UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

IMPROVING COST CONTROL MEASURES IN BUILDING PROJECTS IN GHANA: A CASE STUDY OF KUMASI METROPOLIS IN THE ASHANTI REGION

JOYCE BELLICENT GYIMAH

A Dissertation in the Department of Construction and Wood Technology Education, Faculty of Construction and Wood Education, submitted to the school of Graduate Studies, University of Education, Winneba, Kumasi Campus in partial fulfilment of the requirements for the award of the Master of Technology (Construction and Wood Technology) degree

DECEMBER, 2016

DECLARATION

CANDIDATE'S DECLARATION

I, JOYCE BELLICENT GYIMAH, declare that this dissertation, with the exception of the quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere

.

SIGNATURE: …….

DATE: ……..

SUPERVISOR'S DECLARATION

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

SUPERVISOR: DR. NONGIBA ALKANAM KHENI

SIGNATURE: ……

DATE: …….

ACKNOWLEDGEMENTS

I thank the Almighty God for His guidance and protection throughout my course of study at UEW-K. Secondly, to my supervisor Dr. Nongiba Alkanam Kheni for his invaluable supervision that made this dissertation a success. I also wish to thank my Uncles, Aunties, Brothers, Sisters and my entire family all in Tarkwa and Takoradi, especially, Nana Abena Kunadwoa II Queen Mother of Wassa Fiase Traditional Area for their prayers and material support. Finally, I wish to thank the acting Omanhene, Nana Kodukyirfo and the registrar, Mr. Alfred Dodoo all of Wassa Fiase Traditional council for their financial assistance.

DEDICATION

I dedicate this work to my son Richmond Kwabena Nhyira Osei-Sakyi.

TABLE OF CONTENTS

CONTENTS **PAGE**

CONTENT **Page**

LIST OF TABLES

ABSTRACT

Managing the cost of projects is important to ensure prudent use of project resources that will enable that project budget is not exceeded. Cost control ensures the cost of project activities are effectively and efficiently managed. The aim of the study was to examine cost control measures in building projects in the Kumasi Metropolis and to make recommendations for improving cost control measures on project sites. The specific objectives of the study included; to identify cost control measures adopted for building projects by building contractors in the Kumasi Metropolis, to identify constraints to effective implementation of cost control measures in building projects in the Kumasi Metropolis and to make recommendations for improving cost measures in construction projects in the Kumasi Metropolis. The study adopted a quantitative research approach involving the administration of survey questionnaires to one hundred and eight (108) site managers of construction firms registered with the Kumasi Metropolitan Assembly. The findings of the study revealed that the cost control measures used in building projects were project cost value reconciliation, overall profit or loss strategy, Profit or loss on each contract at valuation dates, unit costing, standard costing and earned value analysis. The software packages used for project cost control measures included Microsoft project software and project costing system (PCS), The key challenges to effective implementation of cost control measures were lack of incentives in contract clauses for contractors implementing effective cost control in building projects, lack of skilled personnel for implementing effective cost control and lack of ICT equipment and software for implementing effective cost control. Based on the findings, the study has made recommendations towards improving cost control practices in the study area.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cost control is a process that should be effectively put in place during the construction period to ensure that the cost of the building is kept within the agreed cost limits. Cost control can be divided into two major areas; the control of cost during design stages and the control of cost by the contractors once the construction of project has started. According to Nunnally (2008), cost control of a project involves the measuring and collecting the cost record of a project and the work progress. It also involves comparison of actual progress with the planning. The main objective of cost control of a project is to gain the maximum profit within the designated period and satisfactory quality of work. In most cost control procedures, the limit on the expenditure is coupled with requirements that the building will provide some specified minimum area, to ensure that the building will contain sufficient accommodation to meet its brief. Where control is based on schedules of accommodations, these schedules are usually expressed in terms of the net areas of the usable or scheduled rooms. The objectives of cost control are; to give the building client good value for money- a building which is soundly constructed, of satisfactory appearance and well suited to perform the functions for which it is required, combined with economical construction and layout. Secondly, to achieve a balanced and logical distribution of the available funds between the various parts of the building. Thus, the sums allocated to cladding, insulation, finishing, services and other elements of the building will be properly related to the class of building and to each other. Finally, to keep total expenditure within the amount agreed by the client, frequently based on an approximate estimate of cost prepared by the quantity surveyor in the early stages of the design process (Austen and Neale,

2004). There is a need for strict cost discipline throughout all stages of design and execution to ensure that the initial estimate, tender figure and final account sum are all closely related. This entails a satisfactory frame of cost reference (estimate and cost plan), ample cost checks and the means of applying remedial action where necessary (cost reconciliation).

According to Nunnally (2008), cost control of a project involves the measuring and collecting the cost record of a project and the work progress. It also involves the comparison of actual progress with the planning. The main objective of cost control of a project is to gain the maximum profit within the designated period and satisfactory quality of work. A systematic procedure of cost control will give a good result in collecting important cost data in estimating and controlling of the costs of the incoming projects in future. Kwakye (2007) explain that the cost control can be defined as a process where construction cost of a project is managed with the best method and systematic in order that the contractor would not suffer the loss when doing the activities of the project and the cost construction of a project would not be over-estimated by the developer.

Moreover, Mueller (1986) states that the cost control is the ability to influence the final cost of project positively with modifying negative performance trends. According to Ritz (2004), cost control though namely easy, but gives a different meaning to different people. Some people engages it with engineering costs; some states that it is a cost report, value engineering, cost management etc. Austen and Neale (2004) states that the main purpose in cost controlling for a construction project should be active controlling of final costs for owner, and not just to record and registering the payment. Amount of details and the time intervals between cost control reports must be considered, which is different according to the level of management for which they have prepared. For a site manager, it is necessary to receive the cost report on weekly basis.

After preparing the reports based on the cost data collected, it is important to project the costs into future and to estimate or re-estimate the cost of the work yet to be completed. Any new information must take into account since the commencement of the contract. Thus, a suitable reporting system is the important part of a cost control system (Austen and Neale, 2004).

1.2 Statement of the Problem

Many construction projects do not achieve their cost and time objectives due to several factors including lack of effective management of project budget during the design and construction phases. Many past studies have tended to address factors affecting cost overruns of projects (Meeampol and Ogunlana 2006; Doloi 2013; Elanga, Louzolo-Kimbembe & Pettang 2014)). Yet, there is a limited research examining cost control practices of contractors during the construction phases of projects as a means to address the aforementioned problem. The paucity in the literature on cost control is particularly true of the construction industry in developing countries such as Ghana where cost performance of construction projects is, anecdotally, poor. To fill this gap in the literature, the present study seeks to examine cost control measures of construction firms in the Kumasi Metropolis in Ghana with the view of making recommendations for improving cost control practices of contractors in the study setting.

1.3 Aim and Objectives of the Study

The aim of the study is to examine cost control measures in building projects in the Kumasi Metropolis and to make recommendations for improving cost control measures on project sites. The specific objectives of the study are as follows:

- to identify cost control measures adopted for building projects by building contractors in the Kumasi Metropolis;
- to identify constraints to effective implementation of cost control measures in building projects in the Kumasi Metropolis; and
- to make recommendations for improving cost measures in construction projects in the Kumasi Metropolis.

1.4 Research Questions

The study was guided by the following research questions

- What are the cost control measures frequently adopted by building contractors in the Kumasi Metropolis?
- What are the constraints to effective implementation of cost control measures in building projects in the Kumasi Metropolis?

1.5 Significance of the Study

The study will provide useful information for the building contractors, site supervisors, quantity surveyors and estate developers in Ghana as a whole. This study will help the respondents to improve cost control measures, to estimate and to develop construction sites cost effectively.

1.6 Scope of the Study

This research is focused on the improvement of cost control measures in building projects in Ghana, using the Kumasi Metropolis in the Ashanti Region as a case study. Thus the study is geographically limited in scope to Kumasi Metropolis in the Ashanti Region of Ghana. Moreover, the study is theoretically and empirically limited in scope to the improvement of cost control measures in building projects.

1.7 Organization of the Study

This project work consists of five Chapters, Chapter one deals with the background of the study, the statement of the problem, research questions, objectives of the study, significance and organization of the study. In Chapter two the researcher reviewed related literature whiles chapter three deals with the research methodology used in the study. Other aspects of chapter three describes the research design, the population for the study, sample and sample procedures, data gathering instruments, data collection procedures of the study and methods of data analysis. Chapter four describes the research findings and the discussion of the main findings and chapter five presents the summary of the findings, conclusions and recommendations and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature regarding cost control measures frequently used by building contractors, investigated the use of conventional control measures in construction. The chapter specifically covered projects procurement and purchasing, expediting, materials planning, materials handling, distribution, cost control measures, inventory management/Receiving/ Warehousing and transportation strategies.

2.2 Concept of Cost Control

Cost control involves accurate forecast or estimates of costs of projects. This section reviews the elements of estimation and measures for improving estimates. The objective of cost estimating is to develop estimates for the costs needed for a resource to complete the project tasks and activities. Inputs to estimation include the project's Scope Statement and Work Breakdown Structure (WBS). These items define the work to be done and allow a foundation on which estimates can be made. Common methods to develop estimates are by comparing the project to previous efforts, using historical data and statistical models, or bottom-up estimation with each task and effective materials management. The more information that is available, the more accurate the estimate can be. Accurate estimates however are not based solely on data and methods. But there are other inputs and factors that are to take into account.

From Arieh and Li (2003) "Modern manufacturing systems are characterized by fierce global competition over price, quality and time to market. A crucial element in successful competitive standing is the ability to generate quick and accurate cost estimates." To produce

effective and realistic estimates more has to be taken into consideration such as the current project environment, risks and risk management and customer psychology. With regards to cost management, Brinke et al. (2004) stated that in order to be effective, cost management requires information that covers the entire process. In order to produce an effective estimate the Project Manager or individual responsible for ultimately delivering estimation needs to master techniques in multiple facets of the estimation process.

An accurate estimate is not an effective estimate if the scope of the work that is being estimated is incomplete or misunderstood. And while changes to the project can be facilitated through change management later in the project, this is not an optimal approach. Estimates that are based on clear and open communication of all aspects of the project, and with full understanding, are essential (Warko, 2001.) The more information that can be made available during and after estimation, and the more feedback that can be garnered (Brinke et al. 2004) the more accurate the estimates will become. Cost estimation is not only getting the estimates right but managing changes to the quality and nature of inputs, e.g. scope management and good work package definitions.

