UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

EFFICIENT UTILISATION OF CONSTRUCTION MATERIALS FOR EFFECTIVE COST RECOVERY. A CASE STUDY OF SEKONDI-TAKORADI METROPOLIS IN THE WESTERN REGION OF GHANA

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A Dissertation in the Department of CONSTRUCTION AND WOOD TECHNOLOGY EDUCATION, Faculty of TECHNICAL EDUCATION, Submitted to the School of Graduate Studies, University of Education, Winneba in partial fulfillment of the requirements for the award of the Master of Technology (Construction) degree.

DECEMBER, 2015

DECLARATION

CANDIDATE'S DECLARATION

I, Victor Smile Ametsi, declare that this Dissertation, with the exception of quotations and references contained in the published works which have all been identified and duly 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 the Dissertation was supervised in accordance with the guidelines on supervision of Dissertation laid down by the University of Education, Winneba.

SUPERVISOR'S NAME: MR. MICHAEL TSORGALI

SIGNATURE……

DATE…….....……

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DEDICATION

This work is dedicated to my wife, Mrs. Dziedzom Ametsi and our three lovely children, Selassie, Makafui and Etornam.

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ABSTRACT

The purpose of the study was to investigate the efficient utilization of construction materials for effective cost recovery, using the Sekondi-Takoradi Metropolis in the Western Region of Ghana as a case study. This study adopted the case study design. Quantitative and qualitative research approach was used for the study. The population for the study was four hundred and fifty (450). The population of the study was made up of Building contractors/directors, Project Managers and Site Supervisors involved in construction projects in the Sekondi-Takoradi Metropolis in the Western Region of Ghana. Stratified random sampling method was used to select a sample size of one hundred and fifty (150) respondents for the study. The main instrument that was used to collect information for the study was questionnaire, interview and observations. Primary data was collected through a field survey of Building contractors/directors, Project Managers and Site Supervisors in the Sekondi-Takoradi Metropolis. The questionnaire 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 analysing the quantitative data, descriptive statistical tools such as frequencies, percentages were used. The result indicate that efficient utilization of construction materials have positive effect on cost recovery. It is hereby recommended that construction companies should make use of more than one material management technique on a construction project so as to achieve maximum project cost recovery.

Keywords: Cost recovery, Construction materials, efficient utilization, management and Sekondi-Takoradi Metropolis.

CHAPTER ONE

GENERAL INTRODUCTION

This chapter presents the background of the study, statement of the problem, purpose of the study, purpose and objective of the study, research questions, scope and significance of the study.

1.1 Background to the Study

The importance of the construction industry to the growth of a country's economy cannot be over emphasized. United Nations Industrial Development Organization (UNIDO) (1993), suggested in their report that, the construction industry has the potential of saving the country's wealth if adequate attention is paid to it by policy makers and economic planners in developing countries. Shen and Tam (2004), indicated that the construction industry plays an important role (provision of shelter and infrastructure development) in meeting the needs of society and enhancing quality of life. Construction has been an important player in the economy of many countries, especially developing countries (Takim, 2005).

The goal of efficient materials management is to ensure that construction materials are available at their point of use when needed. The efficient materials management system attempts to ensure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost (Stukhart, 1995). The construction industry is becoming increasingly competitive and material management (MM) is now considered to be one of the frontiers for cost reduction to improve profitability and productivity, as construction materials

constitute a major cost component in any construction project. Canter (1993) stated that, materials management is an important element in project management. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs is paramount (Chan 2002). Cost wise all construction works depend on two factors, namely, cost of materials and cost of labour, According to Khyomesh (2011), 30 to 70 percent of project cost is consumed by material with about 30 to 40 percent of labor. But labour cost is nearly the same for good construction work as well as bad construction; therefore attention should mainly be directed to the cost of materials and management of materials (Khyomesh 2011). Construction projects can be accomplished utilizing management processes. These processes include planning, organizing, executing, monitoring, and controlling (Ahuja et al., 1994). During any construction project the three inter-related factors of time, money, and quality need to be controlled and managed. Successful completion of projects requires all resources to be effectively managed. Tersine and Campbell (2004) 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.

Gossom (1983) defines MM as the activities involved to plan, control, purchase, expedite, transport, store, and issue in order to achieve an efficient flow of materials and that the required materials are bought in the required quantities, at the required time, with the required quality and at an acceptable price. Ebole (2005) defines MM as the planning and controlling of all necessary efforts to make certain that the right quality and quantity of materials are appropriately specified on time, are obtained at a reasonable cost and are available when needed. Dobler and Burt (1996) state that MM is designed to improve the activities related to the flow of materials. They added that MM should coordinate purchasing, inventory control, receiving, warehousing, materials handling, planning, and transportation.

Effective MM involves an integrated coordination of all materials related functions. These functions can be carried out efficiently only when sufficient emphasis is placed on early project planning, use of qualified personnel, adequate personnel training and proper communication amongst those involved in the process (Jeruto & Mutwol, 2012). Studies have revealed that, effective material management (MM) techniques improves construction performance with respect to delivery time and project cost (Ademeso & Windapo, 2012). Therefore it is believed that effective implementation of effective MM techniques could go a long way to enhance project success in the Ghanaian construction industry.

Some companies have increased the efficiency of their activities in order to remain competitive and secure future work. Many other firms have reduced overheads and undertaken productivity improvement strategies. Considerable improvement and cost savings would seem possible through enhanced materials management. This study

therefore, assessed the efficient utilization of construction materials for effective cost reduction to enhance productivity at the construction sites using Sekondi-Takoradi Metropolis as a case study.

1.2 Statement of the Problem

Construction project implementation in Sekondi-Takoradi Metropolis is still facing challenges. The main hurdles are failure to solve project specific problems. Normally projects taken up for implementation will never complete, in time or complete at a later stage leaving cost and time overrun. As the cost of materials is important, the management of materials especially at the inventory level are crucial for the successful project completion. The researcher observed that, throughout the metropolis, developing communities are facing severe problems with regard to supply of materials, being the core of the construction sector.

Most construction project sites in the Sekondi-Takoradi Metropolis are characterized by emergency purchases of materials, inadequate storage facility or deterioration during storage, material shortages and sometimes condemnation of materials and works by consultants. Past research indicate that poor material management applications on site is one of the major causes of cost recovery delay commonly faced in the construction industry. Also, poor materials management has been identified as one of the major factors affecting productivity on construction project sites in the Sekondi-Takoradi Metropolis. The researcher observed in addition that, poor material management contribute to accident on-site.

It is therefore undeniable fact that, efficient utilization of construction materials have positive impact on construction cost reduction on construction project delivery. Hence the focus of the study is to access the factors that affect efficient utilization of construction materials in the Sekondi-Takoradi Metropolis.

1.4 Purpose of the Study

The purpose of the study is to assess the efficient utilization of construction materials for effective cost recovery for sustainable construction project in the Sekondi-Takoradi Metropolis in the Western Region of Ghana

1.5 Objectives of the Study

The objective of the study is to assess the efficient utilization of construction materials for effective cost recovery using the Sekondi-Takoradi Metropolis as a case study. However, the specific objectives of the study are:

i. To examine the importance of efficient utilization of construction management and cost control in the Sekondi-Takoradi Metropolis.
ii. To identify the factors that affects the effective management of construction materials in the Sekondi-Takoradi Metropolis.
iii. To identify strategies that can enhance efficient utilization of construction materials in the Sekondi-Takoradi Metropolis.

1.6 Research Questions

The following research questions have been formulated to guide the study:

1. What is the importance of efficient utilization construction management and cost control in the Sekondi-Takoradi Metropolis?
2. What are the factors that affect the effective management of construction materials in the Sekondi-Takoradi Metropolis?
3. What strategies can be developed to enhance efficient utilization of construction materials in the Sekondi-Takoradi Metropolis?

1.7 Scope of the Study

The study is focused on construction professional working on projects in the Sekondi-Takoradi Metropolis. This study is geographically limited in scope to the Sekondi-Takoradi Metropolis. However, the study is limited in scope to concept of material management, materials and financial problems, ascertaining and maintaining the flow and supply of materials, waste minimization management, supply chain management in the construction industry and effect of delivery delay on cost reduction.

1.8 Significance of the Study

The study is significant for the following reasons.

- The result of the study will create awareness in the construction firms the about significant factors that lead to efficient material management and effective cost control.

- Findings from the study will help the stakeholders to develop policies and practices that could minimize material wastage.
- Help contractors, clients, consultants and all parties involved in construction projects about ways of improving their current methods of material management.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

These chapters focused on reviewing the existing literature in relation to efficient utilization of construction materials. It includes Concept of Material Management, scope of material management, causes of material waste on construction site and factors affecting material management in construction project delivery, materials and financial problems, ascertaining and maintaining the flow and supply of materials, waste minimization management, supply chain management in the construction industry and effect of delivery delay on cost reduction.

2.2. Concept of Material Management

Materials management function is always a major concern to management of any industrial organization, since high inventory and an inefficient procurement process significantly affect profitability Canter (1993). Problems multiply due to the current dynamic business environment in many countries. Hence, existing materials planning, procurement process and inventory management systems require a review. MM is an indispensable activity of all types of organizations, whether manufacturing, trading or even nonprofit organizations. Organizations are continually involved in procurement, storage and stock replacement of types of production. Christopher (1998), defined MM as a process that coordinates planning, assessing the requirement, sourcing, purchasing, transporting, storing and controlling of materials, minimizing the wastage and optimizing the profitability by reducing cost of material. He further argued that, building materials

account for about 60 to 70 percent of direct cost of a project or a facility, the remaining 30 to 40 percent being the labour cost.

