UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION

ASSESSMENT OF MATERIAL MANAGEMENT ON BUILDING CONSTRUCTION SITES: A STUDY OF SELECTED CONSTRUCTION COMPANIES IN THE CAPE COAST METROPOLIS

STEPHEN ANDERSON

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BY

STEPHEN ANDERSON

A thesis in the Department of Construction and Wood Technology Education, Faculty of Technical Education (FTE), submitted to the school of Graduate Studies of the University of Education, Winneba, in partial fulfilment of the requirements for award of the degree of Master of Technology (M.Tech) in Construction Technology of the University of Education, Winneba

AUGUST 2018

DECLARATION

Candidate's Declaration

I, STEPHEN ANDERSON declare that this thesis, with the exception of quotations and references contained in the published works which have been identified and duly acknowledged, is entirely the results of my own original research work, and it has not been submitted, either in part or whole for another degree in this University or elsewhere.

SIGNATURE……..……

DATE…….……..……..

Supervisor's Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines on supervision of project work laid down by the University of Education, Winneba.

Name of Supervisor: **Dr. Peter P. Yalley**

Signature…….……..

Date……

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DEDICATION

I dedicate this work to my family

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ABSTRACT

The control of materials on construction sites is handled by planning and purchasing departments, site supervisors and engineers as well as contractor's organization and this have been posing various problems to contractors in realizing reasonable profit margin. The main purpose of the study was to assess material management of construction companies in Cape Coast Metropolis. This study assessed the current practices of managing materials on building projects, the problems associated with materials management and measures for managing materials in building projects in Cape Coast Metropolis. The study was carried out through the administration of questionnaire to professionals in both consulting and contracting firms and data collected were analyzed using descriptive statistics. The study found that majority of the employees' had adequate knowledge on materials management practices (purchasing of materials, material planning method and transportation of materials). The most severe problem militating against materials management was lack of proper work planning and scheduling while other problems include inadequate cash flow to contractors due to delayed payments, burglary, theft and vandalism. The study recommends that management should improve their supervision on site, materials should be adequately handled when delivered, care should be given to materials handling process and more awareness should be given to the knowledge of materials management on building projects most especially on construction sites.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The construction industry plays an important role in any economy and its activities are also vital to the achievement of the socio-economic development goals of providing shelter, infrastructure and employment (Anaman & Osei-Amponsah, 2007). Construction has been an important player in many countries economy, especially developing countries. The sector currently accounts for more than 11% of global GDP (Betts et al., 2011). In Ghana just like many other developing countries the construction industry is playing a vital role to achieve socio-economic development goals, providing shelter, infrastructure, and employment and above all contributing significantly to the GDP of the country (Owusu, 2014).The construction industry is becoming increasingly competitive and materials management is now considered to be one of the frontiers for cost reduction to improve profitability and productivity (Kuebutornye, 2016).

Materials management is a critical component of the construction industry and it is an important function in project management. Stukhart (2007) defines materials as the items that are used to produce a product and which include raw materials, parts, supplies and equipment items. Material management is the 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 (Ayegba, 2013). Materials management defined materials management functions which include planning and material take off, vendor evaluation and

selection, purchasing, expenditure, shipping, material receiving, warehousing and inventory, and material distribution (Pande & Sabihuddin, 2015).

In the construction industry, all construction works depends on two factors, namely, cost of materials and cost of labour (Ayegba, 2013). Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs. In light of this, Stukhart (2007) argued that the total cost of installed material may be 50% or more of the total cost even though the factory cost may be a minor part of the total, probably less than 20-30%. Bestowing to Khyomesh and Vyas (2011), 30-70% of project cost is consumed by material with about 30 to 40 percent of labour. This is because the manufactured item must be stored, transported, and restored before it is put in place or "consumed" at the site.

Therefore, efficient procurement and handling of material represent a key role in the successful completion of the work. Efficient management of materials can result in substantial savings in project costs (Wendy, 2006). Poor materials management can result in increased costs during construction. The main goal of material management is to ensure that the materials are available at their point of use when needed. The goals of material managements include the following; thus to get the right quality, the right quantity of supply, delivery at the right time, at the right place and at the right cost (Moro, 2015). The material management system attempts to ensure 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 (Kasim, 2011). Material management is therefore carried out to reduce wastage of materials, reduce shortage of materials, and minimize material damages, insufficient

storage space and avoid delays in supply. Material Management helps to improve the productivity which at the end will have major cost and time benefits (Ayegba, 2013).

In view of these goals, it is important for the material manager or contractor to consider that there may be significant difference in the date that the material was requested or date when the purchase order was made, and the time at which the material will be delivered. These delays can occur if the contractor needs a large quantity of materials which the supplier is not able to produce at the time or by any other factors beyond his control. The material manager or contractor should always consider that procurement of materials is a potential cause for delay (Haddad, 2006). The manger or the contractor should be considered management of materials at all the phases of the construction process and throughout the construction and production periods. This is because poor material management can often affect the overall construction time, quality and budget (Priya, 2014).

Construction projects suffer from delays, budget overruns, and claims (Ahadzie & Amoa-Mensah, 2010). According to Nwachukwu et al. (2010), the rate at which building construction projects fail, or are abandoned (under construction) is largely dependent on effective application of materials management techniques in developing economies. He further indicated that failure or abandonment of construction projects in developing economies may be attributable to inefficient material management practices on construction projects sites. Current materials management practices in the construction firms 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, also lack of information on materials management (Ntim, 2016).

Material management inefficiencies has led to time and cost overruns of more than 100% in the implementation of projects (Konadu-Agyemang, 2001). Poor materials management practices have in the recent past also contributed to the abandonment of projects as a result of poor planning and control of materials, lack of materials when needed, poor identification of materials, re-handling and inadequate storage cause losses in labour productivity and overall delays that can indirectly increase total project costs (Ahadzie & Amoa-Mensah, 2010). Most contractors involve the use of sub-standard elements, shoddy jobs through the use of cheap inexperienced labour which most often results in building collapse, abandoned projects and liquidation of contractors (Ntim, 2016).When materials are not managed well, it can lead to materials surplus, reduction in productivity and lack of up-to-date and real time information (Kasim, 2011).

During any construction project the three inter-related factors of time, money, and quality need to be controlled and managed. Successful completion of projects requires all resources to be effectively managed (Haddad, 2006). Attention must be paid to how materials are been procured, stored and managed in order to achieve perfect work, effective handling of materials, right usage of materials and control of construction resources. It is important for the project manager to consider that there may be significant difference in the date that the material was requested or date when the purchase order was made, and the time at which the material will be delivered (Idowu, 2014). Therefore, there is a need

for efficient materials management in order to control productivity and cost in construction projects.

Past research has revealed that effective material management techniques contribute to construction project success with respect to delivery time, project cost, quality, and safety (Ademeso & Windapo, 2012, Keitany & Mutwol, 2014). Therefore, it is believed that effective implementation of effective materials management techniques could go a long way to enhance project success in the Ghanaian construction industry. A properly implemented materials management program can achieve the timely flow of materials and equipment to the jobsite, and thus facilitate improved work face planning, increased labour productivity, better schedules, and lower project costs. Hence, organizations need to understand the effects of proper materials management techniques on the effectiveness of project execution (Mohammed & Anumba 2006).

With good construction material management, construction cost can be reduced hence profits can be made and the various bad practices by contractors can be avoided. Researchers have continuously identified that efficient management of materials can result in substantial savings in project costs, (Khyomesh & Vyas, 2011). So with good construction material management construction cost overrun can be avoided profits can be made even with the lowest bid and the various bad practices by contractors can be avoided. It is against this background that this study is initiated to assess material management of construction companies in Cape Coast Metropolis.

1.2 Statement of the Problem

Materials resource management has been the backbone of every construction firm. However, the present state of the building construction industry in Ghana reflects various problems ranging from delays in project execution/delivery, substandard work, disputes, to cost and time overrun as a result of material shortage and wastages on sites, theft and displacement of materials on sites, as well as poor accounting and security system of the concerned sites/firms (Ahadzie & Amoa-Mensah, 2010; Adafin, et al., 2011; Kasim, 2011; Ayegba, 2013; Idowu, 2014; Ntim, 2016). Studies have shown that material forms about 60%-70% cost of the entire project and 5%-27% of the total material purchased goes waste (Agyekum, 2012). The wastage may be due to lack of improper planning by most of the managing bodies. The occurrence of this situation had made most of the projects abandoned at the final stages with the complaint of lack of capital. Most completed projects have heaps of sand, chipping, quarry dust, rusted steel rods, and rotten timber, broken down vehicles left at the site (Gascuena et al., 2010).These suggest that when materials are not managed well, it can lead to materials surplus, reduction in productivity and lack of up-to-date and real time information.

According to Dahiru (2010), lack of materials not only causes delays, but a consequent decrease in productivity and resulting to cost overruns. This is no doubt lack of effective material management is one of the major cause of this problem. Failure of the project manager to make available materials need could lead to delay. Non-compliance strictly with project bill of quantities, schedule of materials, specifications and construction programme 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, and hence no proper material stock control practice (Inyang-Udoh, 2002). Besides that, Dey (2001) noted that the rate at which materials are being wasted due to improper management is becoming unbearable to the contractors due to its effect on their profit margin and proper usage of material to achieve quality job been done through various techniques.

According to Association of Building and Civil Engineering Contractors of Ghana (2015), transport difficulties, improper handling of construction materials on site, misuse of specification, lack of proper work plan, inappropriate materials delivery and excessive paperwork adversely affect materials management practices on most sites in the Northern Region. Kuebutornye (2016) revealed that most construction project sites in the Northern region are characterized by emergency purchases of materials, inadequate storage, double handling of materials, material shortages, theft and sometimes condemnation of materials and works by consultants. All these problems have associations with poor materials management practices used on project sites. Proper storage is very necessary in the construction industry both at the pre, during and post construction stage, since most of the materials go waste and hence an attempt to develop an adequate means of storage of materials at the site. It is against this background that this study is initiated to assess material management of construction companies in Cape Coast Metropolis.

1.3 Purpose of the Study

The main purpose of the study was to assess material management of construction companies in Cape Coast Metropolis. Specifically, the study is guided by the following objectives.

1. To explore the knowledge of employees on effective materials management.
2. To investigate the effect of effective materials management practices or techniques on building construction project delivery success
3. To examine the problems associated with materials management on building projects.

1.4 Research Questions

1. What is the knowledge of employees on effective materials management?
2. What is the effect of effective materials management practices on building construction project delivery success?
3. What are the problems associated with materials management on building projects?

1.5 Significance of the Study

The construction industry is one of the most important components of every economy. The study is significant for the following reasons. The findings would enable the construction firms to be aware of the efficient materials management practices to be adopted to ensure project success. The study would contribute to literature on factors influencing material management on building construction sites. Findings from the study would help the stakeholders to develop policies and practices that could improve material management on

sites. The study would also serve as a guide for personnel in the building industry, such as directors of construction companies, project managers and site supervisors to help improve management of materials on building construction sites by making better decisions in order to have quality work done.