Lutters et al. (2000) made the observation that unlike computers, humans can rely on their unique ability to interpret information based on knowledge and experience while computers cannot effectively deal with decision making with incomplete information. This supports the notion that computer or numerical models alone cannot produce effective cost estimates. Communication and the human element is critical to incorporate into effective cost estimation. Curiosity should be a technique employed as well with regards to communication and effective estimation. Curiosity and asking questions can help alleviate uncertainty; the ability to keep asking questions until you get the answers you need (Warko, 2001)

Looking into the future and proactively managing project scope creep can help improve the estimation process. Warko (2001) comments that documenting assumptions and managing scope are critical to developing good estimates. Two primary causes of cost overruns are spending more money to complete work than was budgeted, and adding work to the project without adding additional funding (Levine, 2001) If scope is not managed, as the project progresses some of the estimates for tasks will no longer be accurate. As a technique to providing better estimates, recommendations for managing scope creep can also be applied to the estimation process (Levine, 2001).

2.3 Cost Control Practices in Construction Projects

This section deals with the strategies and processes that can enhance effective management of cost of resources in construction projects.

2.3.1 Promoting efficient utilization of construction materials

There are several steps within the scope of material management and each of these steps can give rise to potential problems. The more the responsibility is divided, the more potential problems that exist. Table 2.1 below shows the steps in material management and the pertinent action related to these steps. Some actions are described in terms of the documentation produced, such as receiving report and vendor data (Ahuja et al, 1994).

Table 2.1: Cost Control Strategies

S/No	Step or Sequence	Contribution action
1	Request for Quotation (RFQ)	Drawings, specifications. Material bills Terms and conditions
2	Bids	Approved bidders list Pre-qualification of bidders Bid evaluations
3	P.O. (Purchase Order)	Bid clarification Notice of award
4	Expediting	Vender data Manufacturer inspection Delivery Routings
5	Transport	Carrier and route Ownership en route Custom
6	Receiving	Inspection and acceptance Receiving report Storage
7	Inventory	Dispersal (i.e. material handling) Inventory level

Source: Ahuja et al, (1994)

In a study conducted by Ahuja, and Dozzi (1994), specifications and drawings are needed to implement the request for quotation process successfully. The specifications and drawings are utilized by a rather diverse group of participants. The specifications and drawings help the contractor to estimate, control, manage and direct the works. Also they help the purchasing department to purchase materials and equipment that described in the drawings and specifications, finally they help the owner to know what to buy and what he is entitled to receive.

There are relations between the specifications and drawings that will clear and generally show the following information and items. From drawings we can obtain information about the location of materials, equipment, fixtures, details and overall dimensions, interrelation of materials, equipment and space, sizes of equipment, identification of materials at it locations and another alternatives. And from specifications we can obtain type and quality of materials,

equipment and fixtures, quality of workmanship, methods of fabrication, installation, erecting, test and code requirements, unit, options and alternatives (Ahuja, & Dozzi 1994).

2.3.2 Purchasing Function as a cost control measure

Stukhart, and Bell, (1987), said that the purchasing function is central to constructions 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, and Bell, (1987), vendor selection follows policy and procedures as a key step in accomplishing the work. In selecting vendor for the project, purchasing is forming the foundation for the success or failure of the project. Vendors must be selected on the basis of their capabilities, geographical location, prior experience, and owner preference. Measurement of capabilities includes such considerations as past performance, financial condition, bargaining agreements, capacity, competitiveness, responsiveness, and schedule adherence.

Stukhart, and Bell (1987), stated several methods of contracting are available to the purchasing organization, depending on the commodity or service required. Purchasing orders are the most common form of contract utilized on construction projects. Although blanked orders and other forms of agreement are used in varying degrees. Under any form the contract must encourage the on time delivery and completion of the work. Standard or general terms and conditions of the order or contract generally address various commercial aspects of transaction; they define the respective rights, duties, and obligations of the contracting parties. Special terms

and condition also must be incorporated into the body of the purchase order or contract. Items such as schedule test information, data submittals, drawing approvals, expediting, and terms of payment are typical of the information, which must be clearly specified. Purchase orders often require technical service agreements to complete the scope of work when the vendor's technical representative is required at the site to supervise installation and or erection (Stukhart & Bell, 1987).

2.3.3 Effective Expediting in Construction Material Management

Several types of expediting exist, each with a different level of intensity and cost. The least intense type of expediting is simple status reporting. Periodic telephone contact is made with the vendor to determine the status or progress of an order, and the information is reported to the project in some systematic format. This type of expediting provides basic information to the construction project, but does little to prevent or overcome delays or problems with an order. Reactive or correction expediting is more intense than the simple status reporting. But it is initiated only in response to some event or action. Vendor contact may be made in response to a problem of delayed or late delivery (Ahuja & Dozzi 1994).

Moreover, Ahuja and Dozzi, (1994), concluded that proactive or preventative expediting is the most intense aggressive type of expediting. Here, vendor and sub vendor contact is initiated as soon as the order is issued and continues through the live of the order. The expeditor will review all elements of the order to ensure that the vendor understand the various submit al, testing, and delivery requirements. The expeditor will seek to gain a thorough understanding of the vendors engineering, purchasing, and manufacturing operations as they relate to the particular order.

This enables the expeditor to monitor all elements of the vendor's performance with the intent of anticipating and resolving problems before they seriously impact the projects. Experienced professional expeditors serve as a key bridge between the engineering and purchasing activities that specify and order materials and the field operations that are dependent on those materials for their progress. Accurate and dependable expediting information is essential for informed management of the projects, and facilitates the mobilization of buyer and vendors resources in response to problems or delays (Ahuja & Dozzi 1994).

2.3.4 Effective Transportation of Construction Materials

The movement of equipment, materials, and personnel to the job site represents a unique and specialization element of efficient construction materials management. Experienced traffic personnel can have a positive impact on the execution of the project while minimizing transportation cost (Ahuja & Dozzi, 1994). Significant saving is possible with national agreements or negotiated project transportation, and through various commercial arrangements for the transportation of construction goods, materials, documentation, or personnel. Special consideration is required in setting terms, thereby determining the proper point for transfer of materials ownership and liability. The prime contract, especially insurance clauses, may have a direct impact on the purchasing terms and conditions concerning effective transportation of construction materials (Ahuja & Dozzi, 1994).

Early specialized activities in the project planning phases, such as properly performed route survey and consideration of local traffic conditions, can significantly affect later execution of the work and cost reduction of the construction work. These front end efforts affect engineering by defining shipping envelopes, weight limits, and schedule limitations, the traffic

function or group significant input to purchase documents including packing specifications, shipping instructions, invoicing instructions, and document requirements. This group's expertise is necessary in developing routing guides, shipments progress reports, and troubleshooting as transportation problems develop. Transportation or traffic expertise aids the materials management team in handling numerous types of special loads from delicate electronics to massive modules, each requiring transport equipment that is specially designed or of limited availability. Knowledge of 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 (Ahuja & Dozzi 1994).

Assigning the above responsibilities to suppliers may present an easy upfront decision, but can later lead to painful lessons if the expertise is not available to the construction materials management team to ensure that traffic functions are handled properly. Traffic or logistics for foreign sites present an added dimension to the transportation requirements for a project. Each phase of the transportation effort is more complex, with often-stringent requirements due to ocean shipment and transportation to remote areas of the world. Each country's customs requirements are unique with potentially significant duties, taxes, and delays that must be considered in the planning efforts (Ahuja & Dozzi 1994).

2.3.5 Management of Surplus Materials as a Cost Control Measure

All projects can expect a certain amount of surplus, however, the key to successful surplus construction materials management is a well-conceived and well-executed construction materials management plan. Various shortcomings in the engineering, materials control, procurement, and field materials management phases of the work may results in surplus

materials. Understanding and anticipating these potential problems areas are the first in minimizing surplus (Stukhart & June 1987).

Many causes of surplus can be identified. Surplus can be caused by a poorly performed materials take off (MTO). Engineering revision and changes are yet another cause of surplus, particularly if the MTO occurs early and systems are not adequately responsive to changes. Inadequate construction materials management practices also may lead to surplus, particularly on fast track projects. Primary causes are:

- Duplicate buying and poor control systems/procedures leading to procurement of unnecessary materials.
- Minimizing surplus on a project requires a proactive and timely system of communication among all functions involved in the materials acquisition and installation cycle.
- Option for disposal include using the surplus in the alternative services, using the surplus materials on other projects, returning them to the vendor, or selling them to a third party. All options require complete records and timely reporting to achieve optimum results. The best option is to do the necessary planning and to implement the necessary materials management system to reduce surplus at the source (Ahuja & Dozzi 1994).

2.3.6 Effective Control of Construction Waste Aimed at Cost Reduction

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 (Sanmath, 2011). 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 et al. 2013). Waste rate estimation method can be used to improve the handling material, reduce the waste rate, and improve productivity (Al-Hajj et al. 2011, Meghani et al., 2011).

Concept of 3R and 4R can also be beneficial to reduce the wastage of construction materials, which includes reduce, reuse, recycle, and recovery. These can be applied to the entire life cycles of products and services (Kareem et al. 2013, Thomas et al. 2013, Nitish Bagdi et al. 2013). The free-flow mapping presentation technique can be adopted in the study for investigating the waste flow practice on construction sites. The technique has been considered advantageous in presenting flows of processes logically, clearly, and in the simplest way (Shen et al. 2004). The prediction of waste flow can be modelled through the building elements at the construction stages (Siti Akhtar Mahayuddin et al. 2013).

For effective reduction of material waste management strategy for construction waste can be used such as reduce waste generation, maximize reusing, and recycling, reduce the intake of mixed construction waste at landfills. The use of environmental friendly construction methods has been encouraged, such as using a large panel system on any project site, applying prefabrication components effectively, and reducing the application of wet trade (Shen et al. 2004). A management strategy for construction waste also involves the maintenance of a well-managed public filling programme with sufficient facilities and access. Sort mixed construction waste and not just dispose of it in any single place, reuse and recycle as of materials as far as possible, design better and construct more efficiently to minimize waste etc. (Harikumar et al. 2014).

Various strategies for Construction and Demolition waste reduction also include standardization of design, stock control for minimization of over ordering, environmental education to workforce etc. (Bagdi et al. 2013). Government implemented construction waste disposal charging scheme (CWDCS) can provide financial incentives to C&D waste generators to reduce waste and encourage reuse and recycling. Government's interventions like Landfill tax, higher tax for using virgin construction materials, tax credits for recycling etc can be used on construction site for waste minimization and cost reduction (Poon et al. 2013, Mansi Jain 2012).