According to Stock & Lambert (2001) and Chopra & Meindl (2001), MM makes production flow possible, as it gives dynamism to static elements such as materials, products, equipment's, layout and human resources. Wild (1995), in his view stated that, MM is a concept which brings together under one management responsibility for determining the manufacturing requirement, scheduling the manufacturing processes and procuring, storing and dispensing materials. As such it is concerned with and controls all activities involved in the acquisition and use of all materials employed in the production of finished goods. It is clearly evident that, MM concepts enhance communication and coordination by bringing together to one responsible individual, all functions which are interrelated. This integration of interrelated materials functions is the basis of MM concept.

In the earlier years, MM was treated as a cost centre, since Purchasing Department was spending money on materials while Stores was holding huge inventory of materials, blocking money and space (Ramakrishna, 2005). In order to better understand MM, the following processes of planning, procurement, and logistics, material handling, stock and waste control are discussed.

2.2.1 Importance of Material Planning on Construction Project Delivery

Stukhart (1995) stated that, there's the need to be an appropriate materials planning to be done concurrently with engineering, construction, and other project plans. The study also 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 MM strategy (Faniran & Mason, 1998), particularly in terms of increasing productivity and profit, and facilitating the timely completion of construction projects (Wong and Norman, 1997).

2.2.2 The Importance of the Procurement on Construction Project Delivery

The term procurement encompasses a wide range of activities that includes purchasing of equipment, materials, labour and services required for construction and implementation of a project (Barrie and Paulson, 1992). The objective of procurement in materials management is to provide quality materials at the right time and place, and at an agreed budget. Payne et al. (1996) stated that, procurement is about organising the purchasing of materials and issuing delivery schedules to suppliers and following-up, to make sure that suppliers deliver on time. A failure in the purchasing process or in overseeing and organising the buying functions listed as by Canter (1993) could result in:

- Over-ordering of materials (wastage problems);
- Over-payments for materials (inadequate administration procedures);
- Loss of benefits (lack of skilled negotiating procedures); and
- Lack of knowledge (when and where the best service/source might be available at any particular time).

In order to avoid failure, it is important to know how the typical purchasing procedure takes place. Procurement of materials begins with defining the requirements of the project, followed by the selection of suppliers or subcontractors, and ends with the delivery of materials at the destination (Kent, 1991). Purchasing materials from the best source, at the right price and with timely delivery are challenges of many construction companies. Therefore, a control strategy is needed during materials procurement to achieve the targeted objectives. All requests for quotations and purchases must be initiated through a properly authorised requisitioning procedure normally controlled by the Project Manager.

2.2.3 The Importance of Effective Construction Material Handling

Tompkins and White (1984) defined effective material handling as using the right method, amount, material, place, time, sequence, position, condition, and cost. Material handling involves storing and controlling of the construction materials. Handling of materials is the flow component that provides for their movement and placement. The importance of appropriate handling of materials is highlighted by the fact that they are expensive and engage critical decisions. Due to the frequency of handling materials there are quality considerations when designing a materials handling system. Material handling equipment selection is an important function as it can enhance the production process; provide effective utilization of manpower, increase production and improve system flexibility (Chan 2002).

Material storage on site requires close attention in order to avoid waste, loss and any damage of materials which could affect the operation of the construction project.

Problems always arise during materials supply because of improper storage and protection facilities (Canter 1993). Studies on MM 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 take into 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 waste due to unfavourable weather conditions, as well as running out of stock. It is also important to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, are obtained at a reasonable cost, and are available when needed (Bell and Stukhart, 1986).

2.2.4 The Importance of Stock and Waste Control of Construction Materials

The European Construction Institute's Total Productivity Management report (ECI1994:34-38) 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". The bulk of construction materials delivery requires proper management of stock control. Stock control is a technique devised to cover and ensure all items are available when required and can include raw materials, processed materials, and components for assembly, consumable stores, general stores, maintenance materials and spares, work in progress and finished products (Prabu and Baker, 1986). Construction activities can generate an enormous amount of waste (Teo and Loosemore 2001) and materials waste has been recognized as a major problem in the construction industry (Formoso et al., 2002). The cause of waste in construction projects indicates that

it can arise at any stage of the construction process from inception, right through to design, construction and operation of the built facility (Faniran & Caban, 1998). Waste can be reduced through the careful consideration of minimization strategies and through better reuse of materials in both the design and construction phases (Dainty and Brooke, 2004).

2.2.5 The Importance of Logistics on Construction Project Delivery

Logistics is a concept that emphasises 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 design and 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 and Yang, 2001); and planning of access and routing of material within a construction site (Olusegun et al., 1998).

2.3 Strategies that can Enhance Efficient Utilization of Construction Materials

2.3.1 Material Management Steps

There are several steps within the scope of material management and each of these steps can give rise to potential problems.

2.3.2 Request for Quotation (RFQ)

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 equipments that described in the drawings and specifications, finally they help the owner to know what to buy and what he is entitled to receive. 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 is 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 and Dozzi, 1994).

2.3.3 Purchasing Function and Efficient Construction material management

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. According to 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 that, 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, and Bell, 1987).

2.3.4 The Impact of Expediting and Efficient 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 and 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 submittal, 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 and Dozzi, 1994).

2.3.5 The Importance of Effective Transportation and Efficient Construction Material Management

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 and 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 and 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 and 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 and Dozzi 1994).

2.4 The Effective Management of Surplus Materials and its impact on Efficient Construction Management

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 and Bell, 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 and Dozzi, 1994).

2.4.1 The Effective Control of Construction Waste and its impact on 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 of material, reduce the waste rate, and improve productivity (Al-Hajj et al., 2011, Meghani et al., 2011).

Concept of 3R and 4R can be also beneficial to reduce the wastage of construction materials, which includes reduce, reuse, recycle, and recovery. These can be applied to the entire lifecycles of products and services (Kareem & Panday 2013, Thomas et al., 2013, 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 & Moselhi, 2004). The prediction of waste flow can be modelled through the building elements at the construction stages (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 for effectivity, 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 & Sonmez 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 & Nygren 2013, Mansi 2012).

2.4.2 The Impact of Establishing Responsibilities and Authority on 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.

2.5 The Benefits of using Just in Time (JIT) Strategy for Construction Cost Recovery

JIT is a technique developed by Taichi Ohno and his fellow workers at Toyota (Ohno, 1987). The acronym JIT has been highly visible since the late 1980's, as manufacturers attempted to meet competitive challenges by adopting newly emerging management theories and techniques, referred to by some as Lean Production (Womack 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 throughput. 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 et all, 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, 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, 1987).

2.5.1 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.

2.6 Effective Materials Management on Construction Projects for Cost Reduction

The construction industry is the most significant industry in the economy and the successful measure with completion within time, budget, accordance with specification and satisfaction of stakeholders (Nguyen & Ostwald 2004). Construction is the process of physically erecting the project and putting construction equipment, materials, supplies, supervision, and management necessary to accomplish the work (Clough et al., 2000). Construction projects are complex, with many organizations involved such as clients or owners, architects, engineers, contractors, suppliers and vendors. This includes the heterogeneous and often complex process of producing unique, large and immovable products with a supply of the resources (money, equipment, material, and labour). The management of materials in construction projects is an important function that significantly contributes to the success of a project. As projects grow in scale and complexity, materials management becomes more difficult, often requiring the use of appropriate tools and techniques to ensure, amongst other things, that materials are delivered on time, stock levels are well managed, the construction schedule is not compromised, and that wastage is minimised. Materials management is especially problematic for large and complex projects, where sophisticated tools and techniques are necessary. The management of materials in complex construction projects needs adequate consideration due to the various elements involved and the importance of the project.

2.6.1 The Implementation of appropriate Information and Communication Technologies (ICT) to manage construction materials

The implementation of appropriate Information and Communication Technologies (ICT) could facilitate new management processes for complex construction projects. For example, the potential of emerging technologies such as wireless technologies and tagging technologies could have a strong impact on construction materials management processes in the future. The improper handling and management of materials on construction sites has the potential to severely hamper project performance (Ogunlana & Popescu 1996). The result of improper handling and managing materials on site during construction process will influence the total project cost, time and the quality (Putra et al., 1999). The costs of materials management may range from 30-80% of the total construction costs depending on the type of construction (Muehlhausen, 1991).

However, Kini (1999), accounted 50-60% of the total cost of construction projects is for construction materials and equipment. According to Stukhart (1995) (1M) materials are a major component on any project with value 50-60%. Therefore, there is a need for efficient materials management in construction projects. This is because poor materials management will affect the overall construction time, quality and budget. Therefore, an effective materials management system is required in order to avoid problems, such as delays in a construction project. Delays in materials supply have been found to be a major cause of time overrun (Dey, 2000).

Many factors accelerate the delay of project duration, however poor materials management can have a major effect on site activities. For example, Ogunlana et al.,

(1996), suggested that the main reasons for project delays on housing projects in Thailand were incomplete drawings, material management problems, organization deficiencies, shortage of construction materials, and inefficiencies in site workers. Dey (2000) also suggested the delays in materials supply was a major cause of time overrun. Thus, it would seem that materials delays are a major cause of delays in construction projects. There is also a need for an integrated material handling process from the design stage to the usage of materials-This could happen, with a good management system with the implementation of ICT in managing construction materials. Hence, a good materials management environment enables proper materials handling on construction sites (Dey, 2000).