This study would be of importance to building professionals and the general public because it would not only clarify but also create awareness of the extent to which inadequacies in material management can adversely affect project delivery. The study will also help contractors, clients, consultants and all parties involved in construction projects about ways of improving their current method of material management. The findings of the study would serve as a resource base or a reference material for other researchers and scholars who are interested in carrying out further research in this field subsequently.

1.6 Scope of the Study

This study focuses on assessment of material management on building construction companies in the Cape Coast Metropolis. The study specifically focused on knowledge of effective materials management, problems associated with effective materials management, effect of effective materials management practices and critical factors for improving materials management on construction project sites. Geographically, the study was limited to contractors, material managers, site supervisor and employees (labourers) of building construction companies in the Cape Coast Metropolis.

1.7 Limitations of the Study

The willingness of the material managers to reveal weaknesses in their respective organizations was uncertain; the respondents might have given desired data, which made their firms look good. Nevertheless, managers'

perception is frequently used in material management research. Insufficient fund tends to impede the efficiency of the researcher in sourcing for the relevant materials, literature or information and in the process of data collection (internet, questionnaire and interview). The researcher would simultaneously engage in this study with other academic work. This consequently would cut down on the time devoted for the research work.

1.8 Organization of the Study

This research was categorized into five chapters. Chapter one involved the introduction which is subdivided into seven sections: background to the study, statement of the problem, purpose of the study, research questions, significance of the study, delimitation and limitations of the study. Chapter two entailed the literature review. Chapter three focused research methodology which comprised, research design, study population, sample and sampling procedures, data collection instrument, data collection procedures and data processing and analysis. Chapter four looked at results and discussions. The last chapter, chapter five entailed summary, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The purpose of this study was to assess material management of building construction companies in Cape Coast Metropolis This chapter reviews literature on effects of effective materials management techniques on construction organizations. It covers the role of a material manager on site, the concept of construction materials, classification of construction materials, concept of material management, objectives of material management, component of material management, material management techniques, challenges of material management, benefits of effective material management, factors affecting effective materials management in construction project, and relationship between material management and construction project success

2.2 The Concept of Construction Materials

Endless quantities of materials are required at various times and in various locations, in order to complete a successful project and make significant contributions to the cost effectiveness of projects. Therefore, a deep understanding of material behavior is essential to enable efficient construction (Kini, 1999). Ballot (2006) defines materials as; the physical materials that are purchased and used to produce the final product and does not suggest that materials are the final product. In other words, materials are the parts used to produce the final product. Bailey et al. (2009) defined materials as the goods purchased from sources out of the organization that are used to produce finished products. Stukhart (2007) defined materials as the items that are used to produce a product and which include raw materials, parts, supplies and equipment items.

It also includes construction materials like sand, stone, roofing sheet, cement, and sand Crete blocks.

2.3 Classification/Types of Construction Materials

Several studies have categorized construction materials in terms of how they appear, thus either in their raw state or finished product.

Dobler and Burt (2009) and Chandler (2008) categorised construction materials into five categories:

1. **Raw materials-** materials that the company converts into processed parts (i.e. Sand, Stones, Water).
2. Purchased parts- parts that the company buys from outside sources (i.e. ceiling, Roofing sheet, Glazing Window).
3. **Manufactured parts**- parts built by the company (i.e. Blocks, Frames, Reinforcement materials).
4. **Work in process**- these are semi-finished products found at various construction (i.e. Walls, Precast Concrete).
5. **MRO supplies-** maintenance, repairing, and operating supplies used in the building process but are not part of the final products (i.e. Formworks, Pegs).

Stukhart (2007) states that the main categories of materials encountered in a construction project are engineered materials, bulk materials, and fabricated materials.

1. **Bulk materials-** these are materials manufactured to standards and are purchased in quantity. They are bought in standard length or lot quantities Examples of such materials includes pipes, wiring, and cables.

They are more difficult to plan because of uncertainty in quantities needed.

2. **Engineered materials-** these materials are specifically fabricated for a particular project or are manufactured to an industry specification in a shop away from the site. These materials are used for a particular purpose. This includes materials that require detailed engineering data.
3. **Fabricated materials**- these are materials that are assembled together to form a finished part or a more complicated part. Examples of such materials include steel beams with holes and beam seats.

Chandler (2008) states that construction materials can be classified into different categories depending on their fabrication and in the way that they can be handled on site. He classifies the materials into five categories. They are:

1. **Bulk materials-** these are materials that are delivered in mass and are deposited in a container.
2. **Bagged materials-** these are materials delivered in bags for ease of handling and controlled use.
3. Palleted materials- these are bagged materials that are placed in pallets for delivery.
4. **Packaged materials-** these are materials that are packaged together to prevent damage during transportation and deterioration when they are stored.
5. **Loose materials-** these are materials that are partially fabricated and that should be handled individually.

Hendrickson, (2008) also classified materials by the way of loading and unloading or the process of delivery and these are as follows;

1. **Bulk materials:** These are materials which are in their natural or semi-processed state, such as excavated materials, wet concrete mix, etc. They are usually measured in banks and volumes;
2. **Standard off-the-shelf**: These are standard materials which can be stored on shelves are easily to be stockpiled; and their process of delivery is very simple. Example are the standard pipes, valves, mortise locks, hinges, etc.; and
3. **Fabricated members:** These are the materials that are already made and sent to the site to be stored. They are normally made to the specific dimension and units depending their weight and how it will be delivered. Example is the I-beam and columns.

Kamau (2011) and other studies have categorized construction materials in terms of how they appear, thus either in their raw state or finished product. These classifications are as follows;

1. **Raw materials:** These categories represent the original state of the materials and are the materials which are normally in its natural process. They are not affected so much by the weather and pilferage; and most at times bulky in nature. Consumes a lot of space when not properly planned well at the site. Chippings (gravels) and sand are examples;
2. **Factory goods:** These categories deal with those items which have passed a series of processes and the end point are to pick and install. They are normally well packaged and most of them are off the shelf items. Examples include cement, ceramic items (closets, bath, basin, tiles) and ironmongery; and

3. **Workshop finished items:** They are the semi-finished product, thus slight works will be done on them before using. They are normally with their standard measurements and those materials are normally expensive since any default on it will create for it replacement. Examples include glass, timber, roofing materials, etc.

2.4 The Concept of Material Management

Different researchers provide different definitions for material management. Therefore, different definitions can be found in different references. Basically, material management is concerned with the planning, identification, procuring, storage, receiving and distribution of materials. Ballot (2006) defines materials as the physical materials that are purchased and used to produce the final product and does not suggest that materials are the final product. In other words, materials are the parts used to produce the final product. Bailey and Farmer (2002) define materials as the goods purchased from sources out of the organization that are used to produce finished products. Stukhart (2007) defines materials as the items that are used to produce a product and which include raw materials, parts, supplies and equipment items.

Ballot (2006) defines material management as the process of planning, acquiring, storing, moving, and controlling materials to effectively use facilities, personnel, resources and capital. Bailey and Farmer (2002) define material management as a concept concerned with the management of materials until the materials have been used and converted into the final product. Activities include cooperation with designers, purchasing, receiving, storage, quality control, inventory control, and material control. Stukhart (2007) defines material management as the activities involved to plan, control, purchase,

expedite, transport, store, and issue in order to achieve an efficient flow of materials and that the required materials are bought in the required quantities, at the required time, with the required quality and at an acceptable price.

Plemmons and Bell (2005) define material management as the plan and control of all activities to ensure the correct quality and quantity of materials and equipment to be installed as specified in timely manner, obtained at reasonable cost and are available when needed. Dobler and Burt (2009) state that material management is designed to improve the activities related to the flow of materials. They add that material management should coordinate purchasing, inventory control, receiving, warehousing, materials handling, planning, and transportation. Tersine and Campbell (2007) define material management as the process to provide the right materials at the right place at the right time in order to maintain a desired level of production at minimum cost.

From these definitions, it evident that material management is a function responsible for planning and controlling of materials flow. The purpose of material management is to control the flow of materials effectively. The purpose of material management is to assure that the right materials are in the right place, in the right quantities when needed. The responsibility of one department (i.e. material management department) for the flow of materials from the time the materials are ordered, received, and stored until they are used is the basis of material management.

Material management structure should be organized in such a way that it allows for integral planning and coordination of the flow of materials, in order to use the resources in an optimal way and to minimize costs (Beekman-Love,

2008). Gossom (2003) indicates that a material management system should have standard procedures for planning, expediting, transportation, receipt, and storage to ensure an efficient system for materials control. Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing procurement or purchase costs presents important opportunities for reducing costs. Poor materials management can also result in large and unavoidable costs during construction. First, if materials are purchased early, capital may be tied up and interest charges incurred on the excess inventory of materials.

Even worse, materials may deteriorate during storage or be stolen unless special care is taken. For example, electrical equipment often must be stored in waterproof locations. Second, delays and extra expenses may be incurred if materials required for particular activities are not available. Accordingly, insuring a timely flow of material is an important concern of project managers. Materials management is not just a concern during the monitoring stage in which construction is taking place. Decisions about material procurement may also be required during the initial planning and scheduling stages. For example, activities can be inserted in the project schedule to represent purchasing of major items such as elevators for buildings (Dubler & Burt, 2009). The availability of materials may greatly influence the schedule in projects with a fast track or very tight time schedule. Sufficient time for obtaining the necessary materials must be allowed.

2.5 Material Management in Building Construction Project

Construction industry is the most significant industry in the economy and the successful measure with completion within time, budget, accordance

with specification and satisfaction of stakeholders (Nguyen et al, 2004). The management of materials in construction projects is an important function that significantly contributes to the success of a project. As projects grow in scale and complexity, materials management becomes more difficult, often requiring the use of appropriate tools and techniques to ensure, amongst other things, that materials are delivered on time, stock levels are well managed, the construction schedule is not compromised, and that wastage is minimized.

Materials management is especially problematic for large and complex projects, where sophisticated tools and techniques are necessary. The management of materials in complex construction projects needs adequate consideration due to the various elements involved and the importance of the project. It is important to manage all materials from the design stage to the construction stage of the project as poor handling of construction materials affects the overall performance of construction projects in terms of time, budget (cost), quality and productivity. The wastage of materials should also be minimized during construction in order to avoid loss of profit for construction companies (Kasim & Anumba, 2005).

John (2013) observed that the relevance of materials management to the total production operation cannot be overestimated; materials management activities actually start before the production begins by providing optimum materials required for production and its supply at the various production stages. Forecasting of company's sales and purchasing of various materials required for production is needed at the planning stage. Purchasing, procurement of materials, transportation, storage, inventory control, quality control and inspection of materials, materials handling, packaging, warehouse planning,

accounting, scrap, surplus and obsolete materials disposal, finished goods safety and care are the functions performed by materials management.

The purpose of material management is to control the flow of materials effectively. The improper handling and management of materials on construction sites has the potential to severely hamper project performance (Ogunlana et al, 1996). The result of improper handling and managing materials on site during construction process will influence the total project cost, time and the quality (Che Wan Putra et al, 1999). The costs of materials management may range from 30-80% of the total Construction costs depending on the type of construction (Muehlhausen, 1991). However, Kini (1999), noted that 50-60% of the total cost of construction projects is for construction materials and equipment. According to Stukhart (2007), materials are a major component on any project with value 50-60%. Therefore, there is a need for efficient materials management in construction projects. This is because poor materials management will affect the overall construction time, quality and budget.