2.3.7 Construction Waste Management

Ahuja and Dozzi, (1994), concluded that the purpose of clearly establishing the responsibilities and authority of the participants is not for attaching blame should something go wrong in the process, but to communicate clearly what is expected and avoid misunderstandings as to who does what and when. The scope of each participant's involvement must be clearly defined. If not, increased effort will be expended to rectify missed expectations in quantity, quality, or cost. Unexpected effort reduces productivity of the operation. A quality effort is required in all parts of the project, otherwise poor quality in the construction material management process becomes apparent immediately at the point of use. By comparison, poor quality of engineering, for example, may not become apparent at all.

Ahuja and Dozzi, (1994), stated that several participants contribute to the construction material management process and the scope of their involvement should be clearly stipulated in the contractual document. An efficient construction material management system leads to improve productivity and must necessarily include all participants. The alternative is an inefficient, incomplete plan, which will prove counterproductive. If an owner purchases a long-

lead item and later assigns the purchase order to the contractor, a clear understanding of the purchase order is required, as well as full knowledge of any relevant correspondence, to ensure that nothing is overlooked.

2.3.8 Just In Time (JIT) Strategy for Construction Cost Control

JIT is a technique developed by Taichi, Ohno and his fellow workers at Toyota (Ohno, Taichi., 1987).The acronym JIT has been highly visible since the late 1980's, as manufacturing attempted to meet competitive challenges by adopting newly emerging management theories and techniques, referred to by some as Lean Production (Womack and *et al*, 1991). Manufacturing JIT is a method of pulling work forward from one process to the next "just-in-time"; i.e. when the successor process needs it, ultimately producing through put. One benefit of manufacturing JIT is reducing work-in-process inventory, and thus working capital profitability. An even greater benefit is reducing production cycle times, since materials spend less time sitting in queues waiting to be processed. However, the greatest benefit of manufacturing JIT is forcing reduction in flow variation, thus contributing to continuous, ongoing improvement (Womack and *et al,* 1991).

Ohno's (1987), fundamental purpose was to change production's directives from estimates of demand to actual demand. A purpose originally rooted in the absence of a mass market and the need to produce small lots of many product varieties. In assembly line production systems managed by lean production concepts, the directives for production are provided by means of kanban from downstream processes. This system insures that whatever is produced is throughput, i.e. is needed for the production of an order. Kanban works as a near-term adjusting mechanism within a system of production scheduling that strives for firm and stable aggregate

output quantities, and provides all suppliers in the extended process progressively more specific production targets as the plan period approaches, resulting ultimately in a firm 2-6 week production schedule. This system provides sufficient flexibility to adjust to actual demand, while assuring that all resources are applied to the production of throughput. In manufacturing, the need for flexibility comes from a potential difference between forecast and actual demand. Many products are being produced, so it is important to minimize the time required to produce any specific type of product demanded (Ohno Taichi., 1987).

In construction, there is only one product produced once. And in the case of industrial construction, that product is the facility for producing manufacturing's products. It is consequently important to reduce the time needed to produce the facility, not necessarily the time to produce any component. The application of JIT to construction differs substantially from its application to manufacturing because construction and manufacturing are different types of production, and because of the greater complexity and uncertainty of construction. The extent and significance of uncertainty in construction has been adequately addressed, but a moment's reflection supports the view that construction is complex. The number of parts, relative lack of standardization, and the multiple participants and constraining factors easily make the construction of an automobile factory more difficult than the production of an automobile in that factory. When this complexity is joined with economic pressures to minimize time and cost, that uncertainty results is not surprising (Ohno Taichi., 1987).

2.3.9.1 Using JIT to reduce variation and waste

By minimizing inventories between processes, Ohno (1987), removed the safety stock that allowed a downstream process to continue working when a feeder process failed. He also

required that operators stop the production line when they were unable to fix problems. Consequently, it became necessary to solve problems rather than simply passing bad product down the line. Problems also became highly visible since they could result in line stoppages. Forced confrontation with problems together with analysis to root causes produced a progressively more steam lined and smoother running production process, with fewer end-of-the line defects and higher throughput. How might this work in construction? Construction is schedule driven. Given a well-structured schedule, if everyone stays on their part of the schedule, the work flows smoothly and maximum performance is achieved, cost reduced and profitability increased. However, as we all know, it is rare that projects perform precisely to their original schedule. Business conditions change, deliveries slip, a design requires correction, etc. If a schedule has sufficient slack in the impacted activities, changes may not impact end dates. When there is little or no slack, players are pressured to make it up in accelerated production.

2.4 Relationship between Cost Control and Materials Management in Construction

Ballot (2001), conceptually, efficient utilization of construction material management is 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, 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 construction material management. Ballot (2001) defines material management as the process of planning, acquiring, storing, moving, and controlling materials to effectively use facilities, personnel, resources and capital.

Tersine and Campbell (2007) define construction 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. The purpose of construction material management is to control the flow of materials effectively. Beekman-Love (2008) states that construction 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. Chandler (2008) states that construction material management systems should be implemented to plan, order, check deliveries, warehousing, controlling the use of materials, and paying for materials. He adds that these activities should be interrelated. Ammer (1980) defines construction material management as the process in which a company acquires the materials that it needs to achieve their objectives. This process usually begins with the requisition of materials from the supplier until the material is used or incorporated into a product.

Bailey and Farmer (1982) define construction 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. Gossom (1983) indicates that construction material management system should have standard procedures for planning, expediting, transportation, receipt, and storage to ensure an efficient system for materials control. Cavinato (1984) states that material management involves the control of the flow of goods in a firm. It is the combination of purchasing with production, distribution, marketing and finance.

Arnold (1991) states that construction material management is a function responsible for planning and controlling of materials flow. He adds that a materials manager should maximize the use of resources of the company. 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, 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, 1994).

This organizational materials 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 insure 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).

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 construction 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 construction material management system are (Tersine & Campbell, 2007, Ammer, 1980, Stukhart, 1995):

- Procurement and purchasing
- Expediting
- Materials planning
- Materials handling
- Distribution

- Cost control
- Inventory management / Receiving/ Warehousing
- Transportation

Ammer (1980), states that 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. 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.

2.4.1 Materials Management Processes for Effective cost control

Construction materials management processes involve the planning, procurement, handling, stock and waste control, and logistics surrounding materials on construction projects. A good materials management environment enables proper materials handling on construction sites. In order to better understand materials management the following processes are discussed: planning, procurement, logistics, handling, stock and waste Planning. The process of planning construction methods has been defined as "understanding what has to be built, then establishing

the right method, in the most economical way to meet the client's requirements" (Illingworth, 1993).

This is a detailed scheme for achieving an objective for certain work tasks. In the case of materials, there is a need for an appropriate planning, which must be done concurrently with engineering, construction, and other project plans (Stukhart, 1995). Stukhart (1995) also mentioned material planning will provide guides for all the subsequent activities and can have a great impact on the project plan. The materials planning process cover setting up and maintaining the records of each part used in each plant to determine target inventory levels, and delivery frequency (Payne et al, 1996). As a result, an excellent management of the materials record will help the flow of materials at the site in order to avoid several problems such as materials out of stock and materials that have not been delivered. Stukhart (1995) mentioned that, material planning would provide guides to all the Subsequent activities and that this could have a great impact on the project plan. The materials planning process covers the set up and maintenance of records and determines the target inventory levels, and delivery frequency (Payne et al, 1996).

Planning of access and routing of materials within a construction site has an important implication for the development of an effective materials management strategy (Faniran et al, 1998; Olusegun et al, 1998) particularly in terms of increasing productivity and profit, and facilitating the timely completion of construction projects (Wong and Norman, 1997). The requirement for efficient materials planning is, to increase productivity and profit of the company, and facilitate the completion of construction projects (Wong and Norman, 1997). Thus, better planning of raw materials on site can help to eliminate project delays and reduces activity times, resulting in better construction service and increase profitability.

2.4.2 Logistics Functions

Logistics is a concept that emphasizes movement and it encompasses planning, implementing, and controlling the flow and storage of all goods from raw materials to the finished product to meet customer requirements (Stukhart, 1995). Raw materials for construction are usually varied, bulky and heavy and required proper handling in the supplying process. Consequently, the construction industry requires active movement of materials from the suppliers to the production area in both the factory and the worksite (Pheng and Chuan, 2001). The primary focus of the logistics concept in construction projects is to improve coordination and communication between project participations during the designand construction phases, particularly in the materials flow control process (Agapiou et al, 1998). They also mentioned that problems arise in the materials flow control process which includes delays of materials supply, due to some materials purchased just before they are required and waste of materials during storage, handling and transporting when procured in large quantities without complying with the production needs on site. The previous research suggested that, the routing of materials is one of the main causes which affect cost and time during construction projects (Varghese and O'Connor, 1995). Hence, the factors that should be taken into consideration during the logistics process for effective materials management include: optimum forecasting of materials movement (Mahdjoubi & Yang, 2001); and planning of access and routing of material within a construction site (Olusegun et al, 1998).

2.4.3 Effective Construction Material Handling

Tompkins and White (1984), define effective construction material handling as using the right method in providing the right amount of the right material, at the right place, time,

sequence, position, condition, and cost. This involves handling, storing, and controlling of the construction materials. Therefore, materials handling provides movement to ensure that materials are located and that a systematic approach is required in designing the system. 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. The selection of the material handling equipment is an important function as it can enhance the production process, provide effective utilisation of manpower, increase production and improve system flexibility (Chan, 2002).

The importance of appropriate handling of materials is highlighted by the fact that there are expensive and engages critical decisions. Estimated costs for materials handling may range from 30-80% (Proverbs et al, 1999) and 10-80% depending on the type of facility (Tompkins and White, 1984) from total construction costs. Because of the percentage amounts, there are certain quality considerations in designing materials handling systems. The materials handling equipment selection is an important function in the design of a material handling system in order to enhance the production process, provide effective utilisation of manpower, increase production, and improve system flexibility (Chan, 2002). In addition, materials scheduling is also an essential part of handling material on site, which has several benefits (Che Wan Putra et al., 1999) such as: showing the quantities involved in each particular operation; providing a key to the distribution of materials on site; and demonstrating useful way of checking quantities required by sub-contractor, Materials must be delivered to site undamaged and without any wastage. Most common problems associated with materials supply is inadequate unloading and

handling facilities, which attribute a high proportion of wastage (Canter, 1993).Therefore, handling with safety during movement of materials at site, which reduce the percentage of materials wastage and finally foster significant improvement can often the total system productivity.