2.6.2 Materials Management Processes for Effective cost Recovery

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 covers 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 & Mason 1998; Olusegun & Sodikor 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.

2.7 Materials Management Problems

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 & Alidrisyi 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). 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.

2.8 Benefits of Effective Construction Material Management

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 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).

2.9 Summary of Causes of Material Waste on building Construction Site

Building design and construction involves many interested parties in nearly all sectors of the economy of Ghana. Various studies in developed countries have indicated that, one method of improving construction project is by managing the construction waste

Trigunarsyah et.al, (2006). Many factors contribute to the generation of material waste. These factors have been grouped by Ekanayake & Ofori (2000) under four categories: (1) design; (2) procurement; (3) handling of materials; and (4) operation. They have concluded that most of the causes of waste are due to design issues. This finding has also been reported by a number of other studies (Ekanayake and Ofori, 2004; Innes, 2004); Keys et al., 2000; Rounce, 1998). It is, thus, agreed that the process of waste minimization must be started at the early stages of the project. A survey conducted by Sanders and Wynn (2004) showed that, improper design resulting in excessive cut-offs is one of the major causes of material waste. Therefore it is important to focus on the stakeholder's attitudes towards waste and on waste generated as a result of construction site activities. In addition to excessive cut off resulting from improper design, the four aspects to be investigated in detail are Design, Procurement, Operation and Handling. It is worth noting that waste generation is not only a technical issue but a behaviouristic one as well. Teo et al. (2000) stated that "the labour intensive nature of construction activity suggests that behavioural impediments are likely to influence waste levels significantly". This statement was supported by Lingard et al. (2000) who pointed out that effective waste minimization depends on the extent to which participants to the construction process change their behaviour in relation to waste issues. Therefore, sources of waste revolve around four factors namely: procurement, handling, operation and culture. Although some of the main sources of waste resulted from these studies were similar, some differences can be seen in Table 2.1.

Table 2.1 Main Sources of Material Waste

Sources of waste	Ekanayake and Ofori (2000)	Innes (2004)	Keys, et al. (2000)	Lingard, et al. (2004)
Design	✓	✓	✓	
Procurement	✓	✓	✓	✓
Material handling	✓	✓	✓	✓
Operation	✓	✓	✓	✓
Culture				✓

A review of the main origins of material waste belonging to each category is summarized in Table 2.2

Table 2.2. Causes of Material Waste on Construction Site

Causes of waste on construction site	Design Related	Procurement Related	Material handling Related	Operation Related	Culture Related
Poor workmanship				✓	
Poor communication between design team				✓	
Inadequate supervision				✓	
Lack of awareness					✓
Lack of incentives					✓
Spoiling of material during fixing				✓	
Poor product knowledge			✓		
Site accidents				✓	
Bad weather condition				✓	
Delivery schedule		✓			
Use of incorrect material				✓	
Damages caused by succeeding trades				✓	
Incomplete and errors in contract document	✓				
Lack of information in the drawing	✓				
selection of inferior quality material and products	✓				
Damage during transportation			✓		
Ordering errors		✓			
lack of attention paid to standard size availability	✓				
Malfunctioning of equipment				✓	
Theft and vandalism			✓		
Lack of support from senior management					✓
complexity of the drawing	✓				
designers unfamiliarity with alternative products	✓				
Delivery methods		✓			
Time restraint				✓	
Lack of training					✓
Material supplied in loose form			✓		
Design changes during construction	✓				
Inappropriate storage facility			✓		
Lack of attention to dimensional coordination	✓				

(Source: Ekanayake and Ofori (2000); Lingard, et al. (2000))

2.9.1 Factors Affecting Materials Management in Construction Projects Delivery

Materials management is an important function required to improve productivity in construction projects delivery. Proverbs et al. (1999) stated that, costs of materials handling may range from 30-80% of total construction costs. In addition, Dey (2001) indicated that, almost 60% of the total working capital of any industrial organization consists of materials costs. Therefore, there is a need for efficient MM in order to control productivity and cost in construction projects delivery. There are many factors which contribute to poor MM in construction projects. Zakeri et al. (1996) suggested that factors such as waste, transport difficulties, improper handling on site, misuse of the specification, lack of proper work plan, inappropriate materials delivery and excessive paperwork all adversely affect MM. Furthermore, Dey (2001) noted that, the common factors related to MM 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 drawing 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.

2.10 Major Categories Identified related to material Mismanagement

The factors that cause the cost overruns in building project are classified into 8 categories based on following issues:

- **Design related issues:** Improper study on material availability study and its source, inflated specification of item over specified codes, inadequate preconstruction survey on material.
- **Client related issues:** Poor cooperation of owner towards purchase, delay in supplier's payment and claim.
- **Contractor related issues:** Improper supervision at site and control, insufficient material handling instructions, engaging inadequate skill on labour, improper construction methods, improper planning and errors during construction, fraudulent activities of subcontractors.
- **Site related issues:** Waste control during material usage, lack of site storage space, operation limitation within site, stealing on site, unforeseen site condition, existence of unnecessary material.
- **Labour and equipment related issues:** Obsolete or unsuitable construction equipment, improper handling of materials at site.
- **Store related issues:** Improper procurement policy, improper inventory control, problem on logistics of materials.
- **External issues:** Problem with neighbours, weather condition.
- **Market condition:** Scarcity of materials in market, fluctuation of price of raw materials.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research approach used to collect data for the study. It involved research design, population, sampling techniques and sample size, data collection techniques and data analysis techniques.

3.2 Research Design

The research employed the case study design. The researcher used the case study method because among the various research designs, case study is frequently regarded as using both quantitative and qualitative research and a combination of both approaches (Bryman, 2004). The researcher used both primary and secondary data sources, which were considered to be more appropriate for this study. These types of research approach were used because they eventually enable the researcher to make judgment about the effectiveness, relevance or desirability of the variables.

3.3 Population of the Study

The population for the study comprised construction firms in Sekondi-Takoradi Metropolis currently registered with the Ministry of Water Resource, Works and Housing (MWRWH). The Ministry of Water Resource, Works and Housing serves as a regulatory body for the construction industry in Ghana. Sekondi-Takoradi Metropolis was selected because it is one of the major Metropolises in Ghana where most contractors and construction activities are highly concentrated (Ankomah, Boakye & Fugar, 2010). The

selection of the respondents was limited to Building Contractors, Project Managers and Site Supervisors in the Sekondi-Takoradi Metropolis. The choice of these respondents was made on the basis that they all work in well established firms and have the requisite knowledge by virtue of the type and size of projects they handle.

3.4 Sampling Techniques and Sample Size

The study employed stratified sampling technique to categorize the contractors into grades depending on their financial capacity (turnover, current assets) and technical capacity (human resources, plants equipment, work experience). The grades of contractors varies from D1 (highest capacity) to D4 (Lowest capacity). In all 142 construction firms were identified as registered members in good standing with the Sekondi-Takoradi Metropolitan Assembly. The researcher used stratified random sampling method to choose three construction companies as a sample for the study. These selected construction companies were Messrs Justmoh Construction Limited, Messrs Big Aidoo Construction Limited and Selmak Enterprise Limited were selected and used as case studies. The researcher chose these construction companies because they have good reputation are well known and are exemplars in efficient utilization of construction materials in the Sekondi-Takoradi Metropolis. This procedure was used because it was not possible to know the total number of contractors, neither was it possible to meet them at their work places.

Stratified random sampling technique was used to select the contractors/directors of construction firms, project managers and site supervisors. This method of sampling therefore would ensure that all participants had an equal opportunity of being selected for

the study. Numbers 1-200 were be written on white papers including blank papers, respondents who picked the first 150 papers formed part of the research. The sample representation comprises of thirty (30) building contractors/directors of the construction company, seventy (70) project managers and fifty (50) site supervisors.

3.5 Data Collection Technique

The study employed data collection techniques like: questionnaire, interview and observation.

3.5.1 Questionnaire

Sets of questionnaires were prepared and administered to contractors, project managers, site supervisors and laborers of the various construction firms. The questionnaire focused on issues regarding material management such as; efficient utilization of construction materials, factors affecting material management and strategies to enhance efficient utilization construction material.

3.5.2 Interview

This strategy was adopted to create the atmosphere for participation of all categories of people in the construction field. Interview focused on very serious issues on material management.

3.5.3 Observations

In order to support the material **(**data) gathered for research work a number of visit were made to three of the construction firms that were exemplars in efficient utilization of construction materials. The time of the observation runs through the data collection period and was being done concurrently with the dissemination of the questionnaire.

3.6 Method of Data Analysis

The data from filled questionnaires was cleaned, edited, coded and keyed into the computer for analysis. The SPSS version 18 was used to analyse data. Data were presented in tabular form, graphical and narrative forms. In analyzing the quantitative data, descriptive statistical tools such as percentages, mean and standard deviation were adopted.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussion obtained from Questionnaires, interview and observation.

4.2 Results and Discussion of Questionnaire

The data collected from both the questionnaire and interview were collated, analyzed and discussed as one.

4.2.1 Results and discussion of questionnaire from contractors

Response Rate

A total of 150 questionnaires were distributed to registered contractors of Sekondi-Takoradi Metropolitan Assembly (STMA) in early September, 2015. By the due date of 30th November, 2015, a total of 136 questionnaires were received, resulting in a nearly 91 percent reply rate (see Table 4.1). A total of 6 invalid data received were discarded. Hence, the usable response rate was 130 (87 percent see Table 4.1). The reason for discarding the data was due to incompleteness and invalid responses. This response rate is considered adequate as, according to Kheni, Dainty & Gibb (2008); Kheni & Ackon, 2015 a response rate of 30 percent is good enough in construction studies in Ghana.