Therefore, an effective materials management system is required in order to avoid problems, such as delays in a construction project. Delays in materials supply have been found to be a major cause of time overrun (Dey, 2001). Many factors accelerate the delay of project duration, however poor materials management can have a major effect on site activities. Ogunlana et al. (1996) suggested that the main reasons for project delays on housing projects in Thailand were incomplete drawings, material management problems, organization deficiencies, shortage of construction materials, and inefficiencies in site workers. Dey (2001) also observed that delays in materials supply was a major cause of time overrun. Thus, it would seem that materials delays are a

major cause of delays in construction projects. There is also a need for an integrated material handling process from the design stage to the usage of materials-This could happen, with a good management system with the implementation of ICT in managing materials. Hence, a good materials management environment enables proper materials handling on construction sites.

2.6 Objectives of Materials Management in Building Construction Project

Problems related to managing the flow of materials can be found in every organization. The efficient management of materials plays a key role in the successful completion of a project. The control of materials is a very important and vital subject for every company and should be handled effectively for the successful completion of a project. Materials account for a big part of products and project costs. The cost represented by materials fluctuates and may comprise between 20-50% of the total project cost and sometimes more. Some studies concluded that materials account for around 50-60% of the project cost (Stukhart, 2007; Bernold & Treseler, 1991). Materials are critical in the operations in every industry since unavailability of materials can stop production. In addition, unavailability of materials when needed can affect productivity, cause delays and possible suspension of activities until the required material is available (Haddad, 2006).

Unavailability of materials is not the only aspect that can cause problems. Excessive quantities of materials could also create serious problems to managers. Storage of materials can increase the costs of production and the total cost of any project. When there are limited areas available for storage, the managers have to find other alternatives to store the materials until they are

needed. Some of these alternatives might require re-handling of materials, which will increase the costs associated with them. Provisions should be taken to handle and store the materials adequately when they are received. Special attention should be given to the flow of materials once they are procured from suppliers (Haddad, 2006).

It is obvious that materials should be obtained at the lowest cost possible to provide savings to the company (Damodara, 2008). In the late 1970's, construction companies experienced an increase in costs and a decrease in productivity. Owners of these companies thought that these increases in cost were due to inflation and economic problems. Further research concluded that these companies were not using their resources efficiently and that the decrease in productivity was also attributable to poor management (Stukhart, 2007). Material management has been an issue of concern in the construction industry. 40% of the time lost on site can be attributed to bad management, lack of materials when needed, poor identification of materials and inadequate storage (Baldwin et al., 1994).

The need for an effective materials planning system becomes mandatory. Some companies have increased the efficiency of their activities in order to remain competitive and secure future work. Many other firms have reduced overheads and undertaken productivity improvement strategies. Considerable improvement and cost savings would seem possible through enhanced materials management. Timely availability of materials and systems are vital to successful construction. Materials management functions are often performed on a fragmented basis with minimal communication and no clearly established responsibilities assigned to the owner, engineer or contractor

(Haddad, 2006). Better material management practices could increase efficiency in operations and reduce overall cost. Top management is paying more attention to material management because of material shortages, high interest rates, rising prices of materials, and competition. There is a growing awareness in the construction industry that material management needs to be addressed as a comprehensive integrated management activity (Haddad, 2006).

Materials Management is the vital function for improving productivity in construction projects. The management of materials should be considered at all the faces of the construction process and throughout the construction and production period. This is because poor materials management can often affect the overall construction time, quality and budget. Project managers and building contractors are faced with a huge responsibility of ensuring that materials are used effectively. It is absolutely important for planning and controlling of materials to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, obtained at a reasonable cost, and are available when needed. To achieve this, they implement different policies and strategies.

According to Haddad (2006), effective construction materials management is a key to successful projects. Although, other researchers have already done intensive research on this topic of material management, this is not only about what materials is but more about material management issues and for effective utilization of materials on construction sites. Materials constitute a major cost component for construction industry (Gulghane, 2015). Patel et al. (2011) state emphatically that the total cost of materials may be 60% or more of the total cost incurred in construction projects. Kasim (2011) explained that

materials management functions include planning and taking off materials, vendor evaluation and selection, purchasing, expenditure, shipping and material receiving. Almost 60% of the total working capital of any industrial organization consists of material cost.

Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing procurement or purchase costs presents important opportunities for reducing costs (Dabler & Burt, 1996). Poor materials management can also result in large and unavoidable costs during construction. First, if materials are purchased early, capital may be tied up and interest charges incurred on the excess inventory of materials. Even worse, materials may deteriorate during storage or be stolen unless special care is taken. For example, electrical equipment often must be stored in waterproof locations. Second, delays and extra expenses may be incurred if materials required for particular activities are not available (Cavinato, 1984).

Accordingly, ensuring a timely flow of material is an important concern of project managers. Materials management is not just a concern during the monitoring stage in which construction is taking place. Decisions about material procurement may also be required during the initial planning and scheduling stages. For example, activities can be inserted in the project schedule to represent purchasing of major items such as elevators for buildings (Dobler & Burt, 1996). The availability of materials may greatly influence the schedule in projects with a fast track or very tight time schedule. Sufficient time for obtaining the necessary materials must be allowed. In some cases, more expensive suppliers or shippers may be employed to save time. Materials

management is also a problem at the organization level if central purchasing and inventory control is used for standard items. In this case, the various projects undertaken by the organization would present requests to the central purchasing group. In turn, this group would maintain inventories of standard items to reduce the delay in providing material or to obtain lower costs due to bulk purchasing (Cavinato, 1984).

This organizational material management problem is analogous to inventory control in any organization facing continuing demand for particular items. Materials ordering problems lend themselves particularly well to computer based systems to ensure the consistency and completeness of the purchasing process. In the manufacturing realm, the use of automated materials requirements planning systems is common. In these systems, the master production schedule, inventory records and product component lists are merged to determine what items must be ordered, when they should be ordered, and how much of each item should be ordered in each time period. The heart of these calculations is simple arithmetic: the projected demand for each material item in each period is subtracted from the available inventory. When the inventory becomes too low, a new order is recommended. For items that are non-standard or not kept in inventory, the calculation is even simpler since no inventory must be considered. With a materials requirement system, much of the detailed record keeping is automated and project managers are alerted to purchasing requirements (Stukhart, 1995).

Waste of construction materials on site refers to the difference between materials delivered to construction site and those that are actually used for the construction work (Onabule, 1991). Hence from Onabule's (1991)

specification it can be affirmed that construction waste are those materials supplied to site for construction and are not being used in the actual construction constituents. This supports Seeley's (1997) views that not all materials delivered to construction sites are used for the purpose for which they are ordered. Furthermore, Formoso et al. (1999) defined waste as "any losses produced by activities that generate direct or indirect cost but do not add any value to the product". Rational management of material to avoid waste is an important consideration for reducing construction cost and construction duration. Therefore, there is a need for efficient material management in order to control productivity and cost in construction projects. Hence the overall objectives of any on-site management activity should be directed to provide full-guard on construction materials and to perform efficient usage of such materials (Mohammed & Anumba, 2006).

The construction industry is the most significant industry in the economy and the successful measure with completion within time, budget, accordance with specification and satisfaction of stakeholders (Nguyen et al, 2004). Construction is the process of physically erecting the project and putting construction equipment, materials, supplies, supervision, and management necessary to accomplish the work (Clough et al., 2000). Construction projects are complex, with many organizations involved such as clients or owners, architects, engineers, contractors, suppliers and vendors. This includes the heterogeneous and often complex process of producing unique, large and immovable products with a supply of the resources (money, equipment, material, and labour). The improper handling and management of materials on construction sites has the potential to severely hamper project performance

(Ogunlana et al., 1996). The result of improper handling and managing materials on site during construction process will influence the total project cost, time and the quality (Che Wan Putra et al, 1999).

The costs of materials management may range from 30-80% of the total construction costs depending on the type of construction (Muchlhausen, 1991). However, Kini (1999) accounted 50-60% of the total cost of construction projects is for construction materials and equipment. According to Stukhart (1995) materials are a major component on any project with value 50-60%. Therefore, there is a need for efficient materials management in construction projects. This is because poor materials management will affect the overall construction time, quality and budget. Therefore, an effective materials management system is required in order to avoid problems, such as delays in a construction project. Delays in materials supply have been found to be a major cause of time overrun (Dey, 2001). Many factors accelerate the delay of project duration; however poor materials management can have a major effect on site activities.

Ogunlana et al. (1996) suggested that the main reasons for project delays on housing projects in Thailand were incomplete drawings, material management problems, organization deficiencies, shortage of construction materials, and inefficiencies in site workers. Dey (2001) also suggested that delays in materials supply was a major cause of time overrun. Thus, it would seem that materials delays are a major cause of delays in construction projects. There is also a need for an integrated material handling process from the design stage to the usage of Materials-This could happen, with a good management system with the implementation of ICT in managing materials. Hence, a good

materials management environment enables proper materials handling on construction sites

2.7 Issues Involved in Material Management at Construction Sites

Basically, the issues of material management are concerned with the planning, identification, procuring, storage, receiving and distribution of materials. The purpose of material management is to assure that the right materials are in the right place and in the right quantities when needed. The responsibility of one department (i.e. material management department) for the flow of materials from the time the materials are ordered, received, and stored until they are used is the basis of material management (Haddad, 2006). Priya (2014) states the issues of material management as planning, identification, procuring, storage, receiving and distribution of materials.

The issues of materials management are well-defined by Gulghane et al. (2015) as the process by which an organization is supplied with the goods and services to achieve its objectives of buying, storage, and movement of materials. According to American Society of Civil Engineers (ASCE,2014), Materials Management is integrated processes that consist of the people, organization, technology and procedures used to effectively identify, quantify, acquire, inspect, transport, receive, store, and preserve the materials. T-Phani et al. (2013) pointed out that Materials Management also called Supply Chain Management or Logistics is the field dedicated to the efficiency of procuring, transporting and distributing the supplies needed for an organization's operations.

2.8 Materials Management Processes

Materials management practices on building project are categorized practices to five processes Gulghane and Khandve (2015), planning, purchasing, and transportation, handling and waste control.

1. **Planning:** Planning is a very major factor in the management of material. It takes care of all the process and at the same time coordinates the rest of the processes. Material planning includes measuring, ordering and scheduling which helps to increase productivity. Most construction firms tend to be costly when proper planning is not implemented (Donyavi, 2009). Khyomesh (2011) informed that the most commonly used basis for planning things out for the project is the Bill of Quantity prepared by the client. Companies may have two major levels in planning that is micro and macro level. Time, cost, material and labor are the four major types of planning undertaken on sites. The planning should be revised as frequently as possible in order to monitor whether work is progressing as planned.