2.4.4 Controlling Cost through Stock and Waste Control

The European Construction Institute's Total Productivity Management report (ECI, 1994) states that "materials delivery to site is a critical, productivity-related aspect which demands the introduction of a carefully developed system of monitoring and control as early as possible". Delivery of the bulk of the construction materials requires proper management of the stock control. Stock control is a technique to ensure all items such as raw materials, processed materials, components for assembly, consumable stores, general stores, maintenance materials and spares work in progress and finished products are available when required (Prabu and Baker, 1986).Construction activity can generate an enormous amount of waste (Teo and Loosemore, 2001) and materials waste has been recognised as a major problem in the construction industry (Formoso et al, 2002). For example, construction materials waste, in the USA contributes approximately 29%. In the UK it contributes more than 50% and in Australia it contributes 20-30%. This is evidence to control constructions materials in a good way during the construction process. The cause of waste in construction projects indicates that waste can arise at any stage of the construction process from inception, right through the design, construction and operation of the built facility (Faniran & Caban, 1998). Therefore, waste can be reduced through the careful consideration of the need for minimisation and better reuse of materials in both the design and construction phases (Dainty and Brooke, 2004). Material storage on site requires close attention

in order to avoid waste, loss and any damage of materials which would affect the operations on the construction project. Problems often arise during materials supply because of improper storage and protection facilities (Canter, 1993). Previous studies have identified that building materials often require a large storage capacity which is rarely available on site (Agapiou et al, 1998). However, Stukhart (1995) suggested that there are a few considerations to be taken into account in the planning of the storage space such as timing of the initial buy, and historical information and experience. Materials management on site should seek to reduce loss of profit due to theft, damage and wastage, as well as running out of stock. Therefore, the requirements of storing space should be taken into consideration from the initial stage of the construction process.

2.5 Constraints in Cost Control Measures

There are many issues which contribute to poor materials management in construction projects. Zakeri et al, (1996) suggested that waste, transport difficulties, improper handling on site, misuse of the specification, lack of a proper work plan, inappropriate materials delivery and excessive paperwork all adversely affect materials management. Shortage of materials contributes to the cause of delay in managing materials in the construction site (Mansfield et al, 1994; Ogunlana et al, 1996; Abdul-Rahman et al; 2006; Aibinu and Odeyinka, 2006). Late delivery of ordered materials is also problematic in materials management. Furthermore, Dey (2001) noted that the common issues relating to materials management are as follows:

Receiving materials before they are required, causing more inventory cost and chances of deterioration in quality; Not receiving materials at the time of requirement, causing loss of

productivity; Incorrect materials take-off from drawings and design documents; Subsequent design changes; Damage/loss of items;

Selection of type of contract for specific materials procurement;

- Vendor evaluation criteria;
- Piling up of inventory and controlling of the same; and
- Management of surplus materials.

The traditional construction methods apply paper-based work during the construction process. This can produce excessive paperwork and contributes poor materials management in construction projects (Zakeri et al, 1996). There is also give problematic, effort-prone and inefficient in the recording and exchanging information of materials component within a supply chain. The implementation of ICT can help the management of construction activities to become more effective and faster. The emergence of ICT systems could transform conventional methods and improve materials management. The use of ICT has also increased with new software related to the construction industry and can support the effective management of materials practices. Therefore, the ICT-enabled solution could help in order to overcome the problems. For example, improving materials supply management through an intelligent system to facilitate bidding, requisition and ordering of materials.

2.7 Implementation of Cost Control during the Execution of Construction Projects

To implement cost control in the execution of projects, it is essential to convert the tender figure into project budget with cost allocations for various activities which are given unique codes. Table 2.1 gives an example of coding system commonly adopted.

Table 2.1 Example of a coding system

S/No.	Cost	Description	Remarks
1	10	All concrete mixing, transporting and placing	Labour and Plant
2	20	All framework fixing and dismantling	Labour and Plant
3	30	All fixing of reinforcement	Labour and Plant
4	40	All bricklaying	Labour and Plant
5	50	Tower crane	Labour and Plant
6	60	All earthworks	Labour and Plant
7	70	Roads and paving	Labour and Plant
8	80	Site overheads and preliminaries	Labour and Plant

Source: Adapted from Olawale and Sun (2010)

According to Olawale and Sun (2010) construction projects must be carefully planned and the budgeted expenditure (excluding head office overheads and profits) is allocated to each cost code/activity in the programme. The authors further contend that in order that the realistic comparisons of budget and actual costs can be made, the budgeted allocation must be derived from accurate quantities, carefully taken from working drawings, and any variations must be included. Table 2.2 gives an example of cost allocation or breakdown of expenditure according to activities over a given time duration. Construction programmes are essential for such cost control systems and cost reports are prepared and presented alongside progress reports.

Table 2.1 Budget cost

Cost codes									
Activity	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**Total**
Earthworks						900		100	1000
Foundations	5000	6000	7000					2000	20000
Columns	1000	1000	2500					500	5000
Ground floor	200	300	300					200	1000
Lift shift	15000	17000	18000		10000			20000	80000
Brick and block	2000	3000	4000					1000	10000
Windows and				13000				3000	16000
Roofing				2000	1000			1000	4000
Internal finishes	100	100	100		100			50	450
Services				1000	500			3000	4500
Electrics				500	1000			5000	6500
External works								4000	4000
Clear site							1800	200	2000
Total	£23300	£27400	£31900	£16500	£12600	£900	£2700	£40150	£155450

Source: Olawale and Sun (2010)

2.6 Benefits of Effective Cost Control Systems

An effective material management system can bring many benefits for a company. Previous studies by the Construction Industry Institute (CII) concluded that labor productivity could be improved by six percent and can produce 4-6% additional savings (Bernold and Treseler, 1991). Among these benefits are:

- Reducing the overall costs of materials
- Better handling of materials
- Reduction in duplicated orders
- Materials will be on site when needed and in the quantities required
- Improvements in labor productivity

- Improvements in project schedule
- Quality control
- Better field material control
- Better relations with suppliers
- Reduce of materials surplus
- Reduce storage of materials on site
- Labor savings
- Stock reduction
- Purchase savings
- Better cash flow management

From a study of twenty heavy construction sites, the following benefits from the introduction of materials management systems were noted (Stukhart & Bell, 1987):

- In one project, a 6% reduction in craft labor costs occurred due to the improved availability of materials as needed on site. On other projects, an 8% savings due to reduced delay for materials estimated.
- A comparison of two projects with and without a materials management system revealed a change in productivity from 1.92 man-hours per unit without a system to 1.14 man-hours per unit with a new system. Again, much of this difference can be attributed to the timely availability of materials.
- Warehouse costs were found to decrease 50% on one project with the introduction of improved inventory management, representing a savings of $ 92,000. Interest charges for inventory also declined, with one project reporting a cash flow savings of $ 85,000 from improved materials management. Against these various benefits, the

costs of acquiring and maintaining a materials management system has to be compared. However, management studies suggest that investment in such systems can be quite beneficial (Stukhart and Bell, 1987).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The chapter presents the methods and procedures adopted to achieve the research objectives and find answers to the research questions. The chapter comprises six main sections namely; an introduction, research design, target population, sampling procedures (size and technique), data collection (instruments and procedures of fieldwork) and data analysis.

3.2 Research Design

The research design includes an outline of what the researcher is writing on including their operational implications to the final analysis of the data. This study adopted the case study strategy. Among the various research designs, case studies are frequently regarded as using either quantitative or qualitative research or combination of both approaches (Bryman, 2004). The research used quantitative research approach. Both primary and secondary data sources were considered to be more appropriate for this study. This type of research was used because it eventually enabled the researcher to comprehensively address the specific objectives and research questions of the study. Research methods can be placed into two basic categories: quantitative and qualitative. Qualitative research gathers information that is not in numerical form whiles quantitative research gathers information in numerical form (frequency and percentage). The study chose quantitative research approach because quantitative research can be analyzed using frequencies and percentages.

3.3 Population of the Study

The target population for the study were site managers of construction companies registered with the Kumasi Metropolis. The number of construction companies registered with the Kumasi Metropolis as at January 2016 were thirty-six (36). Based on this number and given that the average number of site managers per contractor were three (3), the size of the population of site managers were one hundred and eight (108).

3.4 Sampling Procedure and Sample Size

Due to the small number of contractors registered with the Kumasi Metropolis they were all covered in the study. Therefore all the one hundred and eight (108) site managers were covered in the study without recourse to sampling. The census sampling employed in this case has the advantage of overcoming problems associated with arriving at a statistically representative sample.

3.5 Data Collection

The main instrument that was used to collect primary data for the study was questionnaire. The questionnaire was structured to consist of closed ended and open ended type of questions in order to elicit feedback from respondents. Other information that were collected include demographic information and most of the questions were centered on the cost control measures practiced by building contractors and site supervisors in the Kumasi Metropolis. These were the main areas around which data gathered from participants would be analyzed. Likert scale would be used as categories mainly ranging from strongly disagree, disagree, neutral, agree to strongly agree. The questionnaires consist of four sections. Section 1 contains the demographic

information of the respondents. Information's like age, gender, qualification of the respondents would be retrieved. Section 2 also contains questions that identified cost control measures frequently used by building contractors in the Kumasi Metropolis. Section 3 investigates the use of conventional control measures in construction projects in the Kumasi Metropolis. Section 4 assessed the project performance of construction projects of Kumasi Metropolis.

3.5.1 Pilot Testing

The pilot questionnaire was given to 12 people to answer to correct errors which could take the form of repetition of questions and typographical mistakes and the avoidance of double questions.

3.5.2 Data Collection Procedure

Primary data was collected through a field survey of building contractors and sites supervisors in the Kumasi Metropolis. Data was collected through the use of a designed questionnaire administered to participants in their workshops and construction sites. Questionnaires were filled out by participants and the researcher retrieved the questionnaires in two weeks' time.

3.6 Data Analysis

The raw data obtained from a study is useless unless it is transformed into information for the purpose of decision making (Emery and Couper, 2003). The data analysis involved reducing the raw data into a manageable size, developing summaries and applying statistical inferences. Consequently, the following steps were taken to analyze the data for the study. The data was

edited to detect and correct, possible errors and omissions that were likely to occur, to ensure consistency across respondents.

The data was then coded to enable the respondents to be grouped into limited number of categories. The SPSS version 18 was used to analyse data. Data was presented in tabular form, graphical and narrative forms. In analyzing the data, descriptive statistical tools such as tables, frequencies and percentages were used.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The chapter presents the results and discussion of field data. Also, the chapter discusses the results in relation to relevant past studies. The chapter discussed the results of the study based on the research questions guiding the study.