Table 4.1 Statistical Data of Questionnaires Sent and Received

Questionnaires	No.	Percentage
Total Questionnaire Sent	150	
Total Questionnaires Received	136	91%
Invalid Data	6	4%
Usable Data	**130**	**87%**

Source: Field survey, 2015

Classification of Contractors

Table 4.2 shows that twenty eight (28) of the respondents firms representing 22 percent are classified as large size construction firms. sixty (60) of the respondents firms representing 46 percent are classified as medium size construction firms while forty two (42) respondents firms representing 32 percent are classified as small size construction firms. This is an indication that majority of the construction firms in the Western region are small and medium enterprises (SMEs).

Table 4.2: Classification of Contractors

Large (D1K1)	28	22%
Medium (D2K2)	60	46%
Small (D3)	42	32%
Total	**130**	**100%**

Source: Field survey, 2015

Number of Employees in the Respondents' Firms

Table 4.3 demonstrates that (32%) of respondents have 10 employees or less, whilst (12%) of contractors have more than 40 employees. The other (56%) of contracting firms has from 11 - 40 employees. This is an indicative that construction industry provides employment to the citizenry.

Table 4.3: Distribution of Respondents' Number of Employees

No. of Employees	Frequency	Percentage
10 and below	42	32%
11 – 20	34	26%
21 – 30	22	17%
31 - 40	17	13%
More than 40	15	12%
Total	**130**	**100%**

Source: Field survey, 2015

Distribution of Respondents' Persons in Charge of Managing Construction Materials

Table 4.4 shows that none of contracting firms has a specific section for managing construction materials. For other firms, the person in-charge-of managing construction materials is the contractor / director in-charge of the firm (15.4%), the project manager in-charge (14.6%), and site supervisors in-charge (21.5%), whilst majority of the firms' materials are managed by site engineers (48.5%).

Table 4.4: Distribution of Respondents' Persons in Charge of Managing Construction Materials

The Person In-Charge of Managing Construction Materials on Site	Frequency	Percentage
Contractor / Director	20	15.4%
Project Manager	19	14.6%
Site Engineer	63	48.5%
Site Supervisor	28	21.5%
Specific Section	0	0%
Total	**130**	**100%**

Source: Field survey, 2015

Demographic Characteristics of the Respondents

The demographic characteristics of the respondents provided descriptive information on Qualification, Experience, Designation, as well as company inherent characteristics of the respondents companies. This information was necessary to ascertain the validity of the results obtained and to develop an understanding of the background of the respondents with respect to their experience.

Gender Distribution of Respondents

The study gathered the demographic characteristics of the respondents. The table 4.5 depicts that 94.6% of the respondents were males and 5.4% were females. This indicates that more males are engaged in construction works than females in the Sekondi-Takoradi Metropolis of the Western Region of Ghana.

Table 4.5: Gender Distribution of Respondents

Gender	Frequency	Percentage
Male	123	94.6
Female	7	5.4
Total	**130**	**100**

Source: Field survey, 2015

Occupation of the Respondents

Table 4.6 shows that (46.2%) of the respondents were project managers, (34.7% were site supervisors and (19.1%) were contractors/directors of a construction firm.

Table 4.6 Occupation of the Respondents

Occupation	Frequency	Percentage
Project Managers	60	46.2
Site Supervisors	45	34.7
Building Contractor/Director	25	19.1
Total	**130**	**100**

Source: Field survey, 2015

Work Experience of the Respondents

Table 4.7 indicates that 44.6% of the respondents had 6-10 years working experience in the building construction industry, 16.9% had 10-15 years working experience, 14.6% had 3-6 years working experience, 13.1% had more than 15 years working experience and 10.8% confirmed that they had less than 3 years working experience. The study shows that the respondents have a considerable level of working experience in the building construction sector.

Table 4.7 Work Experience of the Respondents

Experience	Frequency	Percentage
6-10 years	58	44.6
10-15 years	22	16.9
3-6 years	19	14.6
More than 15 years	17	13.1
Below 3 years	14	10.8
Total	**130**	**100**

Source: Field survey, 2015

The Factors that Affects the Effective Management of Construction Materials

The effects of Poor Workmanship on the Management of Construction Materials

Poor workmanship can affect the effective management of construction materials. The table 4.8 indicates that 84% of the respondents agreed that poor workmanship can affect the management of construction materials, 12% of the participants were neutral and 4% disagreed. The study concluded that 84% of the respondents agreed that poor workmanship can affect the management of construction materials. 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 ensure 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 and Campbell (2007), Ammer (1990), Stukhart (1995)):

- Procurement and purchasing
- Expediting
- Materials planning
- Materials handling
- Distribution
- Cost control
- Inventory management / Receiving/ Warehousing
- Transportation

Table 4.8 Operational Waste Factors

Poor workmanship	**Frequency**	**Percentage (%)**
Agree	14	56
Strongly agree	7	28
Neutral	3	12
Disagree	1	4
Strongly disagree	0	0
Total	**25**	**100**
Poor communication between designer and builder		
Strongly agree	13	52
Agree	7	28
Neutral	5	20
Disagree	0	0
Strongly disagree	0	0
Total	**25**	**100**
Inadequate Supervision		
Strongly agree	16	64
Agree	4	16
Neutral	3	12
Disagree	1	4
Strongly disagree	1	4
Total	**25**	**100**

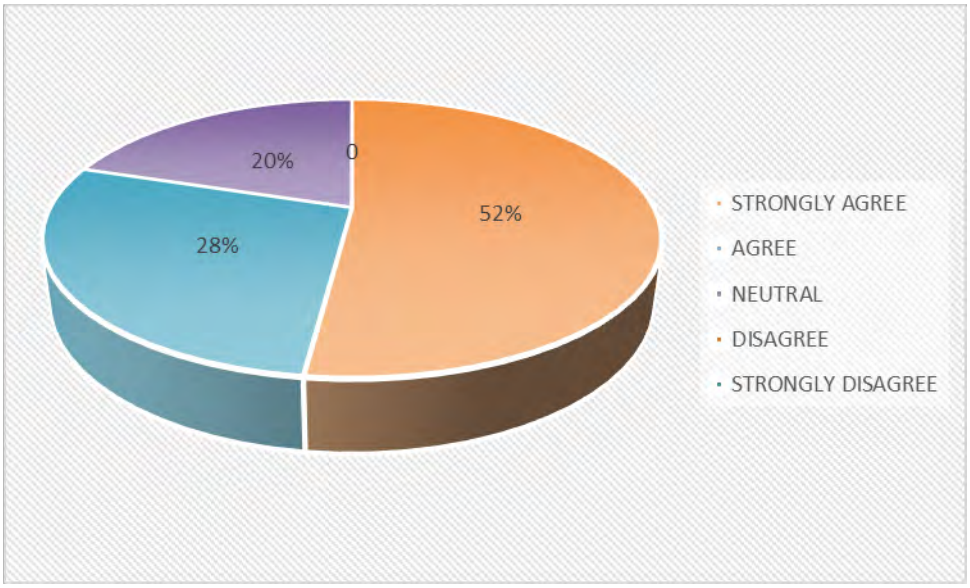
Source: Field survey, 2015

The effects of Poor Communication on the Management of Construction Materials

Communication is very important in the construction sites. Poor communication can affect the management of construction materials. The study shows that 80% of the respondents agreed that poor communication can affect the effective management of construction materials, 20% of the respondents were neutral and none of the participants disagreed. The study concluded that Poor communication affected the management of

construction materials. 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.



Source: Field survey, 2015

Figure 4.1: The effects of Poor Communication on the Management of Construction Materials

The effects of Inadequate Supervision on the Management of Construction Materials

The ability of the site supervisor to supervise workers thoroughly can reduce waste generation and enhance effective utilisation of construction materials. The study depicts that 80% of the respondents agreed that inadequate supervision can eventually cause mismanagement of construction materials. To add more, 12% of the respondents disagreed that Inadequate supervision affected efficient utilisation of construction materials. In a study conducted by 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.

The effects of Improper Planning on the Management of Construction Materials

Planning is very essential in construction material management. Improper planning can affect efficient utilisation of construction materials. Seventy six (76%) of the participants agreed that improper planning can affect the utilisation of construction materials. Moreover, 4% of the respondents disagreed. The results of the study indicates that improper planning can affect efficient utilisation of construction materials. 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 and Burt, 1996).