   During the planning prices, detailing the project in terms of its outcome, team members' roles and responsibilities, schedules, resources, scope and costs are needed. At the end of this phase, a project management plan is produced, which is a document that details how your project will be executed, monitored and controlled, and closed. Burt (1996) observed that planning and programming of work should include strategies, tactics, and tools for managing the design and construction delivery processes and for controlling key factor to ensure the client receives a facility that matches their expectations and function

as it is intended to function. Materials requirement planning is technique used to determine the quantity and timing requirements of dependent demand "materials used in the construction operation.

2. **Purchasing:** Purchasing of the materials and services from outside the firm to support the operations of the firm to marketing, sales and logistics (Hendrickson, 2008). A detailed material schedule and coordination of purchasing and order of materials are important in assuring material availability (Kasim, 2010). The purchasing function is central to material management. Purchasing has the responsibility and the authority to commit project funds for materials, equipment, and services. This activity may be accomplished by the home office, the field, or a combination of both depending on the size and the scope of the project. The home office must maintain planning, procedural, and policy direction over the field operations in order to ensure consistent purchasing practices (Stukhart & Bell 2007). The term procurement encompasses a wide range of activities that includes purchasing of equipment, materials, labour and services required for construction and implementation of a project. 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.
3. **Logistics/Transportation of materials:** Is the concept that deals with the delivery of materials to site and also involve the planning, implementation and controlling the movement and storage of all the

things from raw materials to finish product. The routing of the materials also affects the cost and time to completion of the project (Hendrickson, 2008). 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 (Ahuja & Dozzi 1994).

Good logistics involved the use of minimum of materials on site awaiting assembly, as well as being good for cash flow, this makes 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. Transportation or traffic expertise aids the materials management team in handling numerous types of special loads from delicate electronics to massive modules. Knowledge of requirements, source and availability of this equipment may be critical to successful execution of the work, transport permitting requirements also must be considered early in the project (Bailey & Farmer, 2002).

4. **Handling:** Handling of materials deals with the flow of materials form the suppliers to the site. Due to the rate of handling materials, there are considerations that are used in the materials handling system. The selection of material handling most at times depends on it went or the center of gravity of the material and which enhance the production process, provide effective operation of manpower, increase production and advance the system to be more flexible (Eynon et al., 2014).

Tompkins and White (1984) define 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 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.

Due to the frequency of handling materials there are quality considerations when designing a materials handling system. Material handling equipment selection is an important function as it can enhance the production process, provide effective utilization of manpower, increase production and improve system flexibility (Chan 2002). Sadiwala (2007), affirmed the following improvement of materials handling system which are: Motion which implies that materials movement from one place to another should be handled efficiently to eliminate avoidable movements so as to minimize cost, Time which indicate that materials handling officer must ensure materials get to, or remove from production unit at the right time, Place that materials should be at the right place at the right time to enhance smooth operations, Quantity: which means that materials supply to, or remove from the right place should be according to operating unit demands and Space: which means efficient storage space is paramount to achieving the objectives of materials handling system and overall organization goals.

5. **Stock and waste control:** Stock control is the technique planned to ensure that materials or equipment are available at all time. It includes raw materials, processed materials, assembly components, consumable stores, general stores, maintenance materials and spares, work in progress and finished products. Construction activities generate a lot of waste and cause difficulty to the construction industry. The implementation of materials management which is effective will help to minimize waste of materials and increase profit for the firm (Kasim, 2011). 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 (Prabu, 1986).

   It is of great importance that the bulk of construction materials delivery requires proper management of stock control. Meanwhile, construction activities can generate an enormous amount of waste (Teo, 2001), it has been recognized as a major problem in the construction industry (Formoso, 2002). However, tighter materials planning can reduce waste and can directly contribute to profit-improvement and productivity. Reduction of waste can be done by practicing attitude towards Zero wastage, proper decisions at design stage, site management, proper standardization of construction materials, and codification of the same construction waste can also be reduced by using waste management system on project. The project activities are to be planned at every stage by every construction personnel, who are

involved, in minimizing the overall waste generation at project (Thomas, 2013)

2.9 The Roles of a Materials Manager

According to Haddad (2006), a material manager is the person in-charge of the materials management on construction project site. The material manager ensures the flow of materials from the time the materials are ordered, received, and stored until they are used in the basis of material management (Sundararajan & Shanmugapriya, 2014; Ebole, 2005). The role that a materials manager plays in an organization is strictly economical since the materials manager should keep the total cost of materials as low as possible. The person in charge of handling materials should keep in mind the goals of the company and insure that the company is not paying extra money for materials. The goal of every company is to make a profit. This is the basis for company survival, costs should not exceed income, but keeping in mind customer's expectations.

The typical tasks associated with a material management system are (Tersine & Campbell, 1977; Ammer, 1980; Stukhart, 1995).

1. Procurement and purchasing
2. Expediting
3. Materials planning
4. Materials handling
5. Distribution
6. Cost control
7. Inventory management / Receiving/ Warehousing
8. Transportation

Purchasing and procurement deals with the acquisition of materials to be used in the operations. The primary function of purchasing and procurement is to get the materials at the lowest cost possible, but keeping in mind quality requirements. Expediting is the continuous monitoring of suppliers to ensure on time deliveries of materials purchased. The purpose of materials planning is to procure the materials for the dates when they are needed, storage facilities, and handling requirements. The primary function of materials handling is to manage the flow of materials in the organization (Kasim, Anumba & Dainty (2005). The manager has to assure that the costs associated with handling materials are kept to a minimum. In cost control, the manager has to insure that the costs to buy materials are kept to a minimum. In other words, the manager has to insure that he is buying the products at the lowest possible price. The inventory management deals with the availability of materials. Transportation involves using the safest most economical means to transport the materials to the site where they are needed (Stukhart, 1995)

Cavinato (1984) states that the objectives of a material management system should include lowest final cost, optimum quality, assurance of supply, and lowest administrative costs. The materials manager should obtain the materials needed at the lowest cost possible. By buying products at the lowest possible costs, operating costs can be reduced and profits can be increased. Proper handling and storage of materials can reduce the total cost of materials; therefore the materials manager should ensure that materials are handled properly and stored in the most adequate places (Kasim et al., 2005). Quality is a very important aspect that the materials manager has to keep in mind. When specifications require a high quality product, quality could become the most

important objective. Suppliers play an important role in any organization. Many companies rely greatly on outside suppliers for the materials needed for production. Good relations with suppliers might be decisive for a company to be in business (Stukhart, 2007).

Companies that have good relations with suppliers could be more successful in attracting customers than companies that have bad relations with suppliers. When a company has good relations with its suppliers it could benefit from cost reductions, cooperative environment from the employees of the supplier, and willingness to help with materials ordered and orders pending. When a company has bad relation with their suppliers it might be possible that it experiences late deliveries or wrong materials delivered (Kasim et al., 2005). This will have an impact on the total cost of the product, possibly increasing the total costs, and delaying the completion of the final product. Materials acquisition from the procurement time until it is received in the field can have a significant impact on the schedule of a construction project. Based on the studies presented, it is clear that effective management of materials can minimize the impact that lack of materials or improper management of materials could have on the overall schedule and cost of the project. The materials manager should assure that effective and economical transportation are used to transport materials to the site (Stukhart, 2007)

2.10 Problems Associated with Materials Management in Project

Kasim et al. (2005), identifies improper construction materials management as a factor affecting the general performance of construction projects in respect to construction time, quality, cost and overall construction productivity. Rivas (2011), 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) found that poor planning for construction materials and difficulties associated with site transportation as factors leading to a lack of construction materials on sites. Goodrum and Maloney (2009) recognized that waiting for transportation of materials and equipment on site as the most significant factor impinging on the productivity of construction workers.

Managing materials among sub-contractors is an issue almost on each construction site; materials are sometimes needed to be shifted from one place to another place on the site resulting additional cost of manpower and machinery (Anwar, 2015). Pauline (2014) 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. In construction projects especially high rise buildings insufficient space for the required material is a very common problem and to overcome this problem contractor and subcontractor may arrange an additional warehouse nearby that can cater for the required material (Narimah, 2008). 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.

2.11 Factors that Lead to Mismanagement of Materials on Building Construction Sites

Spillane et al. (2011) postulate that the top five issues in the management of materials on a confined construction site was established using the severity index (SI) ranking. Therefore, the top five issues identified and explained below:

1. **Contractor's Material Spatial Requirements Exceed the Available Space:** Spatial requirement requires thorough attention due to the likelihood of this issue occurring, considering that construction materials make up an average of 40% to 50% of a total project cost (Vainio, 1999; Vrijhoef & Koskela, 2000). With the increase in the utilization of sub-contractors and third parties to the average construction project (Langford & Male, 2001; Holt, et al., 2003), the amount of on-site management and co-ordination is set to increase dramatically (Winch, 2009, 2010). With the increase in contractor involvement coupled with the continued compression of many of today's project schedules (Chang et al., 2005; Nepal, 2006), the need for on-site management to successfully accept delivery and accommodate the numerous material requirements of these subcontractors grows in complexity with the number of contractors on-site.

   In order to provide for and aid in the movement of required material, the space required must be documented, managed and allocated accordingly. Scenarios where the spatial requirements for material on-site exceed the availability of space on site require proactive management to be introduced to mitigate the resulting effect. Where

such instances are mitigated, there is a propensity for reduced accidents (Spillane et al., 2011), increased productivity (Thomas et al., 1989) and ultimately, a greater possibility of achieving project success. In order to alleviate the issue, the vast majority of authors agree that the most advantageous strategy to adopt is one of proactive mitigation through early contractor involvement (Proverbs & Holt, 2000; Trigunarsyah, 2003; Khalfan, et al., 2004; Song, et al., 2009) coupled with continuous communication among the parties (Emmitt & Gorse, 2003), both horizontally and vertically, on and off-site with the various internal stakeholders associated with the project.

2. **Difficult to Coordinate the Storage of Materials in Line with the Programme:** Interestingly, Thomas et al., (2005) identifies storage as the first step in materials management and failure to accommodate materials results in poor productivity and waste (Thomas et al., 1989). The effect of unsuitable storage locations is also an issue in poor labour productivity (Enshassi, et al., 2007), thereby indicating that not only is the presence of adequate storage space essential, but correctly located storage is also a factor in the overall on-site productivity. The negative effect of inadequate/inappropriate material storage is an issue with various trades on-site, such as masonry productivity (Sanders & Thomas 1991). The mismanagement of material storage is a leading factor in spatial congestion and results in reduced levels of productivity on construction projects (Thomas & Riley, (2006). Therefore effective measures must be taken to counteract such instances on-site.

Ensuring an adequate stockpile of materials on-site is essential in the management of production (Horman & Thomas, 2005). Where there is a lack of storage space, this inventory may become compromised, resulting in further negative results in productivity and materials management. Effective site and space utilization is fundamental to the management of materials (Chau et al., 2004). Where space is limited, additional management of the available space is essential to accommodate the various material requirements of a project.