4.2 Response Rate

A total of one hundred and eight (108) questionnaires were personally administered to site managers or personnel of their firms who in turn gave it out to site supervisors. A total of thirty-eight (38) questionnaire were completed and retrieved, out of which two (2) were not properly completed and as such were not included in the analysis. The response rate therefore achieved was for primary data, thirty-six (36) questionnaires were finally used for the analysis of the study. Therefore, the response rate achieved was 33%. This response rate is comparable to response rates achieved in the same setting (Kheni, Dainty & Gibb, 2008)

4.3 Demographic information of the Respondents

This section presents the demographic characteristics of the respondents. The characteristics of the respondents considered includes; gender, age group, working experience and highest educational qualification.

4.3.1 Gender of Respondents

Table 4.1 below shows that 29 respondents representing 80.6% of the respondents were males while 7 respondents representing 19.4% were females. This results is consistent with the fact that the construction industry is male dominated (Dainty and Lingard, 2006).

Table 4.1: Gender of the Respondents

Gender of the respondents	Frequency	Percent
Male	29	80.6
Female	7	19.4
Total	36	100.0

Source: Field survey, 2016

4.3.2 Age of Respondents

Table 4.2 shows that 19 respondents representing52.8% of the respondents were between the age ranges of 41-50 years, 7 respondents representing 19.4% of the respondents were between the ages of 31-40 years and 51-60 years respectively while 3 respondents representing 8.3% were between the ages of 21-30 years. This means that most of the respondents were in their prime ages and have considerable experience in the management of cost in the construction industry.

Table 4.2: Age Group of the Respondents

Age Group of the Respondents	**Frequency**	**Percent**
21-30 years	3	8.3
31-40 years	7	19.4
41-50 years	19	52.8
51-60 years	7	19.4
Total	36	100.0

Source: Field survey, (2016)

Table 4.3 indicates that 15 respondents representing 41.7% of the respondents have worked in the construction industry for more than 15 years now, 8 respondents representing 22.2% of the respondents have worked for 10-15 years now, 6 respondents representing 16.6% of the respondents have worked for more than 15 years, 5 respondents representing 13.9% of the respondents have worked for 3-6 years while 2 respondents representing 5.6% have worked for less than 3 years now. This implies that majority of the respondents had many years of working experience in the construction industry.

Table 4.3: Working experience of the Respondents

Working experience of the Respondents	**Frequency**	**Percent**
Below 3 years	2	5.6
3-6 years	5	13.9
6-10 years	15	41.7
10-15 years	8	22.2
More than 15 years	6	16.6
Total	36	100.0

Source: Field survey, (2016)

Table 4.4 shows that 19 respondents representing 52.8% of the respondents were possessing Bachelor's degrees as their highest qualifications, 10 respondents representing 27.8% of the respondents were possessing Master's degrees while 7 respondents representing 19.4% were possessing Diploma as their highest qualification.

Table 4.4: Highest educational qualification of the Respondents

Highest educational qualification	Frequency	Percent
Diploma	7	19.4
Bachelor's degree	19	52.8
Master's degree	10	27.8
Total	36	100.0

Source: Field survey, (2016)

4.4 Cost control measures in building projects

Table 4.5 indicates the cost control measures in building projects.

Table 4.5: Cost control measures in building projects

Cost Control measures	SD	D	NS	A	SA	Total
Project cost value	-	3 (8.3)	5 (13.9)	16 (44.4)	12	36
Overall profit or loss	4 (11.1)	2 (5.6)	5 (13.9)	15 (41.7)	10	36
Profit or loss on each	3 (8.3)	4 (11.1)	5 (13.9)	14 (38.9)	10	36
Labour/plant/material	5 (13.9)	5 (13.9)	3 (8.3)	15 (41.7)	8 (22.2)	36
Unit costing	2 (5.6)	4 (11.1)	2 (5.5)	21 (58.3)	7 (19.4)	36
Standard costing	-	-	4 (11.1)	19 (52.8)	13	36
Earned value analysis	3 (8.3)	5 (13.9)	2 (5.6)	15 (41.6)	11	36
Programme evaluation and	-	4 (11.1)	3 (8.3)	23 (63.9)	9 (25)	36
Leading parameter method	3 (8.3)	6 (16.7)	2 (5.6)	19 (52.8)	6 (16.7)	36

SD-Strongly disagree, D- disagree, NS- Not sure, A- agree, SA- Strongly agree
Source: Field survey, (2016)

The results shows that majority 28 respondents representing 77.7% of the respondents agreed that project cost value reconciliation is a Cost Control measure used in building projects, 3 respondents representing 8.3% of the respondents disagreed while 5 respondents representing 13.9% of the respondents were uncertain. An effective material management system can bring many benefits to a company. Previous studies by the Construction Industry Institute (CII) concluded that labor productivity could be improved by six percent and can produce 4-6% additional savings (Bernold and Treseler, 1991). Among these benefits are:

- Reducing the overall costs of materials
- Better handling of materials

- Reduction in duplicated orders
- Materials will be on site when needed and in the quantities required
- Improvements in labor productivity
- Improvements in project schedule
- Quality control
- Better field material control
- Better relations with suppliers
- Reduce of materials surplus
- Reduce storage of materials on site
- Labor savings
- Stock reduction
- Purchase savings
- Better cash flow management

The study revealed that majority 25 respondents representing 69.5% of the respondents agreed that overall profit or loss strategy is a Cost Control measure used in building projects, 6 respondents representing 16.7% of the respondents disagreed while 5 respondents representing 13.9% were uncertain. The study shows that 24 respondents representing 66.7% of the respondents agreed that they used Profit or loss on each contract at valuation dates is Cost Control measure used in building projects, 7 respondents representing 19.4% of the respondents disagreed while 5 respondents 13.9% were uncertain. Productivity in construction is often broadly defined as output per labor hour. Since labor constitutes a large part of the construction cost and the quantity of labor hours in performing a task in construction is more susceptible to

the influence of management than are materials or capital, this productivity measure is often referred to as *labor productivity*. However, it is important to note that labor productivity is a measure of the overall effectiveness of an operating system in utilizing labor, equipment and capital to convert labor efforts into useful output, and is not a measure of the capabilities of labor alone. For example, by investing in a piece of new equipment to perform certain tasks in construction, output may be increased for the same number of labor hours, thus resulting in higher labor productivity.

Construction output may be expressed in terms of functional units or constant dollars. In the former case, labor productivity is associated with units of product per labor hour, such as cubic yards of concrete placed per hour or miles of highway paved per hour. In the latter case, labor productivity is identified with value of construction (in constant dollars) per labor hour. The value of construction in this regard is not measured by the benefit of constructed facilities, but by construction cost. Labor productivity measured in this way requires considerable care in interpretation. For example, wage rates in construction have been declining in the US during the period 1970 to 1990, and since wages are an important component in construction costs, the value of construction put in place per hour of work will decline as a result, suggesting lower productivity.

The study indicates that majority 23 respondents representing 63.9% of the respondents agreed that Labour/plant/material (actual versus forecast reconciliation) is Cost Control measure used in building projects, 10 respondents representing 27.8% of the respondents disagreed while 3 respondents representing 8.3% were uncertain. Contractors and craft unions must negotiate not only wage rates and working conditions, but also hiring and apprentice training practices. The purpose of trade jurisdiction is to encourage considerable investment in apprentice training on

the part of the union so that the contractor will be protected by having only qualified workers perform the job even though such workers are not permanently attached to the contractor and thus may have no sense of security or loyalty. The referral system is often a rapid and dependable source of workers, particularly for a contractor who moves into a new geographical location or starts a new project which has high fluctuations in demand for labor. By and large, the referral system has functioned smoothly in providing qualified workers to contractors, even though some other aspects of union operations are not as well accepted by contractors.

The study holds it that 26 respondents representing 77.7% of the respondents agreed that unit costing is a Cost Control measure used in building projects, 6 respondents representing 16.7% disagreed while 2 respondents representing 5.5% were uncertain. The study revealed that majority 32 respondents representing 88.9% of the respondents agreed that standard costing is Cost Control measure used in building projects while 4 respondents representing 11.1% were uncertain. The study revealed that majority 26 respondents representing 72.2% of the respondents agreed that earned value analysis is Cost Control measure used in building projects, 8 respondents representing 22.2% of the respondents disagreed, while 2 respondents representing 5.6% were uncertain. The study shows that 32 respondents representing 88.9% of the respondents agreed that Programme evaluation and review techniques (PERT/COST) are used as a Cost Control measure used in building projects, 3 respondents representing 8.3% were uncertain while 4 respondents representing 11.1% disagreed. The foregoing cost control system in general allocates costs against a gang of workers, e.g. concrete gang. It is therefore the responsibility of the charge-hand of the gang to fill in the daily allocation sheet (Fig 7.3), recording a brief description of the operation upon which the gang was employed and the names and hours worked by each member of the gang. Often this recording is not necessary,

particularly if the type of work being done by the gang is fairly static; the cost control engineer then simply extracts the labour – hours for the gang from the wages sheet. Whenever a bonus system is operated on the project, the gang bonus must be added to the basic costs derived from the wages sheet in order to arrive at the actual cost of doing the work. The carefully bookkeeping that is usual with the bonus system provides figures than can be used to assess the value of work done, since the measurement engineer has had to take a weekly measurement of progress to enable the bonus to be calculated.

Note that all costs of labour and plant should be allocated against the cost codes. If this proves difficult, the device of introducing a code for miscellaneous work is sometimes adopted. This can encourage the inappropriate booking of wasted labour-hours and is not recommended. If, despite this advice, a miscellaneous code is used, the costs in this code should be retrospectively allocated to the other codes.

The study indicates that majority 25 respondents representing 69.5% of the respondents agreed that leading parameter method is Cost Control measure used in building projects, 9 respondents representing 25% of the respondents disagreed while 2 respondents representing 5.6% were uncertain. From a study of twenty heavy construction sites, the following benefits from the introduction of materials management systems were noted (Stukhart and Bell, 1987):

- In one project, a 6% reduction in craft labor costs occurred due to the improved availability of materials as needed on site. On other projects, an 8% savings due to reduced delay for materials estimated.
- A comparison of two projects with and without a materials management system revealed a change in productivity from 1.92 man-hours per unit without a system to

1.14 man-hours per unit with a new system. Again, much of this difference can be attributed to the timely availability of materials.