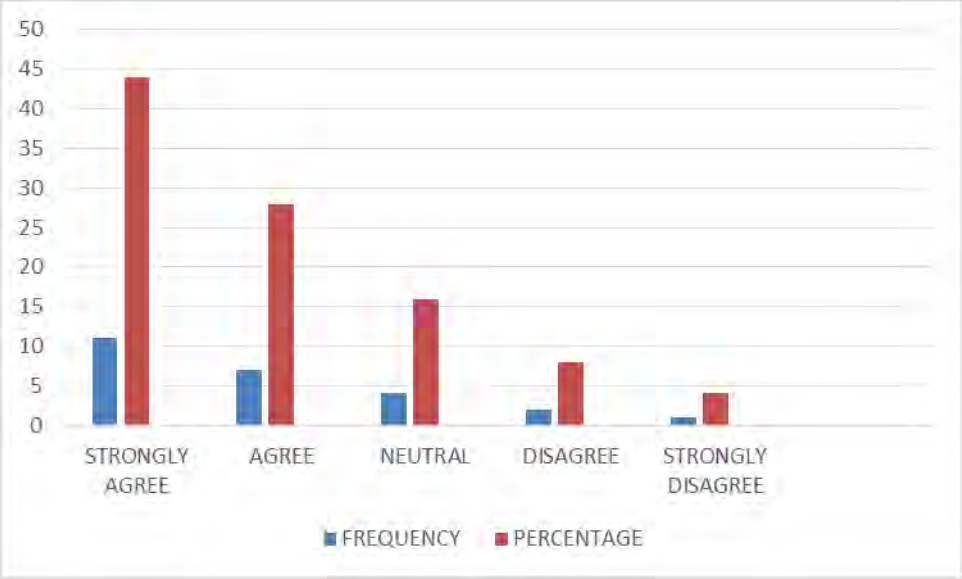
Table 4.9: Improper planning and utilisation of construction materials

Improper planning	**Frequency**	**Percentage**
Agree	14	56
Strongly agree	5	20
Neutral	5	20
Disagree	1	4
Strongly disagree	0	0
Total	**25**	**100**
Use of incorrect material and malfunctioning of equipment		
Agree	7	28
Strongly agree	11	44
Neutral	4	16
Disagree	2	8
Strongly disagree	1	4
Total	**25**	**100**
Spoiling of material during fixing and site accidents		
Agreed	14	56
Strongly agree	7	28
Neutral	2	8
Disagree	1	4
Strongly disagree	1	4
Total	**25**	**100**

Source: Field survey, 2015

The effects of incorrect material and malfunctioning of equipment on the Management of Construction Materials

The use of incorrect material and malfunctioning of equipment can cause serious accidents on the construction sites and affect the management of construction materials. The results of the study holds that 72% of the respondents agreed that the use of incorrect material and malfunctioning of equipment can affect the efficient utilization of construction materials. However, 12% of the respondents disagreed. The results of the study confirmed that 72% of the respondents agreed that the use of incorrect material and malfunctioning of equipment can affect the efficient utilization of construction materials. The availability of the right materials may greatly influence the schedule in projects with a fast track or very tight time schedule. Sufficient time for obtaining the necessary materials must be allowed. In some cases, more expensive suppliers or shippers may be employed to save time. Materials management is also a problem at the organization level if central purchasing and inventory control is used for standard items. In this case, the various projects undertaken by the organization would present requests to the central purchasing group. In turn, this group would maintain inventories of standard items to reduce the delay in providing material or to obtain lower costs due to bulk purchasing (Cavinato, 1984).



Source: Field survey, 2015

Figure 4.2: The effects of incorrect material and malfunctioning of equipment on the Management of Construction Materials

The effects of accidents on the Management of Construction Materials

The spoiling of material during fixing and site accidents can affect the efficient utilisation of construction materials. The results of the study demonstrated that 84% of the respondents agreed that the spoiling of material during fixing and site accidents can affect the efficient utilisation of construction materials. On the contrary, 8% of the respondents disagreed. The study results holds that 84% of the respondents agreed that the spoiling of material during fixing and site accidents can affect the efficient utilisation of construction materials.

Design Waste Related Factors

The change in design during construction can results in the mismanagement of construction materials and make the materials to become waste. Therefore site supervisors must supervise very well, ensuring that the right materials are used for the right design to avoid waste. The study confirmed that 76% of the respondents agreed that the change in design during construction can results in the mismanagement of construction materials and make the materials to become waste. The study further revealed that 8% of the respondents disagreed. The change in design during construction can results in the mismanagement of construction materials and make the materials to become waste. 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.

The results of the study confirmed that 80% of the respondents strongly agreed that lack of attention to dimensional coordination can affect the efficient utilisation of construction materials. The minority of the respondents (4%) disagreed. The study results demonstrated that 80% of the respondents strongly agreed that lack of attention to dimensional coordination can affect the efficient utilisation of construction materials. 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).

In building construction, information on the architectural drawing provides the direction for construction. Lack of information on the drawing can affect productivity and affect the utilisation of construction materials. The study revealed that 88% of the respondents agreed that lack of information on the drawing can affect productivity and affect the utilisation of construction materials and minority 4% disagreed. The results of the study confirmed that lack of information on the drawing can affect productivity and affect the utilisation of construction materials and create waste on the construction site.

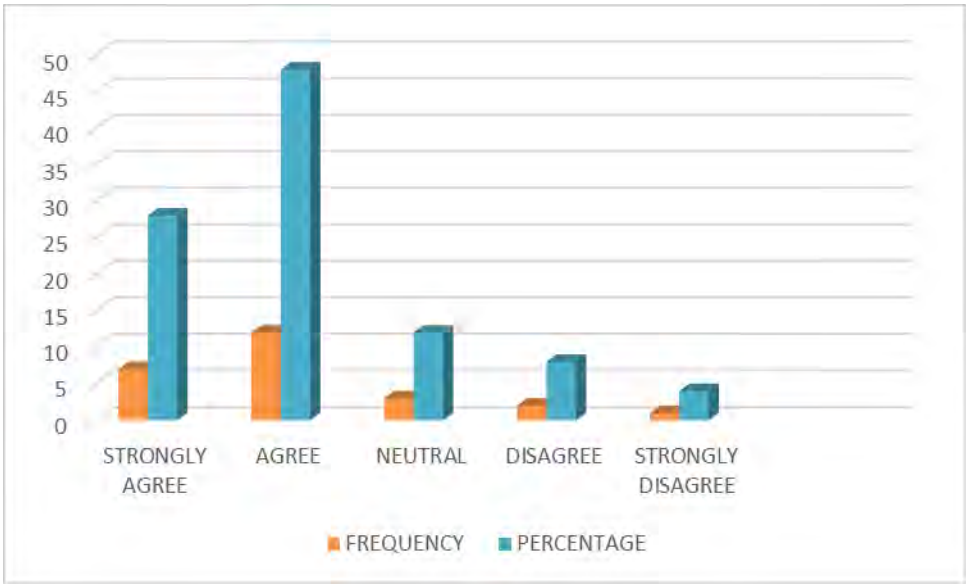
Table 4.10: Design Waste Related Factors

Design change during construction	**Frequency**	**Percentage**
Strongly agree	8	32
Agree	11	44
Neutral	4	16
Disagree	1	4
Strongly disagree	1	4
Total	**25**	**100**
Lack of attention to dimensional coordination		
Strongly agree	13	52
Agree	7	28
Neutral	4	16
Disagree	1	4
Strongly disagree	0	0
Total	**25**	**100**
Lack of information in the drawing		
Agree	14	56
Strongly agree	8	32
Neutral	2	8
Disagree	1	4
Strongly disagree	0	0
Total	**25**	**100**
Selection of Inferior materials and products		
Agree	12	48
Strongly agree	7	28
Neutral	3	12
Disagree	2	8
Strongly disagree	1	4
Total	**25**	**100**

Source: Field survey, 2015

The Selection of Inferior Products

The purchase and selection of inferior materials and products can generate waste and affect the efficient utilisation of construction materials. The results of the study revealed that 76% of the respondents agreed that selecting and purchasing of inferior construction products can affect the efficient utilisation of construction materials. Moreover, 12% of the respondents disagreed. The study concluded that 76% of the respondents agreed that selecting and purchasing of inferior construction products can affect the efficient utilisation of construction materials. 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).



Source: Field survey, 2015

Figure 4.3: The Selection of Inferior Products

Material handling waste Related factors

The availability of storage facilities on the construction can enhance effective storage of the construction materials. Inappropriate storage facilities can affect the efficient utilisation of construction materials. The study holds it that 80% of the respondents agreed that inappropriate storage facilities can affect the efficient utilisation of construction materials. Furthermore, 4% of the participants disagreed. Inappropriate storage facilities can affect the efficient utilisation of construction materials. Simply because thieves can steal the construction materials when there are inappropriate storage facilities. 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.

Table 4.11: Material handling waste Related factors

Inappropriate storage facilities	**Frequency**	**Percentage (%)**
Strongly agree	11	44
Agree	9	36
Disagree	4	16
Strongly disagree	1	4
Neutral	0	0
Total	**25**	**100**
Damage during transportation		
Strongly agree	10	40
Agree	8	32
Neutral	5	20
Strongly disagree	2	8
Disagree	1	4
Total	**25**	**100**
Theft and vandalism		
Strongly agree	12	48
Agree	7	28
Neutral	4	16
Disagree	1	4
Strongly disagree	1	4
Total	**25**	**100**

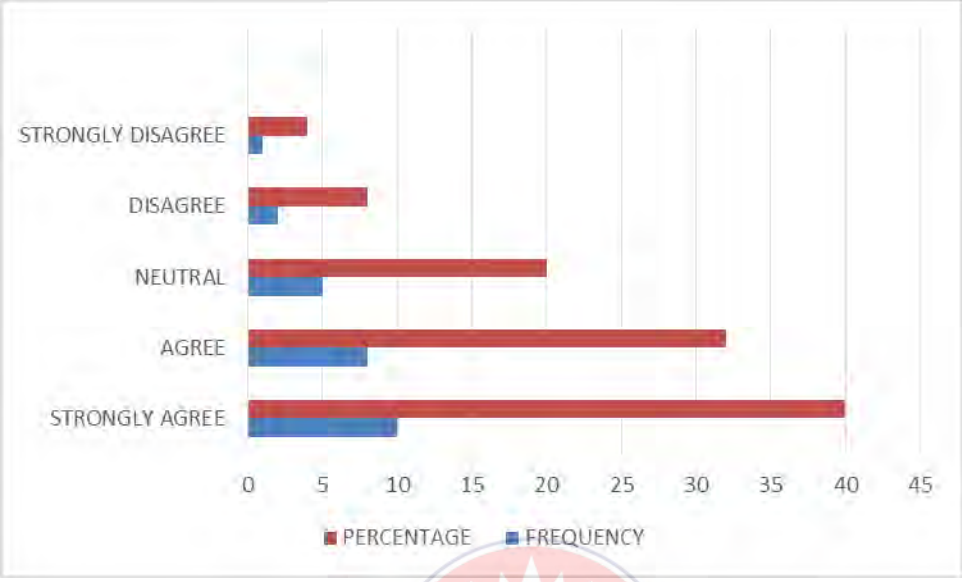
Source: Field survey, 2015

Effective Transportation of the Construction Materials

Transporting the construction materials from the point of sale to the construction sites can also affect the materials and cause damage to the construction if they are not properly packaged and transported to the site. The study confirmed that 72% of the respondents agreed that construction materials can damage if not properly transported to the site. Also, 12% of the participants disagreed. 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 & Popescu 1996; Abdul-Rahman et al; 2006; Aibinu and Odeyinka, 2006). Late delivery of ordered materials is also problematic in materials management.