On reviewing a number of the interviews and the literature (Yang and Mahdjoubi, 1999; Yang, et al., 2003; Mohamed & Anumba, 2006; Soltani & Fernando, 2004), a number of authors identify the experience of the management in the successful allocation of material and its associated storage on-site. This is based on intuition and experience gained through knowledge obtained in the industry. The knowledge gained is tacit and takes years to develop through experience and interaction in the industry. Koskela (1999) aptly concludes by outlining that projects are very often constructed in 'sub-optimal conditions'. In addition, congestion was highlighted as being 'one facet of a wider phenomenon' where extensive management is necessary to accommodate such working conditions on site.

3. **Location of the Site Entrance Makes Delivery of Materials Particularly Difficul**t: The third material management issue is the difficulty in the transportation of materials, particularly in relation to the location of the site entrance. This happens predominantly in the vicinity of the site entrance. This is mainly attributable to bottleneck effects, where multiple deliveries can result in increased management

intervention to alleviate any issue that may arise. This may be classified and detailed under the title of material flow, an important topic in the management of materials on-site. In a study conducted on material management, material flow management was classified as the second most critical factor in project management's level of satisfaction in construction logistics (Jang et al., 2003).

Inadequate working conditions can ultimately lead to increased material handling, resulting in possible injury to personnel (Mitropoulos et al., 2005a). Mitropoulos et al., (2005b) also outlines that the "unpredictability generates hazardous situations" results in "chaos and confusion". Furthermore, the benefit of an effective site layout and thus, the location and number of site entrances, contributes to the flow of materials. The provision of adequate spatial considerations has been considered by a number of authors (Elbeltagi et al., 2004). This is highlighted further where adequate planning is required to avoid excessive movement of materials on-site, thereby, reducing the probability of double handling materials in adverse conditions. Through effective identification and location of site entrances, the possibility of increased handling of materials is mitigated. Thomas and Riley (2006) concludes that interruptions to the normal flow of materials will cause serious degradations to performance and labour productivity. From the aforementioned it is evident that improper location of the site entrance, resulting in inadequate room for the effective handling of materials, is a significant issue in materials management in confined site environments.

The site layout is directly connected to the management of materials (Elbeltagi & Hegazy, 2003; Tam, et al., 2002; Sadeghpour, et al., 2002), and where such management is implemented, monetary savings are attainable (Osman & Georgy, 2005). One of the primary functions of an adequate designed site layout is to aid in the movement of materials, unto and around site, as is necessary in the completion of the various tasks (Elbeltagi et al., 2004). The supply of materials is fraught with difficulties, not only onto site, but also in getting materials to site (Agapiou et al., 1998). With many urban confined site environments, the location of the site entrance or the site itself can be an issue. The role of logistics management and supply chain management are essential in the management of materials and the location of the site entrance, both prior to arriving on-site and during the delivery and unloading process.

To conclude, the ability to design and accommodate adequate logistics management plans, site layout plans and materials management plans are all essential in the management of the transportation of materials both unto and around site (Yang et al., 2003). Where such site layout plans are not implemented, the movement of materials on-site is significantly restricted, resulting in increased manual handling, double handling, waste, lost productivity, increased health and safety risks and inevitably, at the extreme, project failure (Mawdesley et al., 2002).

4. **Difficult to Store Materials on-Site Due to the Lack of Space:** The fourth issue identified by the quantitative analysis was the difficulty with storing materials on-site due to the lack of space. One of the main

reasons for a lack of storage space on-site is over-crowding or congestion of the workspace, which is directly correlated to poor project productivity (Thomas & Riley, 2006). An overcrowded construction site may lead to double handling of materials, again, reducing productivity and increasing damage to materials (Horman & Thomas, 2005) along with increased health and safety concerns (Huang & Hinze, 2003). Inadequate management of materials through over allocation also has been identified as impeding progress, workflow and overall productivity, due to overcrowding the limited work space available (Horman & Thomas, 2005) while also exasperating the issue of security of materials (Berg & Hinze, 2005). Planning is essential to overcome this issue and management of the critical space. Planning has been noted as being fundamental to site management, including spatial management and reducing congestion on-site (Winch & North, 2006).

On confined sites, material waste may increase, resulting in significant increases in cost (Poon, et al., 2004b) and additional project costs (Stukhart & Bell, 2007). It is estimated that on average, 1 to 10% of materials entering site, leave site as waste, due to improper management (Bossink & Brouwers, 1996). This shows the need for effective material management on-site. Formoso et al. (2002) considers the estimate conservative as they report that the range of material waste falls between 2-15%. Formoso et al. (2002) also highlight that the total building waste in urban areas could be as much as 30% in confined construction sites. Lack of space is an inherent difficulty acknowledged throughout the industry, when constructing a development in an urban

environment (Singer, 2002; Tindiwensi, 2000; Navon & Berkovich, 2006). In counteracting this issue, it has been noted that the strategies implemented can often prove problematic and cumbersome when trying to monitor and control a rigid project programme (Navon & Berkovich, 2006; Vrijhoef & Koskela, 1999; Lummus et al., 2001). As a result, the effective management of materials within a confined urban site cannot be over-emphasised and must be acknowledged and implemented throughout any project, but in particular, a spatially restricted development.

5. **Difficult to Coordinate the Storage Requirements of the Various Sub-Contractors:** The final factor identified as significant is the difficulty to coordinate the storage requirements of the various subcontractors. The co-ordination and movement of materials both onto and around site can be a cumbersome and time consuming task but one which is of paramount importance to site management (Soltani & Fernando, 2004). In cases where space is a limited factor, this task becomes infinitely more difficult and requires extensive management interface in the co-ordination of the material storage requirements of the various sub-contractors (Winch & North, 2006). The co-ordination of materials on-site has been classified under a number of sub-sections, as follows (Thomas et al., 1989):

   a) Organization and storage of materials,

   b) Housekeeping of materials and their waste,

   c) Planning of material deliveries,

   d) Material availability on-site,

e) Material handling and distribution on-site.

The effective coordination and movement of materials is fundamental to the success of any project (Kini, 1999), particularly under then headings outlined previously. Where such steps are acknowledged and managed accordingly, increased savings are attainable, with some cases reporting saving of up to six percent in labour costs due to optimised schedules and improved productivity as a direct result of effective materials management (Stukhart & Bell, 2007).

The coordination of materials and other resources has been documented by numerous authors (Thomas et al., 2005; Nepal et al., 2006; Lu et al., 2007), illustrating that effective co-ordination of the various resources is essential to avoid waste or non-value adding activities in the industry (Formoso et al., 2002). Effective co-ordination of resources is essential in the management of the various resources on-site. To further this point, material waste is not always the result of poor co-ordination on-site. In some instances, waste occurs due to design faults and errors occurring during the design stage of a development (Enshassi, 1996; Love & Li, 1999). In the majority, waste on-site has been identified as being caused by poor co-ordination and communication in the management of materials which results in considerable additional cost in both monetary and schedule terms (Thomas et al., 2005).

Koskela (1999) shows that almost 40% of the total cost of materials on-site is made up of purchasing and controlling the movement of materials on-site. Where this task is made more efficient, there are significant savings available (Koskela, 1999). Project co-ordination, including material co-ordination was highlighted as one of the key issues in projects failing to meet

the predetermined project programme (Muholland & Christian, 1999). Through acknowledging the requirement to facilitate effective material co-ordination with the other various tasks and resources on-site, such programme slippages could be mitigated or eliminated as the project progresses. Coordination and communication are often taken collectively due to each generally occurring in unison. Where both facets are taken jointly, the cause of delay and disruption between resources and stakeholders is vastly reduced (Assaf & Al-Hejji, 2006). In addition, co-ordination is fundamental in the management of the allocation of stakeholders to resources - an integral part of the management of the movement and allocation of materials on site (Koskela, 1999). Therefore, the co-ordination of materials is an essential facet in the management of materials on-site, but where spatial limitations occur, this point is significantly more evident (Thomas et al., 1989).

2.12 Measures for Managing Materials in Building Project

In order to achieve good materials management on building project Calistus (2013), opine that the following areas have to be taken very seriously i.e. Training of management and other staff, Inventory control of materials on site, Ensuring proper planning, monitoring and control. Alwi, Hampson, and Mohammed (1999), recommend the following effective management of building projects which includes: Management, supervision and administration of sites, Provision of adequate storage of materials, Proper usage of materials, Materials schedule for the contract on hand, Materials delivery, Provision and accessibility site layout, Attention to weather conditions.

1. **Training of both management and other staff:** Vivian (2006), opine that it is necessary to provide education and training to encourage and

promote the benefit in reuse, recycling and reduce the material consumption; however, cost saving for reuse and reduce the material consumption is difficult to measure, in which the material can be reuse and reduce the consumption for several times. Lingard (2000), observe that it is more effective to provide training and education among staff, and involve employees' participation in implementing waste management and pointed out that employees' participation could only be effective with genuine support from management.

2. **Inventory control of materials on site**: Abdul-Rahman (1994) affirms that it involves taking note of the use and inventory of materials on site and recordings i.e. the loading and off-loading, transit and handling of materials. It is recommended that arrangements be made for materials to arrive on time. When a construction material is delivered to a site, it should be checked for damage, quantity, quality and specification. Kapot (2010) stated that this involves physical control of materials, preservation of stores, minimization of obsolescence and damage through timely disposal and efficient handling, maintenance of stores records, proper location and stocking. Stores are also responsible for the physical verification of stocks and reconciling them with book figures. The inventory control covers aspects such as setting inventory levels, ABC analysis, fixing economical ordering quantities, setting safety stock levels, lead time analysis and reporting.
3. **Ensuring proper planning, monitoring and control**: Mohamed (2006) describe construction site management practice as the process of determining, analyzing, devising and organizing all resources necessary

to undertake construction project. It also includes monitoring and controlling the planned actions towards successful project delivery. Some of the specific activities include the production of a Gantt-chart, network analyses, method statements, resource leveling, progress reports and exception reports. The core element of planning is the establishment of a programme which reflects the planning process in relation to real time (Griffith & Watson, 2004), construction planning is the total process of determining the method, sequence, labour, plant, and equipment required to undertake a building project. All but the simplest tasks require planning in order to be accomplished with the best utilization of time and resources (Chimay, 2006)

4. **Management, supervision and administration of sites**: Supervision is the direction of people at work and management is the planning and control of the work process on construction site, supervision, management and administration of site are gradually spread over the earth because it is a more efficient way of accomplishing work (Alwi, et al, 1999). All work requires the coordination of effort; this is accomplished by giving workers assigned tasks and assigned time in which they are to accomplish these tasks, but instruction is not is not enough. A clear, specific instruction on what is to be done, monitor the worker in the course of their efforts. Jimoh, (2012), this is the arrangement on construction sites that lends to effective information dissemination and exchange. Information such as correspondences, minutes, labour allocations, payroll, progress reporting, notices or claims, instruction, drawing register and technical information does flow

among stakeholders, for processing and further actions during and after project construction.

