the open-ended items, give brief answer in the space provided.
- In the 5–points scale provided, mark a cross (✓) at the point that represents your feeling.
 - ✓ Strongly Disagree = 1
 - ✓ Disagree = 2
 - ✓ Undecided/Neutral = 3
 - ✓ Agree = 4
 - ✓ Strongly Agree = 5

Part one: - General Information

1. Gender: - Female ☐ Male ☐
2. Age:
- 18-20 ☐ 21-30 ☐ 31-40 ☐
- 41-50 years ☐ above 50 years ☐
3. Number of Employees in your team/site (Both Permanent and Temporary)?
- 0 – 9 employees ☐ 10 – 99 employees ☐ 100 – 299 employee ☐ above 300 ☐
4. Profession: - Project Manager ☐ Construction Engineer ☐ Office Engineer ☐
- Civil engineer ☐ Quantity surveyor ☐ Electrical Engineer ☐
- Sanitary Engineer ☐ Construction Forman ☐ Other _____
4. Experience 0 – 5 years ☐ 6 – 10 years ☐ 11 – 15 years ☐ 16 – 20 years ☐
5. Respondent's educational qualification
- Certificate ☐ Diploma ☐ Adv. Diploma ☐ BSC ☐ MSC ☐ PHD ☐

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Part two: - Items related to material management

S/N	2.1 Factors that affects the material management practices in building construction sites	Strongly disagreed (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agreed (5)
Material Planning						
1	Inadequate and incomplete design and specification.					
2	Existence work orders and variations.					
3	Habit of estimation and guess work.					
4	Lack of awareness and knowledge regarding material management.					
Material Purchasing						
5	Unqualified professionals regarding material management and stock control.					
6	Habit of theft, burglary and vandalism of construction materials on the site.					
7	Insecure and unsafe material storage.					
8	Time consuming and inefficient procurement process for construction materials					
9	Habit of storing and collecting construction materials in stores for long time before using.					
Material Storage and Inventory Control						
10	No policy of materials management and waste control					
11	Improper handling of construction materials					
12	Lack of proper warehouse management practices for construction materials like FIFO , LILO ,Kaizen and BPR					
13	Not delivering construction material on the right time.					
14	Weak inventory and stock control to update the projects current stock.					
Material Storage and Inventory Control						
15	Unavailability of both local and industry produced construction materials near the project site.					

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16	Using damaged and expired construction materials.					
17	Unsafe and negligent transportation and delivery of construction materials.					
18	Not enough material quantity inspection, verification and control.					

S/N	2.2 Effect of poor material management on project performance	Strongly disagreed (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agreed (5)
Time Project Performance						
1	Incompletion of project on time.					
2	Late arrival of construction materials.					
3	Not delivering the right material on the right time.					
4	Idle working time due to insufficient stock of materials.					
5	Late and time consuming procurement process will delay the project completion time.					
Cost Project Performance						
1	Increase in project cost due to poor material management.					
2	Extra cost incurred to your project due to material storage and waste control.					
3	Improper handling of materials will result in additional cost to the project.					
4	Extra cost on the project due to overstocking and misplacement of materials.					
5	Lack of standard quality control and inspection increases the project cost.					
Quality Project Performance						
1	Due to improper material handling and management quality of construction material will be affected.					
2	As a result of poor material storage, handling and waste control quality of construction materials will be compromised.					
3	Poor quality control and inspection mechanism in the project.					

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4	No material quality control systems like sampling and testing					
5	Due to unavailability of the right kind of material quality of the work will be impacted.					
Productivity and Waste control Project Performance						
1	Decrease in productivity due to late delivery of construction materials.					
2	Decrease in productivity due to improper handling and storage of materials.					
3	Inefficient site layout for material movement which decreases productivity by increasing material travel time.					
4	Material wastage and mishandling on your project by the construction crew.					
5	Material waste on site due to inappropriate material storage.					
6	Very poor waste control and minimization the project.					

S/N	2.3 Challenges facing contractors in implementation material management	Strongly disagreed (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agreed (5)
1	Lack of user-friendly construction materials software packages.					
2	Lack of capable personnel in using computer-based materials management systems.					
3	A lack of a systematic method to record and control materials during the construction phase with the manual method being preferred in projects.					
4	Lack of understanding of construction materials management system.					
5	Insufficient and poor production of raw material by the country.					
6	Fluctuation in the price of materials.					
7	Material monopoly by supply.					
8	Material demand fluctuation.					
9	Overall suspensions can incidentally due to the peace of a country or town.					

Investigation of the factors affecting construction material management practices and its effect on project performance in building construction projects: the case DCE, 2024

10	Unpredictable weather conditions					
11	Unstable government policies					
12	Using new information technology.					

Appendix C2 :- Supporting letter for data collection