According to the study, 86% of the respondents agreed that theft and vandalism can affect efficient utilization of construction materials and 8% of the respondents disagreed. Theft and vandalism can affect the utilization of construction materials. Construction materials must be stored well to avoid theft. 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 and Caban, 1998).



Source: Field survey, 2015

Figure 4.4: Effective Transportation of the Construction Materials

Procurement Waste Related factors

Construction materials become obsolete and waste when materials mismatch with the required specification. The results of the study confirmed that 72% of the respondents strongly agreed that mismatch of construction materials with the required specification can affect the effective utilization of construction materials. Moreover, 12% of the respondents disagreed. The mismatch of material with required specification can affect the utilization of construction materials. Ammer (1990), 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.

Ordering errors and lack of possibility to order small quantity can generate surplus and waste of construction materials. The study indicates that 80% of the respondents agreed that ordering errors can generate waste in the construction site. However, 8% of the respondents disagreed. Ordering errors and lack of possibility to order small quantity can cause loss to the contractors and generate waste on construction site. The building contractor must do good estimate and order construction materials can order reasonable quantity of materials to suit the available project to avoid waste. 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, 2005).

Table 4.12: Procurement Waste Related Factors

Mismatch of material with specification	**Frequency**	**Percentage**
Agree	12	48
Strongly agree	6	24
Neutral	3	12
Disagree	1	4
Strongly disagree	3	12
Total	**25**	**100**
Ordering errors and lack of possibility to order small quantity		
Strongly agree	12	48
Agree	8	32
Neutral	3	12
Disagree	2	8
Total	**25**	**100**

Source: Field survey, 2015

4.2.2 Results of Questionnaire from Project Manager

The importance of efficient utilization of construction management and cost control

The effective use of resources leads to profitability to the construction company. Waste generation provides loses to the construction company. The study shows in Table 4.13 that, 71.7% of the respondents strongly agreed that effective use of resources leads

to profitability to the construction company. Additionally, 11.6% of the respondents disagreed. The results of the study concluded that effective use of resources leads to profitability to the construction company. 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

Table 4.13: The importance of efficient utilization of construction management and cost control

Effective use of resources leads to profitability to the construction company.	**Frequency**	**Percentage**
Strongly agree	25	41.7
Agree	18	30.0
Neutral	10	16.7
Disagree	5	8.3
Strongly disagree	2	3.3
Total	**60**	**100**
Proper management of resources promotes the availability of construction materials for daily works.		
Strongly agree	28	46.7
Agree	14	23.3
Neutral	9	15.0
Disagree	5	8.3
Strongly disagree	4	6.7
Total	**60**	**100**
Efficient use of resources minimizes the production of waste and promotes effective waste management strategy.		
Strongly agree	28	46.7
Agree	15	25
Neutral	7	11.7
Disagree	6	10
Strongly disagree	4	6.7
Total	**60**	**100**
The construction company earns a good reputation for quality works.		
Strongly agree	24	40
Agree	30	50
Neutral	6	10
Total	**60**	**100**
The Purchasing Function must be used effectively		
Strongly agree	29	48.3
Agree	16	26.7
Neutral	9	15
Disagree	4	6.7
Strongly disagree	2	3.3
Total	**60**	**100**

Source: Field survey, 2015

Proper management of resources promotes the availability of construction materials

Proper management of resources promotes the availability of construction materials for daily works. The availability of construction materials can enhance the management of construction materials for the construction project. The study shows that 80% of the respondents strongly agreed that proper management of resources promoted the availability of construction materials for daily works. The building construction company can save some money whilst managing construction materials properly. 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).

The study demonstrated that 81.7% of the respondents strongly agreed that efficient use of resources minimizes the production of waste and promotes effective

waste management strategy, 16.7% of the respondents disagreed. The study results shows that majority representing 86.2% of the respondents strongly agreed that efficient use of resources minimizes the production of waste and promotes effective waste management strategy. 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.

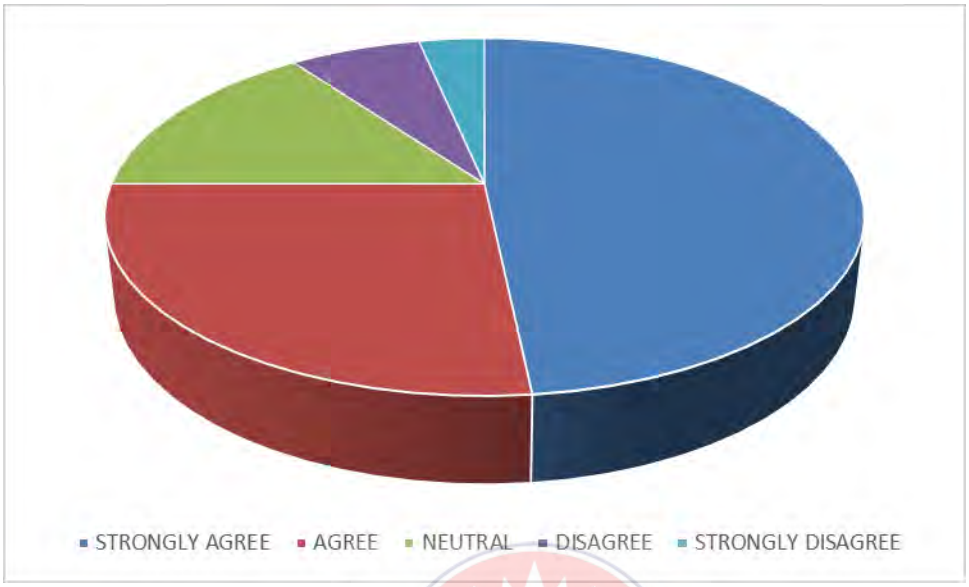
The importance of appropriate handling of materials is highlighted by the fact that they are expensive and engage critical decisions. Due to the frequency of handling materials there are quality considerations when designing a materials handling system. The selection of the material handling equipment 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 effective management of construction materials can enhance quality work and good reputation for the construction company. The study finding confirmed that 90% of the respondents agreed that effective management of construction materials can promote a construction company to earn a good reputation for quality works. To add more, 4.6 % of the respondents were neutral. The study finding indicated that the effective management of construction materials can enhance quality work and good reputation for the construction company. The importance of appropriate handling of

materials is highlighted by the fact that they 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).

The purchasing function can enhance effective management of construction materials. The study conducted revealed that 75% of the respondents agreed that the Purchasing Function must be used effectively to enhance construction management. However, 10% of the respondents disagreed. The Purchasing Function must be used effectively to avoid waste generation. For instance, the ability to purchase and order the right quantity of construction materials can avoid creating surplus and unwanted materials that becomes waste. 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 in productivity.



Source: Field survey, 2015

Figure 4.5: Proper management of resources promotes the availability of construction materials

4.2.3 Results of Questionnaire from Site Supervisors

The strategies that can enhance efficient utilization of construction materials

Table 4.14 revealed that, 68.8% of the respondents agreed that the expediting function and efficient construction material management can enhance the construction company's growth and profitability. Moreover 13.3% of the respondents disagreed. The Expediting function must be consistently practised to enhance efficient 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 and 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 submittal, 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 and Dozzi 1994).

The results of the study holds that 80% of the respondents agreed that the effective management of surplus materials can enhance efficient construction management. Minority 12% of the respondents disagreed. The effective management of

surplus materials can enhance efficient construction management and provide cost reduction. 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 and Bell 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 and Dozzi 1994).