5. **Provision of adequate storage of materials**: Kasim (2005) material storage on site requires close attention in order to avoid waste, loss and any damage of materials which would affect the operation of the construction project. Proper material storage system must be designed to accommodate the loads of the materials to be stored; the sensitive environmental needs for different materials to be permanently stored and preserved; the functional, efficiency and safety of the visiting public and operating personnel; and the protection of the materials from fire, water and man-made threat (Pat, 1991).There must be a proper storage facilities provided for materials on site, some materials are usually not stored in shed or locked up building, also double handling of materials because of improper or indecision about the proper storage facility constitute to waste. Old stock must be available for use after a fresh delivery is made and these materials must be placed in such a way that damage would not be done to it by human activities or traffic on site. Bagged materials such as cement should be stored in a place that is free from moisture.
6. **Proper usage of materials:** Phu and Cho (2014), describes usage of materials is the flow component that provides for their movement and placement. Material usage can be defined as the provision of proper handling techniques either manually or mechanically for the components held on site during construction process. Adequate care must be taken to prevent wastage when working with materials on

construction project, the assembly of installation process involves the practical incorporated into the project of materials depending on how the skills of the workmen involved. Materials on job site at times may have had a little defect due to poor storage or poor quality on the part of the manufacturer.

7. **Materials schedule for the contract on hand**: Kelvin (2013), It has been established that preparation of a good materials schedule helps a long way in solving the problem of material handling on site. This is prepared at the contract stage of building contract by an estimator and also by the contractor in order to know accurately how much material to mobilize the site. This entails accurately detailed type, the size of materials and all other possible information regarding the required materials and the quantities and date on which it should be delivered. Materials schedules are valuable to buyer for ordering and also to site supervisor to ensure that materials when delivered are allocated or unloaded at or for the projects or building elements for which they are specified ordered productivity (Plunkett, 1994). Project schedules should establish guidelines as to when and how the project should be executed, schedule requirements need to be communicated and properly managed throughout the entire project. The purpose of scheduling is to organize and allocates the resources of, equipment and labor with the construction projects tasks over a set period of time.
8. **Provision and accessibility site layout:** Construction site layout involves identifying, sizing, and placing temporary facilities within the boundaries of construction site (Heap, 2007). These temporary facilities

range from simple lay down areas to warehouses, fabrication shops, maintenance shops, batch plant, and residence facilities. Required temporary facilities and their areas are depending in many factors including project type, scale, design, location, and organization of construction work. A detailed planning of the site layout and location of temporary facilities can enable the management to make considerable improvement by minimizing travel time, waiting time, and increasing worker morale by showing better and safer work environment.

Site layout involves the study, planning and organization of unused area of site around the proposed development to accommodate the contractor's construction equipment, materials and buildings for use in the execution of the construction works (Kwakye, 1991). One of the primary considerations for site layout is the need to keep the construction production continuous by maintaining a means of access to the site and facilitate the adequate flow of traffic. Therefore material location is important when preparing a layout plan and this consideration would aid materials handling on construction project.

9. **Attention to weather conditions:** According to research Muhwezi (2012), severe weather conditions were ranked in the first positions as the most significant waste attributes on project in the respective categories, exposing materials to inclement weather such as steel bars which rust and may get damaged. Using research result conducted by (Wahab & Lawal, 2011). Adverse weather is considered one of the main factors causing delays and cost overruns on construction projects (Osama & Khaled, 2002).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The main purpose of this study was to assess material management of construction companies in Cape Coast Metropolis. This chapter presents the methodology that was used in conducting the study. The section focuses on research design, target population, sample size and sampling procedures, research instruments, validity of the instruments, reliability of the instruments, data collection procedures and data analysis techniques.

3.2 Research Design

The study made use descriptive-cross sectional survey design rooted in quantitative approach. Quantitative research is objective in nature and it is an inquiry into a social human problem, based on testing a hypothesis or answering research questions or a theory composed of variables (Naoum, 2007). The quantitative approach was chosen because the study sought to assess the material management on building of Paa Baadu and Jeofra construction companies in the Cape Coast Metropolis; hence, quantitative survey approach. The study further utilized the descriptive cross-sectional survey design. Mmaduakonam (1998) states that “a survey research is a form of descriptive research which is a critical examination of events, subjects objects or ideas with intent of providing exact information about the condition of such phenomenon”. This method of data collection is suitable where the population under study is relatively large, and where the phenomena under investigation can be observed directly by the researcher. Descriptive cross-sectional surveys gather at a particular point in time and describe the nature of existing conditions or identify

standards against which existing conditions can be compared. The purpose of using descriptive-cross sectional survey design is the researcher aim to determine and reports the way things are done in the construction companies without manipulating any variables.

3.3 Study Population

The population for the study comprised contractors, material managers, site supervisor and employees (labourers) of selected registered construction companies in the Cape Coast Metropolis with the Association of Building and Civil Engineering Contractors of Ghana (ABCECG). The main reason for using this category of people is that their activities directly or indirectly have a bearing on material management in the firms (See Table 1 for population distribution).

3.4 Sample and Sampling Procedures

The sample for the study were all contractors, material managers, site supervisors and employers of selected registered constructions companies in Cape Coast metropolis. The sample for the study was 249. This composed of 10 contractors, 26 material managers, 26 site supervisors and 187 employees (labourers) from the selected registered construction companies in Cape Coast Metropolis (see Table 1). Census method was used in selecting the respondents from the construction companies because the population was few and it is realistic to include everyone in the study. So, the contractors, material managers, site supervisor and employees (labourers) of selected registered construction companies were automatic included in the study because they were key informants and their activities directly or indirectly have a bearing on material management in the firms.

Table 1: Population and Sample Distribution

Companies	Contractors	Material Managers	Site Supervisor	Employees (labourers)
Paa Baadu	1	3	4	23
Jeofra	1	2	2	17
Kofi Essuman Ent	1	3	3	16
Stev Asiedu Co.. Work	1	2	3	19
Bethel Winners Ent	1	3	3	22
Tacoa Const. Ltd	1	2	3	15
M. TT Eng Services	1	3	2	17
Samas Constr. Work	1	2	2	19
Monapat Co. Ltd	1	3	2	18
Gaw const. Ltd	1	3	2	21
Total	**10**	**26**	**26**	**187**

Source: Field data, 2017

3.5 Data Collection Instrument

The primary data for the study was collected using self-developed structure questionnaire (see Appendix A). The questionnaire developed was close-ended type based on the aim of this study. The questionnaire was developed using four point Likert scale type (strongly disagree to strongly agree) containing five sections (Section, A, B, C, D & E). Section "A" focused on the background information of the respondents. Section "B" contained information of respondents' knowledge on effective materials management. Section "C" dealt with the problems associated with effective materials management. Section "D" looked at the effect of effective materials management practices and the last section entailed the critical factors for improving materials management (See Appendix A)

The questionnaire was designed to collect data from contractors, material managers, site supervisor and employees (labourers). These experts were selected based on their roles in construction as far as management of materials are concerned. These questionnaires were developed to enable respondents select the response from options. Orodho (2004) states that a questionnaire is the most commonly used method when the respondents can be reached and are willing to co-operate. Questionnaires were considered ideal for collecting data from the teachers since they can express their feelings and attitudes in writing. Further a large number of teachers were used for the study hence questionnaire method was more appropriate to reach the large number of teachers.

3.6 Data Collection Procedures

Since the study involve human beings, ethical consideration was ensured before the data collection. After being cleared by the research supervisor, an introductory letter was obtained from the Department of Construction and Wood Technology Education, Faculty of Technical Education, College Of Technology Education, Kumasi to help obtain a research permit from the selected building construction companies in Cape Coast Metropolis. The researcher then visited the selected building construction companies to make appointments with the respondents. The respondents were assured of confidentiality of their responses. The researcher personally distributed the questionnaire to the respondents. The respondents were given one day to complete the questionnaire. In all 249 questionnaire were distributed and all the questionnaire were retrieved giving 100% return rate.

3.7 Data Processing and Analysis

The data collected through questionnaires was edited, coded and entered into computer. The data fed into computer was then analyzed using the Statistical Programme for Social Scientists (SPSS) version 21.0. The data was analyzed using descriptive statistics (mean, standard deviation, frequency and percentages). Research questions 1 and 2 were analysed using means and standard deviations. A mean of (4 + 3+ 2 + 1) = 2.50 or above indicated agreement with the item statement while the mean of 2.49 or below indicated disagreement with the items in research questions 1 and 2. For ease of analysis in research question 1, the mean of 2.50 or above was regarded as high knowledge level on materials management and the mean of 2.49 or below was regarded as low knowledge level on material management. Also, for ease of analysis in research question 2, the mean of 2.50 or above was regarded as positive effect of effective materials management practices building completion and the mean of 2.49 or below was regarded as negative effect of material management practices on building completion. Research question 3 was answered using frequency and percentages. The results of the data analysis were presented in the form of tables.

CHAPTER FOUR

DATA PRESENATTION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

The main purpose of the study was to assess material management of building construction companies in Cape Coast Metropolis. This chapter deals with the presentation, interpretation and discussion of the results. The presentation of the results is in two sections. The first section presents the results of the respondents' socio-demographic characteristics and the second section presents the results based on the research questions.

4.2 Socio-Demographic Characteristics of Respondents

The background characteristics of the respondents were sought. These included their gender, age and working experience. The data of the background information of respondents were analysed using frequency and percentages as shown in Table 2.

Table 2 shows the results of the respondents concerning their background information. The background data of the respondents were gender, age and working experience. Regarding the gender distribution of the respondents, it was found that the majority (n=237; 95.2%) of the respondents working on the building construction sites were males while only 12 of them representing 4.8% were females. This result implies that the male respondents were more than the female respondents working in the building construction companies. This could be associated to the nature of the job which demand a lot of human efforts. To the age distribution of the respondents, it was found that more of them (n=87; 34.9%) were within the age group of 25-30years.

Table 2: Respondents' Background Information (n=249)

Variables	Freq.	%
Gender distribution		
Male	237	95.2
Female	12	4.8
Age distribution		
Below 25years	37	14.9
Between 25-30years	87	34.9
Between 31-35years	77	30.9
Above 35years	48	19.3
Working experience		
1-5years	99	39.8
6-10years	86	34.5
11-15years	35	14.1
Above 15years	29	11.6

Source: Field data, 2018

This was followed by 77(30.9%) of the respondents who were found to be in the age group of 31-35years while 48(19.3%) and 37(14.9%) of the respondents indicated above 35years and below 25years as the age group. This result suggest that the respondents working in the building construction companies were young adults who we might perceived to be matured on the ground. This could help the selected companies effectively manage the materials used on sites. Also, to the working experience of the respondents, it was found that all of them had some working experiences on the sites. For example, 99(39.8%) of them had been working their respective companies for 1-5years. This was followed by 86 of the respondents representing 34.5% who had been working for 6-10years while 35(14.1%) and 29(11.6%) of the respondents indicated 11-15years and above 15years as their working

experience in the construction companies. This working experience of the respondent could help them in effective management of the sites materials use in order to have success completion rate of the buildings (see Table 2).

Research Question 1: What is the knowledge of employees on effective materials management?

The main objective of this research questions was to examine the knowledge of the respondents concerning material management in the building construction companies. On four-point Likert scale (none, low, moderate and high), the respondents were asked to indicate their knowledge level on materials management on sites. The results was analysed using means and standard deviation. Using the four-point, a mean of 2.5 and above indicates respondents' high knowledge on materials management while a mean of 2.49 and below indicates respondents' low knowledge on materials management. The results were presented in Table 3.