- Warehouse costs were found to decrease 50% on one project with the introduction of improved inventory management, representing a savings of $ 92,000. Interest charges for inventory also declined, with one project reporting a cash flow savings of $ 85,000 from improved materials management. Against these various benefits, the costs of acquiring and maintaining a materials management system has to be compared. However, management studies suggest that investment in such systems can be quite beneficial (Stukhart and Bell, 1987).

4.5 Software packages used for project cost control

Table 4.6 shows the software packages used for projects cost control. These softwares can be used to measure and control cost in the construction industry.

Table 4.6: Software packages used for project cost control

Key: 1- Software is not used at all, 2- software is sometimes used, 3-software is often used, 4-Software is always used.

Software packages used for project cost control	1 Freq. (%)	2 Freq. (%)	3 Freq. (%)	4 Freq. (%)	Total Freq. (%)
Bespoke/ In-house	5(13.9)	21(58.3)	7 (19.4)	3 (8.3)	36(100)
Microsoft project	4(11.1)	2 (5.6)	27 (75)	3 (8.3)	36(100)
Asta power project	-	4 (11.1)	19(52.8)	13(36.1)	36(100)
Primavera sure trak	-	3 (8.3)	6 (16.7)	27 (75)	36(100)
Microsoft excel	-	2 (5.6)	8 (22.2)	26 72.2)	36(100)
COINS	2 (5.6)	15(41.7)	10(27.8)	7 (19.4)	36(100)
WINQS	3 (8.3)	5 (13.9)	25 69.4)	3 (8.3)	36 100)

Source: Field survey, (2016)

The study shows that majority 21 respondents representing 58.3% of the respondents affirmed that Bespoke/ in-house software is sometimes used to control cost, 5 respondents representing 13.9% of the respondents said that the software is not used at all, 7 respondents representing 19.4% said that the software is often used to control cost in the construction firm while 3 respondents representing 8.3% said that the software is always used. The study revealed that majority 27 respondents representing 75% of the respondents affirmed that Microsoft project software is often used to control cost in the construction firm, 3 respondents representing 8.3% said that the software is always used, 2 respondents representing 5.6% said that the software is sometimes used while 4 respondents representing 11.1% said that the software is not used at all. The study depicts that 32 respondents representing 91.6% of the respondents affirmed that project costing system (PCS) is often used while 4 respondents representing 8.4% said that the software is always used to control cost in the construction firm. The study depicts that 19 respondents representing 52.8% of the respondents said that Asta power project software is often used to control cost in the construction firm, 13 respondents representing 36.1% of the respondents said that the software is always used while 4 respondents representing 11.1% said that the software is sometimes used. The study revealed that 75% of the respondents said that primavera sure trak software is always used to control cost in the construction firm, 16.7% said that the software is often used while 8.3% said that the software is sometimes used to control cost. The study shows that majority 26 respondents representing 72.2% of the respondents affirmed that Microsoft excel software is always used to control cost in the construction firm, 8 respondent representing 22.2% of the respondents said that the software is often used while 2 respondents representing 5.6% said that the software is sometimes used to control cost. The study shows that 15 respondents representing 41.7% of the respondents affirmed that COINS

software is sometimes used to control cost in the construction firm, 10 respondents representing 27.8% of the respondents said that the software is often used, 7 respondents representing 19.4% of the respondents said that the software is always used while 2 respondents representing 5.6% said that the software is not used at all. The study indicates that 25 respondents representing 69.4% of the respondents said that the WINQS software is often used to control cost in the construction firm, 5 respondents representing 13.9% said that the software is always used, 3 respondents representing 8.3% said that the software is sometimes used while 3 respondents representing 8.3% said that the software is not used at all.

Furthermore, Dey (2001) noted that the common issues relating to materials management are as follows:

Receiving materials before they are required using more sophisticated softwares, causing more inventory cost and chances of deterioration in quality; Not receiving materials at the time of requirement, causing loss of productivity; Incorrect materials take-off from drawings and design documents; Subsequent design changes; Damage/loss of items;

Selection of type of contract for specific materials procurement;

- Vendor evaluation criteria;
- Piling up of inventory and controlling of the same; and
- Management of surplus materials.

The traditional construction methods apply paper-based work during the construction process. This can produce excessive paperwork and contributes poor materials management in construction projects (Zakeri et al, 1996). There is also give problematic, effort-prone and inefficient in the recording and exchanging information of materials component within a supply chain. The implementation of ICT can help the management of construction activities to become

more effective and faster. The emergence of ICT systems could transform conventional methods and improve materials management. The use of ICT has also increased with new software related to the construction industry and can support the effective management of materials practices. Therefore, the ICT-enabled solution could help in order to overcome the problems. For example, improving materials supply management through an intelligent system to facilitate bidding, requisition and ordering of materials.

4.6 Challenges to effective implementation of cost control measures

Table 4.7 depicts the challenges to effective implementation of cost control measures.

Table 4.7: Challenges to effective implementation of cost control measures

Challenges to effective implementation of cost control measures	SD Freq. (%)	D Freq. (%)	NS Freq. (%)	A Freq. (%)	SA Freq. (%)	Total Freq. (%)	Mean score
Lack of incentives in contract clauses for contractors implementing effective cost control in building projects	3 (8.3)	2 (5.6)	3 (8.3)	23 (63.9)	6 (16.7)	36 (100)	3.80
Lack of skilled personnel for implementing effective cost control	-	3 (8.3)	2 (5.6)	21 (58.3)	10 (27.8)	36 (100)	3.94
Lack of ICT equipment and software for implementing effective cost control	-	5 (13.9)	2 (5.6)	12 (33.3)	17 (47.2)	36 (100)	4.04
Projects are transient lessons learned in implementing cost control on one site cannot be transferred to another	3 (8.3)	2 (5.6)	4 (11.1)	23 (63.9)	4 (11.1)	36 (100)	3.88

The time at which major cost savings can be achieved is during planning and design for the project	-	5 (13.9)	6 (16.7)	7 (47.2)	8 (22.2)	36 (100)	4.01
Schedule information and cost accounts are usually kept separately making the integration of schedule and cost information difficult	3 (8.3)	4 (11.1)	2 (5.6)	9 (25)	18 (50)	36 (100)	3.85
The time constraints allocated to project management planning	3 (8.3)	6 (16.7)	5 (13.9)	15 (41.7)	7 (19.4)	36 (100)	3.86
The perceived cost to implement procedures as contributing to the limited use of formal cost management on projects	4 (11.1)	4 (11.1)	3 (8.3)	20 (55.6)	5 (13.9)	36 (100)	3.87
During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process	-	8 (22.2	5 (13.9)	3 (8.3)	20 (55.6)	36 (100)	3.90
Managers are often forced to infer the cost impacts of schedule changes, rather than being provided with aids for this process	-	-	3 (8.3)	24 (66.7)	9 (25)	36 (100)	4.05

SD-Strongly disagree, D- disagree, NS- Not sure, A- agree, SA- Strongly agree
Source: Field survey, (2016)

The study shows that majority 29 respondents representing 80.6% of the respondents agreed that lack of incentives in contract clauses for contractors implementing effective cost control in building projects is a challenge to effective implementation of cost control measures in the construction industry, 5 respondents representing 13.9% of the respondents disagreed while 2 respondents representing 8.3% were neutral with a mean score of 3.80. There are many issues which contribute to poor materials management in construction projects. Zakeri et al, (1996) suggested that waste, transport difficulties, improper handling on site, misuse of the specification, lack of a proper work plan, inappropriate materials delivery and excessive paperwork all adversely affect materials management. Shortage of materials contributes to the cause of delay in managing materials in the construction site (Mansfield et al, 1994; Ogunlana et al, 1996; Abdul-Rahman et al; 2006; Aibinu and Odeyinka, 2006). Late delivery of ordered materials is also problematic in materials management. Furthermore, Dey (2001) noted that the common issues relating to materials management are as follows:

Receiving materials before they are required, causing more inventory cost and chances of deterioration in quality; Not receiving materials at the time of requirement, causing loss of productivity; Incorrect materials take-off from drawings and design documents; Subsequent design changes; Damage/loss of items;

Selection of type of contract for specific materials procurement;

- Vendor evaluation criteria;
- Piling up of inventory and controlling of the same; and
- Management of surplus materials.

The traditional construction methods apply paper-based work during the construction process. This can produce excessive paperwork and contributes poor materials management in

construction projects (Zakeri et al, 1996). There is also give problematic, effort-prone and inefficient in the recording and exchanging information of materials component within a supply chain. The implementation of ICT can help the management of construction activities to become more effective and faster. The emergence of ICT systems could transform conventional methods and improve materials management. The use of ICT has also increased with new software related to the construction industry and can support the effective management of materials practices. Therefore, the ICT-enabled solution could help in order to overcome the problems. For example, improving materials supply management through an intelligent system to facilitate bidding, requisition and ordering of materials.

The study revealed that majority 31 respondents representing 86.1% of the respondents agreed that lack of skilled personnel for implementing effective cost control is a challenge to effective implementation of cost control measure in the construction industry, 2 respondents representing 5.6% of the respondents were uncertain while 3 respondents representing 8.3% disagreed with a mean score of 3.94.

The study indicates that majority 29 respondents representing 80.5% of the respondents agreed that lack of ICT equipment and software for implementing effective cost control is a challenge to effective implementation of cost control measure in the construction industry, 2 respondents representing 5.6% of the respondents were uncertain while 7 respondents representing 13.9% of the respondents disagreed with a mean score of 4.04. Materials ordering problems lend themselves particularly well to computer based systems to insure 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. The study revealed that 27 respondents representing 75% of the respondents agreed that construction projects are transient lessons learned in implementing cost control on one site cannot be transferred to another and this is a challenge, 5 respondents representing 13.9% of the respondents disagreed while 4 respondents representing 11.1% were uncertain with a mean score of 3.88.

The study shows that 15 respondents representing 69.4% of the respondents agreed that the time at which major cost savings can be achieved is during planning and design for the project and this is a challenge in the construction industry, 5 respondents representing 13.9% of the respondents disagreed while 6 respondents representing 16.7% were neutral with a mean score of 4.01. 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 avoidable 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. 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 case, 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. This organizational materials management problem is analogous to inventory control in any organization facing continuing demand for particular items.

The study revealed that majority 27 respondents representing 75% of the respondents agreed that schedule information and cost accounts are usually kept separately making the integration of schedule and cost information difficult, 7 respondents representing 19.4% of the respondents disagreed while 2 respondents representing 5.6% of the respondents were uncertain with a mean score of 3.85.