Table 4.14: The strategies that can enhance efficient utilization of construction materials

The Expediting function and Efficient Construction Material Management	Frequency	Percentage
Strongly agree	11	24.4
Agree	20	44.4
Neutral	8	17.8
Disagree	4	8.9
Strongly disagree	2	4.4
Total	**45**	**100**
The Effective Management of Surplus Materials can enhance Efficient Construction Management		
Agree	27	60
Neutral	9	20
Disagree	5	11.1
Strongly disagree	4	8.9
Total	**45**	**100**
The Effective Control of Construction Waste has a positive impact on Cost Reduction		
Strongly agree	22	62.3
Agree	10	26.9
Neutral	7	6.9
Disagree	5	11.1
Strongly disagree	1	2.3
Total	**45**	**100**
The Benefits of using Just In Time (JIT) Strategy for Construction Cost Recovery		
Strongly agree	26	57.8
Agree	8	17.8
Neutral	6	13.3
Disagree	4	8.9
Strongly disagree	1	2.3
Total	**45**	**100**

Source: Field survey, 2015

Effective control of construction waste has a positive impact on cost Reduction

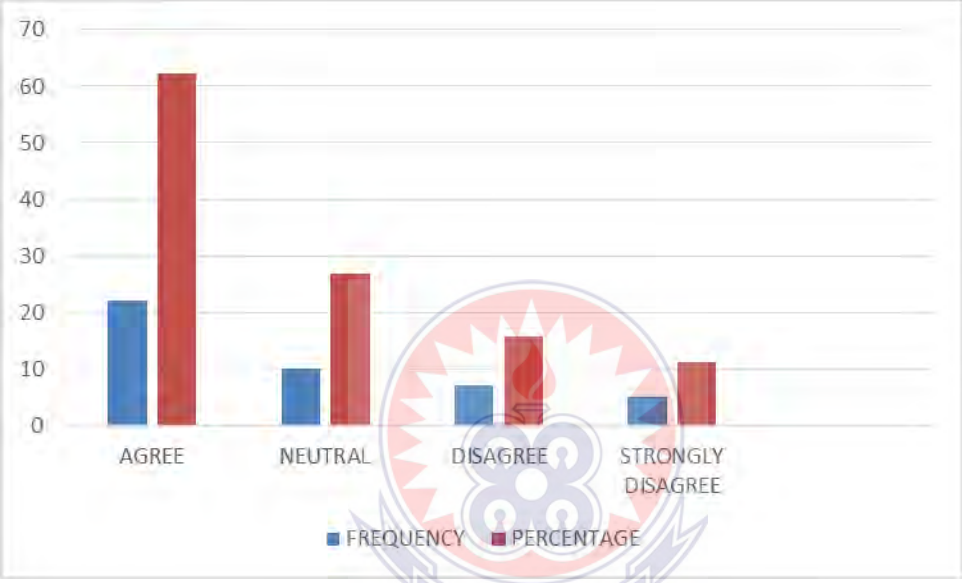
The results of the study demonstrated that 75% of the respondents agreed that the effective control of construction waste has a positive impact on cost reduction. Also, 10% of the respondents disagreed. The study finding revealed that the effective control of construction waste has a positive impact on cost reduction. This means that the construction company can manage waste effectively and gain profit.

The results of the study shows that 75.6% of the respondents agreed that Just In Time (JIT) Strategy can promote Construction Cost Recovery. Minority, 2.3% of the respondents disagreed. The study concluded that 75.6% of the respondents agreed that Just In Time (JIT) Strategy can promote Construction Cost Recovery. 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 all, 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 throughput. 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 and 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, 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, 1987).



Source: Field survey, 2015

Figure 4.6: Effective control of construction waste has a positive impact on cost Reduction

The Importance of using Information and Communication Technologies (ICT) to manage construction materials

The Implementation of appropriate Information and Communication Technologies (ICT) in the construction company can manage construction materials effectively. Majority, 86.6% of the respondents agreed that the implementation of appropriate information and communication technologies (ICT) can manage construction materials efficiently. The implementation of appropriate Information and Communication

Technologies (ICT) could facilitate new management processes for complex construction projects. For example, the potential of emerging technologies such as wireless technologies and tagging technologies could have a strong impact on construction materials management processes in the future. The improper handling and management of materials on construction sites has the potential to severely hamper project performance (Ogunlana et al, 1996). The result of improper handling and managing materials on site during construction process will influence the total project cost, time and the quality (Che Wan Putra et al, 1999). The costs of materials management may range from 30-80% of the total construction costs depending on the type of construction (Muehlhausen, 1991). 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). 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 proper use of the procurement function can enhance the construction material waste management in the construction company. The study depicts that 85.5% of the participants strongly agreed that the proper use of the procurement function can increase the cost recovery. Moreover, 6.6% disagreed. The proper use of the Procurement

Function can significantly avoid waste generation. The term procurement encompasses a wide range of activities that includes purchasing of equipment, materials, labour and services required for construction and implementation of a project (Barrie and Paulson, 1992). The objective of procurement in materials management is to provide quality materials at the right time and place, and at an agreed budget. Payne et al. (1996) stated that procurement is about organising the purchasing of materials and issuing delivery schedules to suppliers and following-up, to make sure that suppliers deliver on time. A failure in the purchasing process or in overseeing and organising the buying functions as listed by Canter (1993) could result in:

- Over-ordering of materials (wastage problems);
- Over-payments for materials (inadequate administration procedures);
- Loss of benefits (lack of skilled negotiating procedures); and
- Lack of knowledge (when and where the best service/source might be available at any particular time).

In order to avoid failure, it is important to know how the typical purchasing procedure takes place. Procurement of materials begins with defining the requirements of the project, followed by the selection of suppliers or subcontractors, and ends with the delivery of materials at the destination (Kent, 1991). Purchasing materials from the best source, at the right price and with timely delivery are challenges of many construction companies. Therefore, a control strategy is needed during materials procurement to achieve the targeted objectives. All requests for quotations and purchases must be initiated through a properly authorised requisitioning procedure normally controlled by the Project Manager.

Transporting the construction materials to the site must be properly taken care of. This can enhance proper storage packages that can land safely on the site. Majority, 84.4% of the respondents agreed that transporting the construction materials safely on site can improve efficient management of construction materials. Minority, 8.9% of the respondents disagreed. 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 and 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 and Dozzi, 1994).

Table 4.15: The Importance of using Information and Communication Technologies (ICT) to manage construction materials

The Implementation of appropriate Information and Communication Technologies (ICT) to manage construction materials	Frequency	Percentage
Agree	29	64.4
Neutral	10	22.2
Disagree	4	8.9
Strongly disagree	2	4.5
Total	**45**	**100**
The proper use of the Procurement Function		
Strongly agree	26	57.8
Agree	12	26.7
Neutral	4	8.9
Disagree	2	4.4
Strongly disagree	1	2.2
Total	**45**	**100**
The Importance of Effective Transportation and Efficient Construction Material Management		
Strongly agree	29	64.4
Agree	9	20
Neutral	3	6.7
Disagree	3	6.7
Strongly disagree	1	2.2
Total	**45**	**100**

Source: Field survey, 2015

The Importance of Recycling waste

It is good to recycle waste at the construction sites. According to the research conducted 68.9% of the respondents confirmed that it is good to recycle waste at the construction sites and 31.1% said no. The study finally concluded that it is very good to recycle construction waste on the site. 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 (2005) 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.

Table 4.16: The Importance of Recycling waste

Do think the waste you generate can be reuse on site?	Frequency	Percentage
Yes	31	68.9
No	14	31.1
Total	**45**	**100**

Source: Field survey, 2015

4.3 Results of Observation

4.3.1 Results of Observation from Messrs Justmoh Company

During the visit in Messrs Justmoh Company, the researcher observed that, the site was well planned and coordinated to the extent that every activity follows without hindrance. It was revealed also that, adequate pre-construction survey on materials were

made before ordering by the purchasing department, employment of security personnel on site was just enough to keep the site safe for all employees of the company, lightening systems were provided at vantage points. This observation is consistent with (Ademeso & Windapo, 2012) findings. However, the researcher observed that, no serious attention were paid to program of activity drawn by the Operation Manager as a result lead to rework. Beekman-Love, P.E.D (2008) characterized rework as the "unnecessary process of redoing a work activity that was incorrectly carried out the first time." It was revealed further that, the root cause of rework were unclear instructions to workers, ineffective management of project team, poor communication, non-compliance specification, untimely deliveries, late designer input and inadequate supervision

4.3.2 Results of Observation from Messrs Big Aidoo Company

Observation made at Messrs Big Aidoo Company shows that, the company have similar characteristics as that of Messr Justmoh thus having a well-coordinated site, adequate pre-construction survey on materials before ordering by the purchasing department, employment of security personnel on site was just enough to keep the site safe for all employees of the company, lightening systems were provided at vantage points. However, rework that occurred in Messr Big Aidoo construction site was attributed to client design changes as compared to rework under Messr Justmoh site was attributed to non-compliance to instructions by operatives.

4.3.3 Results of Observation from Messrs Semak Enterprise

A visit to Messrs Semak Enterprise revealed that, most activities such as: planning of the site was not well coordinated but construction activities go on well. It was revealed also that, no adequate pre-construction survey on materials were made this result in emergency purchases of materials, inadequate storage facility was found to be lacking at the construction site, employment of security personnel on site was quite good at the site, no lightening systems were provided at vantage points. However, the researcher observed that, no serious attention were paid to program of activity drawn by the Operation Manager as a result lead to rework. Beekman-Love, P.E.D (2008) characterized rework as the "unnecessary process of redoing a work activity that was incorrectly carried out the first time." It was reveal further that, the root cause of rework were unclear instructions to workers, ineffective management of project team, poor communication, non-compliance specification, untimely deliveries, late designer input and inadequate supervision.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATION

This chapter summarized the results of the study, provided conclusion remarks and recommendations for further studies.

5.1 Summary of Findings of the Study

The study revealed that most of the contracting companies in Sekondi-Takoradi are:

- Small and Medium size organizations
- Majority of the personnel in-charge of material management have the requisite experience required of the industry to function effectively.