Table 3 shows the results of the respondents concerning their knowledge towards materials management in the building construction companies in Cape Coast Metropolis. The results of the study indicated majority of the respondents had high level of knowledge on materials management. This level of knowledge is exhibited within sub-scale. For example, majority of the respondents highly agreed (M=3.42; SD=0.66) that they considered the nature/type of materials when ordering. This suggests that most of them are aware of the quality and inferior materials in the market. Hence, before nay order is placed for materials, they take into consideration, the nature, and types of the materials. Similarly, the majority of the respondents had high level knowledge (M=3. 32; SD=0.71)

on materials recovering and recycling. Thus, they could recover lost materials and even recycle some of the materials used in the building constructions (see Table 3).

Table 3: Respondents' Knowledge of Materials Management Practices

Statements	Means	SD
Purchasing of materials	3.15	0.67
Material planning methods	3.27	0.53
Transportation of materials	3.21	0.54
Material handling	3.05	0.49
Warehousing management	3.01	0.88
Recovering and recycling of materials	3.31	0.71
Attention to weather conditions	2.98	0.59
Consider the nature/type of materials when ordering	3.42	0.66
Make market survey before ordering materials	3.17	0.61
Consider waste control for effective material handling	2.65	0.82
Average means/SD	**3.12**	**0.65**

Source: Field data, 2018

In Table 3, it was found that the majority of the respondents strongly agreed (M=3.27; SD=0.53) with the statement that they had high level knowledge on material planning methods. Thus, they had adequate knowledge on several methods that could be used in planning the materials they might be using in the building construction process. That is, the respondents adequately plans the building materials that they might need in the construction process in order to avoid shortages and wastages. Planning is a very major factor in the management of material. Material planning includes measuring, ordering and scheduling which helps to increase productivity (Donyavi, 2009). Companies

may have two major levels in planning that is micro and macro level. Time, cost, material and labour are the four major types of planning undertaken on sites. During the planning prices, detailing the project in terms of its outcome, team members' roles and responsibilities, schedules, resources, scope and costs are needed. At the end of this phase, a project management plan is produced, which is a document that details how your project will be executed, monitored and controlled, and closed. Materials requirement planning is technique used to determine the quantity and timing requirements of dependent demand "materials used in the construction operation (Burt, 1996) (see Table 3).

To the statement "transportation of materials", it was found that the majority of the respondents had high level knowledge (M=3.21; SD=0.54) on materials transformation from the manufacturer premises to the construction sites. This implies that anytime building materials are purchased, they are being transported to the construction sites. Materials transportation is the concept that deals with the delivery of materials to site and also involve the planning, implementation and controlling the movement and storage of all the things from raw materials to finish product. The routing of the materials also affects the cost and time to completion of the project (Hendrickson, 2008). Good logistics involved the use of minimum of materials on site awaiting assembly, as well as being good for cash flow, this makes 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. Transportation or traffic expertise aids the materials management team in handling numerous types of special loads from delicate electronics to massive modules. Knowledge of requirements, source and availability of this equipment may be critical to

successful execution of the work, transport permitting requirements also must be considered early in the project (Bailey & Farmer, 2002). Similarly, the majority of the respondents strongly agreed (M=3.17; SD=0.61) with the statement that they made market survey before ordering materials. This means that the respondents just do not make orders or materials requisition but they first survey the market to assess competing offerings then they place the order (see Table 3).

From Table 3, it was observed that the majority of the respondents strongly revealed (M=3.15; SD=0.67) that they purchased materials for their building constructions. This implies that most of the respondents possessed high level knowledge on materials management because, they first survey the market to assess competing offerings, then place the order which in turns is about materials purchasing. A detailed material schedule and coordination of purchasing and order of materials are important in assuring material availability (Kasim, 2010). The purchasing function is central to material management. Purchasing has the responsibility and the authority to commit project funds for materials, equipment, and services. This activity may be accomplished by the home office, the field, or a combination of both depending on the size and the scope of the project. The home office must maintain planning, procedural, and policy direction over the field operations in order to ensure consistent purchasing practices (Stukhart & Bell, 2007). 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 (see Table 3).

In Table 3, it was found that the majority of the respondents had adequate knowledge (M=3.05; SD=0.49) on materials handling. Handling of materials deals with the flow of materials form the suppliers to the site. The selection of material handling most at times depends on it went or the center of gravity of the material and which enhance the production process, provide effective operation of manpower, increase production and advance the system to be more flexible (Eynon et al., 2014). 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. Material handling equipment selection is an important function as it can enhance the production process, provide effective utilization of manpower, increase production and improve system flexibility (Chan, 2002) (see Table 3).

The majority of the respondents also indicated that they had adequate knowledge on (M=3.01; SD=0.88) on materials warehousing. This implies that after the materials had been purchased and transported, they are being store and kept in safe place to devoid pilferage, evaporation and theft. Stock control is the technique planned to ensure that materials or equipment are available at all time. It includes raw materials, processed materials, assembly components, consumable stores, general stores, maintenance materials and spares, work in progress and finished products. Construction activities generate a lot of waste and cause difficulty to the construction industry. The implementation of materials management which is effective will help to minimize waste of materials and increase profit for the firm (Kasim, 2011). 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 (Prabu, 1986) (see Table 3).

From these results, it is concluded that majority of the respondents highly agreed (MM=3.12; SD=0.65) with the statements concerning their knowledge on materials management practices. This implies that most of the respondents had adequate or high level knowledge on materials management. According to Material management structure should be organized in such a way that it allows for integral planning and coordination of the flow of materials, in order to use the resources in an optimal way and to minimize costs (Beekman-Love, 2008). Gossom (2003) indicates that a material management system should have standard procedures for planning, expediting, transportation, receipt, and storage to ensure an efficient system for materials control. The control of materials is a very important and vital subject for every company and should be handled effectively for the successful completion of a project. (Stukhart, 2007; Bernold & Treseler, 1991) (see Table 3).

Research Question 2: What is the effect of effective materials management practices on building construction project delivery success?

The main objective of this research questions was to examine the effect of effective materials management practices on building construction project delivery success. On four-point Likert scale the respondents were asked to indicate their perceived effect of effective materials management practices on building construction project delivery success. The results was analysed using means and standard deviation. Using the four-point, a mean of 2.5 and above

indicates positive effect of effective materials management practices on building construction project while a mean of 2.49 and below indicates negative effect of poor materials management practices on building construction project. The results were presented in Table 4.

Table 4: Effect of Effective Materials Management Practices on Building Construction Project

Statements	Means	SD
Improves project schedule	3.35	0.55
Enhances labour productivity	3.18	0.43
Enhances good relationship with suppliers	2.87	0.64
Improves cooperation with suppliers	2.71	0.59
Increases profitability	3.53	0.73
Improves the quality of the project	3.66	0.49
Ensures project completion on time	3.43	0.62
Increases customer satisfaction	3.21	0.71
Average Means/SD	**3.24**	**0.60**

Source: Field data, 2018

Table 4 shows the results of the respondents concerning their perceived effect of materials management on building project completion. It is evident from the results that majority of the respondents perceived that effective materials management had a positive effect on building construction project delivery success. For example, the majority of the respondents strongly agreed (M=3.66; SD=0.49) with the statement that effective materials management improved the quality of the project. Similarly, this improvement in project quality facilities profit margin of the building construction companies. This was evident by the respondents who strongly indicated (M=3.53; SD=0.73) that

effective materials management increased firm' profitability (see Table 4). Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing procurement or purchase costs presents important opportunities for reducing costs. Poor materials management can also result in large and unavoidable costs during construction. John (2013) observed that the relevance of materials management to the total production operation cannot be overestimated; materials management activities actually start before the production begins by providing optimum materials required for production and its supply at the various production stages (see Table 4).

In Table 4, it was realised that the majority of the respondents highly agreed (M=3.43; SD=0.62) with the statement that effective project management ensured project completion on time. The respondents believed that when the materials on site are properly management, it helps to avoid waste and pilferage which in the long-run, it helps to completion the building project on time. This might also help to increases customers' satisfaction towards the services and work done (see Table 4). The purpose of material management is to control the flow of materials effectively. The improper handling and management of materials on construction sites has the potential to severely hamper project performance (Ogunlana et al, 1996). The result of improper handling and managing materials on site during construction process will influence the total project cost, time and the quality (Che Wan Putra et al, 1999). Construction costs depending on the type of construction (Muehlhausen, 1991). However, Kini (1999), noted that 50-60% of the total cost of construction projects is for construction materials and equipment (see Tale 4).

To the statement "effective materials management improves project schedule" it was found that the majority of the respondents strongly agreed (M=3.35; SD=0.55) with the statement effective materials management improved project schedule. This implies that when the materials for any building construction are effectively use and manage, it helps to ensure that the schedule and time line for the project completion are followed. This also help to speed up the project completion rate. According to Stukhart (2007), materials are a major component on any project. Therefore, there is a need for efficient materials management in construction projects. This is because poor materials management will affect the overall construction time, quality and budget. Therefore, an effective materials management system is required in order to avoid problems, such as delays in a construction project. Dey (2001) also observed that delays in materials supply was a major cause of time overrun. Thus, it would seem that materials delays are a major cause of delays in construction projects. Ogunlana et al. (1996) suggested that the main reasons for project delays on housing projects in Thailand were incomplete drawings, material management problems, organization deficiencies, shortage of construction materials, and inefficiencies in site workers. A good materials management environment enables proper materials handling on construction sites. Materials are critical in the operations in every industry since unavailability of materials can stop production (see Table 4).

From Table 4, it was found that the majority of the respondents agreed (M=3.21; SD=0.71) with the statement that effective materials management increased customer satisfaction. Similarly, the majority of the respondents highly indicated (M=3.18; SD=0.43) that effective material

management enhanced labour productivity. Provisions should be taken to handle and store the materials adequately when they are received. Special attention should be given to the flow of materials once they are procured from suppliers (Haddad, 2006). Unavailability of materials is not the only aspect that can cause problems. According to Haddad (2006), effective construction materials management is a key to successful projects. The need for an effective materials planning system becomes mandatory. Some companies have increased the efficiency of their activities in order to remain competitive and secure future work. Timely availability of materials and systems are vital to successful construction. (Haddad, 2006). Better material management practices could increase efficiency in operations and reduce overall cost (see Table 4).

From the results, it is concluded that majority of the respondents strongly agreed (MM=3.24; SD=0.60) with the statement concerning their perceived effect of materials management on building project completion. This implies that the majority of the respondents perceived that effective materials management had positive effective on building project completion (see Table 4).

Research Question 3: What are the problems associated with materials management on building projects?

The main objective of this research questions was to identify the problems associated with effective materials management on building projects. The results was analysed using frequency and percentages and presented in Table 5.