The study shows that 22 respondents representing 61.1% of the respondents agreed that the time constraints allocated to project management planning is a challenge, 9 respondents representing 9 respondents representing 25% of the respondents disagreed while 5 respondents

representing 13.9% were uncertain with a mean score of 3.86. The study depicts that majority 25 respondents representing 69.5% of the respondents agreed that the perceived cost to implement procedures as contributing to the limited use of formal cost management on projects is high and this is a challenge, 8 respondents representing 22.2% of the respondents disagreed while 3 respondents representing 8.3% were uncertain with a mean score of 3.87.

Good project management in construction must vigorously pursue the efficient utilization of labor, material and equipment. Improvement of labor productivity should be a major and continual concern of those who are responsible for cost control of constructed facilities. Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades. Organizations which do not recognize the impact of various innovations and have not adapted to changing environments have justifiably been forced out of the mainstream of construction activities.

The study results revealed that 23 respondents representing 63.9% of the respondents agreed that during the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process, 13 respondents representing 22.2% of the respondents disagreed while 5 respondents representing 13.9% were neutral with a mean score of 3.90. The study shows that majority 33 respondents representing 91.7% of the respondents agreed that managers are often forced to infer the cost impacts of schedule changes, rather than being provided with aids for this process while 3 respondents representing 8.3% of the respondents were uncertain with a mean score of 4.05.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The main purpose of the study was to improve cost control measures in building projects in Ghana using the Kumasi Metropolis in the Ashanti Region as a case study. This study adopted the case study strategy. The study used quantitative research approach. The population for the study were site managers of construction companies registered with the Kumasi Metropolis. The size of the population of site managers were one hundred and eight (108). Purposive sampling method was used to select all the one hundred and eight (108) site managers for the study. The main instrument that was used to collect primary data for the study were questionnaire. Primary data was collected through a field survey of building contractors and sites supervisors in the Kumasi Metropolis. Data was collected through the use of a designed questionnaire administered to participants in their workshops and construction sites. Questionnaires were filled out by participants and the researcher had to go for the questionnaires and work with it. The collected data was coded to enable the respondents to be grouped into limited number of categories. The SPSS version 18 was used to analyse data. Data was presented in tabular form, graphical and narrative forms. In analyzing the data, descriptive statistical tools such as tables, frequencies and percentages were used.

5.2 Key Findings of the Study

- **Cost control measures in building projects**

The results shows that majority 77.7% of the respondents agreed that project cost value reconciliation is a Cost Control measure used in building projects. The study revealed that majority 69.5% of the respondents agreed that overall profit or loss strategy is a Cost Control measure used in building projects. The study shows that 66.7% of the respondents agreed that they used Profit or loss on each contract at valuation dates is Cost Control measure used in building projects.The study indicates that majority 63.9% of the respondents agreed that Labour/plant/material (actual versus forecast reconciliation) is Cost Control measure used in building projects. The study holds it that 77.7% of the respondents agreed that unit costing is a Cost Control measure used in building projects. The study revealed that majority 88.9% of the respondents agreed that standard costing is Cost Control measure used in building projects. The study revealed that 72.2% of the respondents agreed that earned value analysis is Cost Control measure used in building projects. The study shows that 88.9% of the respondents agreed that Programme evaluation and review techniques (PERT/COST) are used as a Cost Control measure used in building projects. The study indicates that majority 69.5% of the respondents agreed that leading parameter method is Cost Control measure used in building projects.

- **Software packages used for project cost control**

The study shows that 58.3% of the respondents affirmed that Bespoke/ in-house software is sometimes used to control cost. The study revealed that majority 75% of the respondents affirmed that Microsoft project software is often used to control cost in the construction firm. The study depicts that 91.6% of the respondents affirmed that project costing system (PCS) is

often used. The study depicts that 52.8% of the respondents said that Asta power project software is often used to control cost in the construction firm. The study revealed that 75% of the respondents said that primavera sure trak software is always used to control cost in the construction firm. The study shows that majority 72.2% of the respondents affirmed that Microsoft excel software is always used to control cost in the construction firm. The study shows that 41.7% of the respondents affirmed that COINS software is sometimes used to control cost in the construction firm. The study indicates that 69.4% of the respondents said that the WINQS software is often used to control cost in the construction firm, 13.9% said that the software is always used.

- **Challenges to effective implementation of cost control measures**

The study shows that majority 80.6% of the respondents agreed that lack of incentives in contract clauses for contractors implementing effective cost control in building projects is a challenge to effective implementation of cost control measures in the construction industry. The study revealed that majority 86.1% of the respondents agreed that lack of skilled personnel for implementing effective cost control is a challenge to effective implementation of cost control measure in the construction industry. The study indicates that majority 80.5% of the respondents agreed that lack of ICT equipment and software for implementing effective cost control is a challenge to effective implementation of cost control measure in the construction industry. The study revealed that 75% of the respondents agreed that construction projects are transient lessons learned in implementing cost control on one site cannot be transferred to another and this is a challenge. The study revealed that majority 75% of the respondents agreed that schedule information and cost accounts are usually kept separately making the integration of schedule and

cost information difficult is a challenge. The study shows that 84.1% of the respondents agreed that the time constraints allocated to project management planning is a challenge. The study depicts that majority 88.8% of the respondents agreed that the perceived cost to implement procedures as contributing to the limited use of formal cost management on projects is high and this is a challenge. The study results revealed that 63.9% of the respondents agreed that during the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process. The study shows that majority 91.7% of the respondents agreed that managers are often forced to infer the cost impacts of schedule changes, rather than being provided with aids for this process.

5.3 Conclusions

The study concluded that the cost control measures used in building projects were project cost value reconciliation, overall profit or loss strategy, Profit or loss on each contract at valuation dates, labour/plant/material (actual versus forecast reconciliation), unit costing, standard costing, earned value analysis, Programme evaluation and review techniques (PERT/COST) and leading parameter method areCost Control measures used in building projects.

The study further concluded that the Software packages used for project cost control are Bespoke/ in-house software, Microsoft project software, project costing system (PCS), Asta power project software, primavera sure trak software, Microsoft excel software, COINS software and WINQS software

Moreover, the challenges to effective implementation of cost control measures are lack of incentives in contract clauses for contractors implementing effective cost control in building projects, lack of skilled personnel for implementing effective cost control, lack of ICT equipment and software for implementing effective cost control is a challenge to effective implementation of cost control measure in the construction industry, construction projects are transient lessons learned in implementing cost control on one site cannot be transferred to another and this is a challenge, the time at which major cost savings can be achieved is during planning and design for the project and this is a challenge in the construction industry, schedule information and cost accounts are usually kept separately making the integration of schedule and cost information difficult, the time constraints allocated to project management planning is a challenge. Also, The perceived cost to implement procedures as contributing to the limited use of formal cost management on projects is high and this is a challenge, during the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process and managers are often forced to infer the cost impacts of schedule changes, rather than being provided with aids for this process.

5.4 Recommendations

Based on the key findings and conclusions of the study, the study highlighted the following recommendations:

1. The stakeholders in the construction industry should provide adequate incentives in contract clauses for contractors implementing effective cost control in building projects. This could facilitate the implementation of the construction projects in the industry.

2. The managers of the construction industry should recruit competent skilled personnel for implementing effective cost control.
3. The stakeholders in the construction industry should provide adequate ICT equipment and software for implementing effective cost control. This could enhance the smooth documentation of cost control in the industry.
4. The managers of the construction industry should organise periodic training programmes for the site supervisors to learn modern and sophisticated methods of cost control to improve their cost control measures.
5. The site supervisors should intensify their record keeping practices in order to facilitate cost control.

5.5 Suggestions for Further Research

According to the recommendations of the study, the researcher suggested that a similar study should be conducted to assess the effects of training programmes on site supervisors on cost control measures.

REFERENCES

Agapiou, G., Dainty, M., & Brooke, A. (1998). Construction Waste Minimization. Bachelor researcher, Islamic University-Gaza.

Ahuja, Hira, N. & Dozzi, S. P. (1994). Project management techniques in planning and controlling construction projects, (2nd ed.). New York: John Wiley& Sons Inc.

Aibinu, O., & Odeyinka, J. (2006) Interactions between construction planning and influence factors. *Journal of Construction Engineering and Management, 124*(4), 245-256.

Al-Hajj, M., Adeli, T., & Akintoye, A. (2011). *Factors Affecting Accuracy of Pre-tender Cost Estimate in Gaza Strip., Gaza strip.* Master thesis in Construction Management, The Islamic University of Gaza Strip.

Ammer, D. S. (1980). *Materials Management and Purchasing, Richard* D. Irwin, Inc. Homewood, Illinois.

Arnold, J. R. (1991). *Introduction to materials management*. Englewood Cliffs, New Jersey: Prentice-Hall

Austin, A.D. & Neal, G. (2004). Managing Construction Project", John Wiley & Sons, Inc., United States.

Bailey, P., & Farmer, D. (1982). *Materials Management Handboo.* Aldershot, Hants, England: Gower Publishing Company Limited.

Beekman-Love, G. K. (2008). *Materials management*, Martinus Nijhoff: Boston: Social Sciences Division.

Bernold, Leonhard E., & Treseler, John F. (1991). Vendor Analysis for Best Buy in Construction. *Journal of Construction Engineering and Management, 117*(4), 645-658.

Brinke, E., Lutters, E., Streppel, T., & Kals, H. (2004). Cost estimation architecture for integrated cost control based on information management. *International Journal of Computer Integrated Manufacturing, 17*(6), pp. 534-545.

Canter, A. (1993). A survey of current cost estimating practices in the UK,. *Construction Management and Economics, 18*(1), 161-172.

Canter, M. R. (1993). *Resource management for construction*. Basingstoke: Macmillan Press

Chandler, I. E. (2008). *Materials management on building site*. Great Britain, Pitman,

Che Wan Putra, G. D., Skitmore, M., & Sidwell, T. (1999). *Risk factors leading to cost overrun in the delivery of highway construction projects.* Australia: Research Centre: School of Urban Development.

Cavinato, J. L. (1984). *Purchasing and materials management.* Minnesota: West Publishing Company.

Chandler, I. E. (2008). *Materials management on building sites*. Lancaster, England: The Construction Press.

Chen, Z., Li, H., & Wong, C. T. C. (2002). An Application of Bar-Code System for Reducing Construction Wastes. Elsevier Science, *Automation in Construction 11*, 512-535.

Dainty, M., & Brooke, A. (2004). Construction Waste Minimization. Bachelor researcher, Islamic University-Gaza.