The study also indicate that most of the contractors agree with factors that affect efficient utilization of construction materials on site such as:

- Poor workmanship
- Poor communication on construction site
- Inadequate supervision
- Improper planning of construction materials.
- Improper procurement policy
- Inadequate preconstruction survey on materials required for project

The study further revealed that effective material management has strong significant effect on cost recovery in construction project in terms:

- Increase profitability to the construction company.
- Promote proper management of resources at the construction site

- Promotes effective waste management strategy
- Earns a good reputation for the construction company for quality works.
- Effective management of surplus materials enhance efficient construction management.
- Effective control of construction waste on construction site

The study further revealed that, majority of the respondents agreed that the following strategies enhance efficient utilization of construction materials

- Just in Time (JIT) Strategy promote Construction Cost Recovery.
- Implementation of appropriate information and communication technologies (ICT) can manage construction materials efficiently.
- Proper use of the procurement function increase the cost recovery.
- Transporting the construction materials safely on site improve efficient management of construction materials.
- Majority of the respondents confirmed that it is good to recycle waste at the construction sites.

5.2 Conclusions

In conclusion, managers of construction firms should be more concern about planning and monitoring of materials schedule; promoting proper management of resources at the construction site; promoting effective waste management strategy; the use of Just in Time (JIT) Strategy to promote construction cost recovery; implementation of appropriate information and communication technologies; proper use of the procurement function; and also provision of adequate security; provision of adequate

supervision at the site and use of competent workers as well as effective training workers to enhance their material management and ultimately improve their construction cost recovery.

5.3 Recommendations

Based on the analysis of the results and findings of the study, the following recommendations are made towards improving the efficient utilization of construction materials in the Ghanaian construction industry. These recommendations could form the basis for interventions designed to improve construction project cost recovery.

It is recommended that the existing material management approach in use should be improved so as to prevent shortage of materials on site or the non-availability of material as and when required on site and this can be achieved if:

- The site manager or project manager prepare and monitor material schedule on all projects.
- The site manger makes it compulsory for the store keeper to record the use and inventory of material on daily basis during the construction process, to enable him or her alert or inform the necessary authority if there is shortage of any material, for prompt ordering.
- Most sites should employ personnel to secure the material on site during the day and at night to ensure that all materials are protected from theft or pilfering.
- As much as possible contractor should make adequate preconstruction survey on materials before commencement of any construction project

- Construction companies should make use of more than one material management technique on construction projects so as to achieve maximum project cost recovery.
- Contractors should expedite effort to pay their suppliers promptly

Additionally, Top management of contracting companies should encourage development and using construction materials management systems. They can make incentives for their staff members to attend training courses in construction materials management and its applications. They should be encouraged to actually use computerized construction materials management systems to save effort and time, and to achieve more accurate results.

Public employers can contribute in improving the current construction materials management practices of the contractors by requesting them to implement construction materials management systems during construction. This could be done by adding relevant clauses in the project conditions of contract.

Universities, contractors union, and engineering associations have to do more efforts to improve the existing construction materials management practices, which may include:

- Encouraging the contractors to use construction materials management techniques by addressing the importance of these techniques.
- Helping the contractors to understand the techniques by initiating training courses, lectures, seminars, and workshops.
- Transferring of technology and experiences of other countries in the construction materials management field and adapting them to suit the local contractors.

5.4 Suggestions for Further Research

The study was limited to only the Sekondi-Takoradi Metropolis in the Western Region of Ghana. The researcher therefore suggest that further work on the effective use of construction materials on more organizations to be done to evaluate how proper management of construction materials enhanced the cost recovery of the construction firms. Moreover, the population should be increased since a larger population will bring to fore wide range of views.

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APPENDIX A

QUESTIONNAIRE FOR THE CONTRACORS/DIRECTORS

EFFICIENT UTILIZATION OF CONSTRUCTION MATERIALS FOR EFFECTIVE COST RECOVERY

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.

Personal Information

1. Please indicate your gender. (Please tick [√])

Male [ ] Female [ ]

2. Please indicate your occupation. (Please tick [√])

Contractor/Director [ ] Project manager [ ] Site supervisor [ ] local planning officer [ ]

3. What contractor classification does your company belong to? (Please write in the box)

4. What is the number of years you have been working in the construction industry? (Please tick [√])

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

5. Please, state your current position with your company. (Please write in the box)

The factors that affects the effective management of construction materials in Sekondi-Takoradi Metropolis in the Western Region of Ghana.

Please use the following likert scale to answer the following questions relating to the factors that affects the effective management of construction materials. Answer these questions objectively. Tick as many as possible 1= Strongly Disagree 2= Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

No.	The factors that affects the effective management of construction materials	Likert Scale				
		1	2	3	4	5
	OPERATIONAL WASTE FACTORS					
6	Poor workmanship	1	2	3	4	5
7	Poor communication between designer and builder	1	2	3	4	5
8	Inadequate supervision	1	2	3	4	5
9	Damages caused by succeeding trades	1	2	3	4	5
10	Required quantity unclear due to improper planning	1	2	3	4	5
11	Bad weather condition	1	2	3	4	5
12	Use of incorrect material and malfunctioning of equipment	1	2	3	4	5
13	Spoiling of material during fixing and site accidents	1	2	3	4	5
	DESIGN WASTE FACTORS					
14	Design change during construction	1	2	3	4	5
15	Lack of attention to dimensional coordination	1	2	3	4	5
16	Lack of information in the drawing	1	2	3	4	5
17	Incomplete and errors in contract document	1	2	3	4	5
18	Designers unfamiliarity with alternative products	1	2	3	4	5
19	Selection of inferior quality material and products	1	2	3	4	5
20	Lack of attention paid to standard size available in the market	1	2	3	4	5
21	Complexity of the drawing	1	2	3	4	5
	MATERIAL HANDLING WASTE FACTORS					
22	Inappropriate storage facilities	1	2	3	4	5
23	Damage during transportation	1	2	3	4	5
24	Material supplied in loose form	1	2	3	4	5
25	Unfriendly attitudes of project team	1	2	3	4	5
26	Theft and vandalism	1	2	3	4	5
	PROCUREMENT WASTE FACTORS					
27	Mismatch of material with specification	1	2	3	4	5
28	Ordering errors and lack of possibility to order small quantity	1	2	3	4	5

APPENDIX B

QUESTIONNAIRE FOR THE PROJECT MANAGERS

EFFICIENT UTILIZATION OF CONSTRUCTION MATERIALS FOR EFFECTIVE COST RECOVERY

The importance of efficient utilization of construction management and cost control in Sekondi-Takoradi Metropolis in the Western Region of Ghana.

Please use the following likert scale to identify the importance of efficient construction management and cost control. Answer these questions objectively. Tick as many as possible. 1= Strongly Disagree 2= Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

No.	Benefits of efficient construction management and cost control	Likert Scale				
		1	2	3	4	5
1.	Effective use of resources leads to profitability to the construction company.	1	2	3	4	5
2.	Proper management of resources promotes the availability of construction materials for daily works.	1	2	3	4	5
3.	Efficient use of resources minimizes the production of waste and promotes effective waste management strategy.	1	2	3	4	5
4.	The construction company earns a good reputation for quality works.	1	2	3	4	5

APPENDIX C

QUESTIONNAIRE FOR THE SITE SUPERVISORS

EFFICIENT UTILIZATION OF CONSTRUCTION MATERIALS FOR EFFECTIVE COST RECOVERY

The strategies that can enhance efficient utilization of construction materials in the Western Region of Ghana.

Please use the following likert scale to evaluate the strategies that can enhance efficient utilization of construction materials. Answer these questions objectively. Tick as many as possible. 1= Strongly Disagree 2= Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

No.	Strategies that can enhance efficient utilization of construction materials	Likert Scale				
		1	2	3	4	5
1	The Purchasing Function must be used effectively	1	2	3	4	5
2	The Expediting and Efficient Construction Material Management	1	2	3	4	5
3	The Effective Management of Surplus Materials can enhance Efficient Construction Management	1	2	3	4	5
4	The Effective Control of Construction Waste has a positive impact on Cost Reduction	1	2	3	4	5
5	Establishing Responsibilities and Authority on Construction Waste Management	1	2	3	4	5
6	The Benefits of using Just In Time (JIT) Strategy for Construction Cost Recovery	1	2	3	4	5
7	Using JIT to reduce variation and waste	1	2	3	4	5
8	Effective Materials Management on Construction Projects for Cost Reduction	1	2	3	4	5
9	The Implementation of appropriate Information and Communication Technologies (ICT) to manage construction materials	1	2	3	4	5
10	The proper use of the Procurement Function	1	2	3	4	5
11	The Logistics Functions must be used properly	1	2	3	4	5
12	The Importance of Effective Construction Material Handling	1	2	3	4	5
13	The Importance of Stock and Waste Control	1	2	3	4	5
14	The Importance of Effective Transportation and Efficient Construction Material Management	1	2	3	4	5

Interview questions for Site supervisors,

Date…….. Interviewee no:……..

Please Ametsi, Victor Smile is my name. I am researching into the efficient utilization construction materials for effective cost recovery. I would be very glad if you will not mind to provide answers to the questions on the topic under study.

Thank you.

1. In your opinion will you get less productive work achieved in a day if a waste minimization plan is introduced? Yes { } No { } explain below

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2. Would you feel better about your company and become more motivated about the work you do if waste minimization plan is introduced? Yes { } No { } explain

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3. Do think the waste you generate can be reuse on site? Yes { } No { } explain

4. Can you suggest ways of minimizing or reducing waste?