Table 5: Challenges Associated with Effective Materials Management (n=249)

Statements	Agree *f* (%)	Disagree *f* (%)
Lack of proper work planning and scheduling	187(75.1)	62(24.9)
Cash flow problems to contractor due to delayed payments	166(66.7)	83(33.3)
Burglary, theft and vandalism	205(82.3)	44(17.7)
Materials shortage during construction	213(85.5)	36(14.5)
Suddenly alteration price of materials	215(86.3)	34(13.7)
Lack of coordination between contractors and suppliers	157(63.1)	92(36.9)
Insufficient storage space	162(65.1)	87(34.9)
Late delivery of ordered material	201(80.7)	48(19.3)
Damage to materials during transportation to the site	207(83.1)	42(16.9)
Rejection of materials due to non-compliance to the specification	121(48.6)	128(51.4)
Average frequency/percentages	**183(73.5)**	**66(26.5)**

Source: Filed data, 2018

Table 5 indicates the results of the respondents concerning their perceived challenges associated with effective materials management on building projects. It is clearly evident from the results that materials management among the building construction companies is constrained with several challenges. For example, the highest challenges confronting effective materials management on building projects was sudden alteration price of materials. The majority (n=215; 86.3%) of the respondents strongly believed that sudden change of price of material is the major problems associated with effective materials management on building projects yet, 34(13.7%) never

agreed with the statement as a challenges associated with effective materials management. Similarly, the majority (n=213; 85.5%) of the respondents strongly perceived materials shortage during construction as the second highest challenges or problems associated with effective materials management while 36 of the respondents representing 14.5% disagreed with the statement. The third challenges identify by the majority (n=207; 83.15) respondents confronting effective materials management was damaged to materials during transportation to the site while 42(16.9%) never perceived this a problems for effective materials management on sites. Materials are critical in the operations in every industry since unavailability of materials can stop production. In addition, unavailability of materials when needed can affect productivity, cause delays and possible suspension of activities until the required material is available (Haddad, 2006). Priya (2014) states the issues of material management as planning, identification, procuring, storage, receiving and distribution of materials.

In Table 5, another significant challenge's or problem identify by the majority (n=205; 82.3%) of the respondents confronting effective materials management on site was burglary, theft and vandalism while 44 of the respondents never perceived this to be a problem associated with effective material management on site. Also, the majority (n=201; 80.7%) indicated late delivery of ordered material as a significant problems associated with effective material management on site while 48(19.3%) of the respondents disagreed with the statement. To the statement "lack of proper work planning and scheduling as a challenge associated with effective material management on site", it was found that most (n=187; 75.1%) agreed with the statement while 62(24.9%) of

the respondents disagreed with the statement. Unavailability of materials is not the only aspect that can cause problems. Excessive quantities of materials could also create serious problems to managers. Storage of materials can increase the costs of production and the total cost of any project. When there are limited areas available for storage, the managers have to find other alternatives to store the materials until they are needed. Some of these alternatives might require re-handling of materials, which will increase the costs associated with them. Provisions should be taken to handle and store the materials adequately when they are received. Special attention should be given to the flow of materials once they are procured from suppliers (Haddad, 2006) (see Table 5).

From Table 5, most (n=187; 75.1%) of the respondents also identify lack of proper work planning and scheduling as a problem confronting effective materials management on sites while 62(24.9%) of the respondents disagreed with the statement as a problem associated with effective materials management on sites. Also, it was found that cash flow problems to contractor due to delayed payments (n=166; 66.7%) is also a challenge confronting effective materials management on sites while 83 of the respondents representing 33.3% disagreed with the statement. Another significant challenge perceived by most of the respondents (n=162; 65.1%) that affect effective material management on site was insufficient storage space. It is obvious that materials should be obtained at the lowest cost possible to provide savings to the company (Damodara, 1999). Poor materials management can also result in large and unavoidable costs during construction. Ogunlana et al. (1996) suggested that the main reasons for project delays on housing projects in Thailand were incomplete drawings, material management problems, organization deficiencies, shortage of

construction materials, and inefficiencies in site workers. Hence, a good materials management environment enables proper materials handling on construction sites,

From these results, it is concluded that the majority of the respondents strongly agreed (n=183; 73.5%) with the statement concerning the challenges facing effective materials management on sites. This implies that majority of the respondents believed that effective management material is faced with several challenges.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The main purpose of this study was to assess material management of construction companies in Cape Coast Metropolis. This chapter presents the summary of the study. Based on the key findings, conclusions and implication of the findings were drawn and appropriate recommendations were suggested.

5.2 Summary of the Findings

1. The study found that the majority of the respondents had adequate or high level knowledge on materials management. The study also revealed that, the most prevalent practices of materials management are purchasing of materials, material planning method, transportation of materials. Findings shows that procurement of materials with requisition from site is more common with the contractors and its best practice of materials procurements for construction sites for effective materials management.
2. The study found that the majority of the respondents perceived that effective materials management had positive effect on building project completion. The study shows that effective material management brings positive result in achieving early building project completion. The study also shows the importance of manage all materials from the design stage to the completion stage because poor management of construction materials affects the overall performance of construction projects in terms of time, cost, quality and productivity. The study has confirm that 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.

3. The majority of the respondents believed that effective management material is faced with several challenges. The study also establish that the following: damage by mishandling and re-work due to poor workmanship, inadequate storage facilities on site, delay in material supply, inadequate supervision, poor site security, weather and other natural occurrence, alteration of designs, over ordering of construction materials, theft and vandalism, lack of proper work planning and scheduling, cash flow problems to contractors due to delayed payments and burglary, theft and vandalism are problems associated with materials management. This might cause material wastage on building construction sites.

5.3 Conclusions

Based on the findings from the question raised in this research, the following conclusions are drawn. The study concluded that effective material management brings positive result in achieving early building project completion. Therefore, the need for improving purchasing, transportation and introduction of new possibilities, like, purchase requisition slip, and

transportation order respectively. The study also shows the importance of manage all materials from the design stage to the completion stage because poor management of construction materials affects the overall performance of construction projects in terms of time, cost, quality and productivity.

The study also concluded that, the most prevalent practices of materials management are purchasing of materials, material planning method, transportation of materials while the prevalent challenges are lack of proper work planning and scheduling, cash flow problems to contractors due to delayed payments and burglary, theft and vandalism are problems associated with materials management. For effective materials management, measures shown by the study include adequate management and supervision; it shows that administration of sites was the best in respect to conditions for achieving good materials management.

5.4 Recommendations

1. In order to achieve good materials management on building project, it is recommended that contractors should provide intensive training of management and other staff. It is necessary to provide education and training to encourage and promote the benefit in reuse, recycling and reduce the material consumption; however, cost saving for reuse and reduce the material consumption is difficult to measure, in which the material can be reuse and reduce the consumption for several times. It is more effective to provide training and education among staff, and involve employees' participation in implementing waste management and pointed out that employees' participation could only be effective with genuine support from management.

2. It is recommended that the contractors and the management of the construction companies should provide and ensure effective inventory control of materials on site. It is recommended that arrangements be made for materials to arrive on time. When a construction material is delivered to a site, it should be checked for damage, quantity, quality and specification. Stores are also responsible for the physical verification of stocks and reconciling them with book figures
3. It is recommended that the contractors and the management of the construction companies should ensure proper planning, monitoring and control. The management of the companies or constrictors should establishment of a programme which reflects the planning process in relation to real time.
4. It is recommended that the contractors and the management of the construction companies should provide intensive supervision and monitory. They should provide a clear, specific instruction on what is to be done, monitor the worker in the course of their efforts.
5. It is recommended that the contractors and the management of the construction companies should provide an adequate storage of materials. Material storage on site requires close attention in order to avoid waste, loss and any damage of materials which would affect the operation of the construction project. Proper material storage system must be designed to accommodate the loads of the materials to be stored. There must be a proper storage facilities provided for materials on site
6. The study recommends that Contractor should make provisions for training and retraining of management and site personnel in order to

improve their efficiency for effective material management and contractors should ensure the use of skilled craftsmen for their works and provide efficient supervision with professionals to ensure effective material management on building construction sites. For effective materials management, measures shown by the study include adequate management and supervision; it shows that administration of sites was the best in respect to conditions for achieving good materials management.

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APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA
COLLEGE OF TECHNOLOGY EDUCATION, KUMASI
DEPARTMENT OF CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION

Questionnaire for Respondents

Dear Respondent

This questionnaire is design to provide for evaluating effectiveness of the effects of the materials management techniques on construction project success considering the perspectives of materials managers in the construction industry. Thank you for taking the time to complete this questionnaire; your co-operation is appreciated. Please ensure that you read the following before answering the questionnaire:

Instructions:

- Please do not leave out any questions. If you have difficulty understanding question please ask the researcher.
- Please answer questions honestly. Even if your answers are negative in nature

SECTION A
Background Information

1. Gender a) Male [ ] b) Female [ ]

2. Age group a) 25-30yrs [ ] b) 31-35yrs [ ]
   c) above 35yrs [ ]

3. Highest academic qualification
   a) MSc [ ] b) BSc [ ]
   c) HND [ ] d) CTC [ ]

4. Working experience in the industry
   a) 1-5year [ ] b) 6 – 10yrs [ ]
   c) 11-15years [ ] d) above 15yrs [ ]

SECTION B
Employees' Knowledge of Management

Please, indicate the extent to which you agree or disagree with the following statement about your knowledge on Materials Management by indicating 1=strongly disagree (SD), 2=Disagree (D), 3=Agree (A) and 4= Strongly Agree (SA)

S/N	Statements	SD 1	D 2	A 3	SA 4
1	Purchasing of materials				
2	Material planning methods				
3	Transportation of materials				
4	Material handling				
5	Warehousing management				
6	Recovering and recycling of materials				
7	Attention to weather conditions				
8	Consider the nature/type of materials when ordering				
9	Make market survey before ordering materials				
10	Consider waste control for effective material handling				

SECTION C
Effect of Effective Materials Management Practices

Please, indicate the extent to which you agree or disagree with the following statement about Measures for Improving Materials Management by indicating 1=strongly disagree (SD), 2=Disagree (D), 3=Agree (A) and 4=Strongly Agree (SA)

S/N	Statements	SD 1	D 2	A 3	SA 4
1	Improves project schedule				
2	Enhances labour productivity				
3	Enhances good relationship with suppliers				
4	Improves cooperation with suppliers				
5	Increases profitability				

6	Improves the quality of the project				
7	Ensures project completion on time				
8	Increases customer satisfaction				

SECTION D

Challenges Associated with Effective Materials Management

Please, indicate the extent to which you agree or disagree with the following statement about the challenges Associated with Effective Materials Management by indicating 1=strongly disagree (SD), 2=Disagree (D), 3=Agree (A) and 4=Strongly Agree (SA)

S/N	Statements	SD 1	D 2	A 3	SA 4
1	Lack of proper work planning and scheduling				
2	Cash flow problems to contractor due to delayed payments				
3	Burglary, theft and vandalism				
4	Materials shortage during construction				
5	Suddenly alteration price of materials				
6	Lack of coordination between contractors and suppliers				
7	Insufficient storage space				
8	Late delivery of ordered material				
9	Damage to materials during transportation to the site				
10	Rejection of materials due to non-compliance to the specification				