Dainty, A. R. J., & Lingard, H. (2006). Indirect discrimination in construction organizations and the impact on women's careers. *Journal of Management in Engineering, 22*(3), 108–118

Dobler, D. W., & Burt, D. N. (1996). *Purchasing and Supply Management: Text and Cases, McGraw-Hill Series in Management.* USA.: The McGraw-Hill Companies Inc.

Doloi, H. (2013). Cost overruns and failure in project management: Understanding the roles of key stakeholders in construction projects. *Journal of Construction Engineering and Management, 139* (3), 267-279.

Dey, L. R. (2000). Is "estimate accuracy" an oxymoron? *AACE International Transactions, 1,* 1-1.5.

ECI, Construction industry institute, (1994). *Improving early estimates.* Austin, USA: University of Texas.

Elanga, G. B. E., Louzolo-Kimbembe, P., & Pettang, C. (2014). Evaluation of cost overrun factors in the construction projects in developing countries: Cameroon as case study. *International Journal of Emerging Technology and Advanced Engineering, 4* (10), 533-538.

Fanirau, A., & Caban, A. (1998). Implementation of automated site data collection with a medium-size contractor. Boston, MA: Proceedings of ASCE Computing in Civil Engineering.

Faniran, A. E. & Mason, A. K. (1998). Cost estimation predictive modeling: Regression versus neural network. *The Engineering Economist, 42*(2), 137– 161.

Faniran, O. O., Oluwoye, J. O., & Lenard, D. J. (1998). Interactions between construction planning and influence factors. *Journal of Construction Engineering and Management, 124*(4), 245-256.

Gossom, W. J. (1983). *Control of Projects, Purchasing, and Materials*. Tulsa, Oklahoma: Penn Well Publishing Company,

Harikumar, P., & Sonmez, R. (2014). Range estimation of construction costs using neural networks with bootstrap prediction intervals. *Expert Systems with Applications, 38*, 9913-9917.

Illingworth, J. (1993). *Construction Planning and Scheduling*. Columbus, Ohio: Prentice-Hall.

Kareem, K. R. & Pandey, R. K. (2013). Study of Management and Control of Waste Construction Materials in Civil Construction Project. *International Journal of Engineering and Advance Technology, 2(*3), 2013, 345-350.

Kheni, N. A., Dainty, A. R. J. & Gibb, A. G. F. (2008). Health and safety management in developing countries: a study of construction SMEs in Ghana. *Construction Management and Economics, 26*(11) 1159-1169.

Kwakye, A. A. (2007). *Construction Project Administration in Practice.* Addison Wesley Longman Limited.

Levine, H. A. (2001). *Using and managing contingency:* part 2--Cost Contingency. Retrieved from http://www.gantthead.com November 2006.

Lutters, E., Brinke, E., Streppel, T., &Kals, H. (2000). Information management and design & engineering processes. *International Journal of Production Research, 38* (17), 4429.

Mansi, J. H. (2012). *Computerized building cost estimating system.* Malaysia: University Teknologi Malaysia.

Meeampol S., & Ogunlana S. O. (2006). Factors affecting cost and time performance on highway construction projects. *GCU Journal of Financial Management of Property and Construction*, 11(1), 3-20.

Meghani, T., Bouabaz, M., & Hamami, M. (2011). A Cost Estimation Model for Repair Bridges Based on Artificial Neural Network. *American Journal of Applied Sciences, 5*(4), 334-339.

NitishBagdi, Duran, O., Rodriguez, N., & Consalter, L. (2013). Neural networks for cost estimation of shell and tube heat exchangers. *Expert Systems with Applications, 3*(6), 7435–7440.

Nunnally, S. W. (2008). *Construction Methods and Managements*. New Jersey: Prentice-Hall Inc.

Ogunlana, D., & Popescu, P. (1996). *Construction cost analysis and estimating*. Upper Saddle River., N.J.: Prentice Hall.

Ohno, Taichi. (1987). *Toyota Production System*. Productivity Press.

Olawale, Y., & Sun M. (2010). Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. *Construction Management and Economics*, *28*(5), 509 – 526.

Olusegun, Sodikov, J. (1998). Cost estimation of highway projects in developing countries: artificial neural network approach. *The Eastern Asia Society for Transportation Studies, 6*(3), 1036 - 1047.

Poon, D., & Nygren, K. (2013). Stock Prediction – A Neural Network Approach. Royal Institute of Technology.

Payne, C., Phaobunjong, K. & Ovararin, N. (1996). *Estimating Building Costs.* New York: Marcel Dekker, Inc.

Pheng, R., &Chuan, A. (2001). Time-Cost-Quality-Risk of Construction and Development Projects or Investment. *Middle-East Journal of Scientific Research, 10*(2), 218-223.

Prabu, V and Baker, M (1986). *Materials Management.* UK: McGraw-Hill.

Ritz, George J. (2004). *Total Construction Project Management*. USA: McGraw-Hill.

Stukhart, G. (2005). Construction Materials Management. Marcel Dekker Inc. New York.

Stukhart, G. and Bell, L.C. (1987). Costs and Benefits of Materials Management Systems, *ASCE Journal of Construction Engineering and Management, 113*(2), 222- 234.

Shen, G., Hegazy, T., & Moselhi, O., (2004). Elements of Cost Estimation: A Survey in Canada and the United States. *Cost Engineering, 37*(5), 27-31.

Sanmath, R. (2011). Predicting bid prices in construction projects using non-parametric statistical models. USA: Texas A & M University.

Siti Akhtar, Mahayuddin, E., & Sodikov, R. (2013). Conceptual cost estimation of building projects with regression analysis and neural networks. *Canadian Journal of Civil Engineering, 31*(4), 677- 683.

Stukhart, G & Bell, D. (1987). *Construction materials management.* New York: Marcel Dekker Inc.

Teo, M. M. M., & Loosemore, M (2001). A theory of waste behaviour in the construction industry. *Construction Management and Economics, 19*(7), 741-751.

Tompkins, J. A., & White, J A (1984). *Facilities planning.* New York: John Wiley and Sons.

Tersing, Richard J., & Campbell, John H. (2007). *Modern Materials Management*. The Netherlands: North- Holland Publishing Company, Amsterdam.

Thomas, H. Randolph, & Sanvido, Victor E. (2013). Role of the Fabricator in Labor Productivity. *Journal of Construction Engineering and Management, 126*(5), 358-365.

Warko, J. (2001). Curiosity: The prerequisite for good estimates. Retrieved from http://www.gantthead.com November 2006

Womack, James P., Daniel, T., Jones, & Roos, D. (1991). *The Machine That Changed theWorld: The Story of Lean Production*. New York. Harper Perennial

Wong, M., R. & Norman, Baldwin, A. N. (1997). *Estimating and Tendering for Civil Engineering Works.* (2nd ed.). Oxford: BSP Professional Books.

Wong, E. T. T., & Norman, G. (1997). Economic evaluation of materials planning systems for construction. *Construction Management and Economics, 15*, 39-47.

Zakeri, M, Olomolaiye, P., Holt, G. D., & Harris, F. C. (1996). A survey of constraints on Iranian construction operatives' productivity. *Construction Management and Economics, 14*, 417-426.

APPENDIX A

QUESTIONNAIRE FOR THE RESPONDENTS

IMPROVING COST CONTROL MEASURES IN BUILDING PROJECTS IN GHANA: A CASE STUDY OF KUMASI METROPOLIS IN THE ASHANTI REGION

QUESTIONNAIRES FOR SITE MANAGERS

Dear respondent, thank you for accepting and taking the time to complete this questionnaire; your co-operation is appreciated. Please feel free to answer the questions, your confidentiality is assured.

Section A: Demographic Information of the Respondents

1. Please indicate your gender. *(Please tick)*

Male [ ] Female [ ]

2. What is your age category? *(Please tick [✓]).*

Under 20 years	□	21 – 30 years	□
31 – 40 years	□	41 – 50 years	□
51 – 60 years	□	Above 60 years	□

3. For how long have you worked with this company?

Below 3 years [ ] 3-6 years [ ] 6-10 years [ ] 10-15 years [ ] More than 15 years [ ]

4. What is your highest educational qualification?

Certificate [ ] Diploma [ ] Bachelor's degree [ ] Master's degree [ ] PhD [ ]

Section B: Respondents' opinions on Cost Control measures in building projects.

5. To what extend do you agree on the use of the following cost control techniques by your company? Please rate using a scale of 1 to 5 where 1 represents strongly disagree, 2 represents disagree, 3 uncertain, 4 represents agree and 5 represents strongly agree. *Please tick [√] the appropriate box below.*

Techniques used for cost control	**Rating**				
	1	2	3	4	5
Project cost value reconciliation					
Overall profit or loss					
Profit or loss on each contract at valuation dates					
Labour/plant/ material (actual versus forecast reconciliation)					
Unit costing					
Standard costing					
Earned value analysis					
Programme evaluation and review techniques (PERT/COST)					
Leading parameter method					

6. How often do you use the following computer softwares in relation to project cost control? Please indicate using a scale of 1 to 4 where 1 represents the software is not used at all, 2 represents the software is sometimes used, 3 represents the software is often used, 4 represents the software is very often used and 5 represents the software is always used. *Please tick* [√] *the appropriate box below*.

.

Software packages used for project cost control	**Rating**				
	1	2	3	4	5
Software packages used for project cost control					
Bespoke/ in-house					
Microsoft project					
Project costing system (PCS)					
Asta power project					
Primavera sure trak					
Microsoft excel					
COINS					
WINQS					

7. To what extent do you agree on the following challenges to effective implementation of cost control measures in building projects? Please rate using a scale of 1 to 5 where 1 represents strongly disagree, 2 represents disagree, 3 uncertain, 4 represents agree and 5 represents strongly agree. *Please tick [√] the appropriate box below.*

Constraints	**Rating**				
	1	2	3	4	5
Lack of incentives in contract clauses for contractors implementing effective cost control in building projects.					
Lack of skilled personnel for implementing effective cost control.					
Lack of ICT equipment and software for implementing effective cost control.					
Projects are transient lessons learned in implementing cost control on one site cannot be transferred to another.					
The time at which major cost savings can be achieved is during planning and design for the project.					

Schedule information and cost accounts are usually kept separately making the integration of schedule and cost information difficult.					
The time constraints allocated to project management planning					
The perceived cost to implement procedures as contributing to the limited use of formal cost management on projects.					
During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process.					
During the actual construction, changes are likely to delay the project and lead to inordinate cost increases.					
Managers are often forced to infer the cost impacts of schedule changes, rather than being provided with aids for this process.					