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Developing Guidelines for Managing Subcontractors within the Constraints of Cost and Time

by

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MASTER OF PHILOSOPHY

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DECLARATION

I hereby declare that this submission is my own work towards the MPhil Construction Management and that, to the best of my knowledge, it contains no material previously published by another person, nor material which has been accepted for the award of any other degree of any University, except where due acknowledgement has been made in the text.

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ABSTRACT

Subcontractors have been found to execute significant portion of construction works, hence their contribution to the overall project cannot be under-estimated. A construction subcontractor is that organisation that enters into a contract with a client or a general contractor to execute some portions of work for the main contractor. The main contractor and the consultant's ability to achieve a project within the stipulated time and within cost, is contingent largely on the subcontractor's performance. In most construction projects, the onus lies on the main contractors to manage the project with respect to tasks including procurement of material and equipment, contract administration, project financing and progress monitoring. While subcontractor management has the opportunity to produce quality results, it also has the potential to disrupt a project if performed incorrectly. To overcome the challenges faced by Main Contractors in managing subcontractors, this research aimed to develop guidelines for use by main contractor in managing sub-contracts to help improve the performance of projects in terms of time and cost. In order to achieve the aim stated above, the study adopted a quantitative approach with the aid of structured survey questionnaire as the key tool for data collection, with a response rate of 67%. The data collected was processed using the statistical package for social science (SPSS) and later conveyed into the Microsoft Excel 2010 for analysis using descriptive statistical tools and measures namely tables; mean and standard deviation and Relative Importance Index (RII). The findings revealed that subcontracting is a common occurrence in building projects in Ghana and that significant portions (as much as 40 percent) of projects/works are outsourced to subcontractors. Again, the study identified topmost challenges of subcontract management as Non-Adherence to schedule, Site coordination challenges, Lack of proper communication, Lack of safety and Contractor's financial challenges. Furthermore, the showed that the factors affecting

the cost and time performance of subcontractors include: Extent of subcontractor's commitment to schedule, Practical and technical ability of Main Contractors, Project Manager's recognition of the other construction activities related to subcontractors tasks, Efficiency of project staff, Clear understanding of the contract conditions, requirements and project objectives and Many project execution obstacles. Finally, study established that the cost and time related factors most affected by subcontractor management are: Waste rate of materials, Planned time for project construction, Time needed to implement variation orders and Time required in rectifying defects. The study therefore recommended that Project managers must not adopt 'brick and mortar' approach to subcontractor management; the management approach adopted must be tailored to suit the job at hand. Main contractors should also pay attention to helping build the technical capacity of subcontractors in relation to project planning, scope management and project cost and time management.

Keywords: Cost, Cost constraint, Construction industry, Subcontract, Subcontractor, Subcontracting, Subcontract Management, Time, Time constraint.

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DEDICATION

I wish to first dedicate this work to my wife, Diana Asantewaa and our wonderful sons; Nyamekye, Adom and Aseda. You are indeed precious gifts of God to us.

I also dedicate this to the memory of my Mother, Felicia Mansah who died when I was preparing for one of the seminars towards this degree.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABCEG	Association of Building and Civil Engineers Ghana
AGCA	Associated General Contractors of America
CPI	Cost Performance Index
CT	Contingency Theory
EVM	Earned Value Management
GCI	Ghanaian Construction Industry
JIT	Just-in-time
LPS	Last Planner System
MBM	Management by Means
MBR	Management by Means
MC	Main Contractors (MC)
MWRWH	Ministry of Water Resources Works and Housing
PMI	Project Management Institute
PPC	Percentage of Plan Completed
QS	Quantity Surveyors
RII	Relative Importance index
SC	Subcontractors
SPSS	Statistical Package for the Social Sciences
SPV	Schedule Performance Index
SV	Schedule variance
TOC	Theory of Constraints
UK	United Kingdom
VSM	Value stream mapping

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND

Construction as an industry has played and continues to play extremely dominant and salient part in the economy of every nation. The pursuits of the industry are also vibrant towards the attainment of the socio-economic growth such as the provision of shelter, infrastructure and employment (Anaman and Amponsah, 2007). Thousands of different construction projects are realize every year. Projects take various forms and magnitudes, and range from relatively minor and simple to very huge and multifarious ones.

Most construction projects involve Consultants, Main Contractors (MC) and Subcontractors(SC) ranging from Specialist sub-contractor, Trade sub-contractor and Labour-only sub-contractor. Several studies have confirmed that the involvement of subcontractors in executing a significant portion of construction work, cannot be under-estimated (Abbasianjahromi *et al*., 2013; Hartmann, 2009; Arditi and Chotibhongs, 2005; Ng *et al*., 2008a and 2008b; and Wang and Liu, 2005). On many building construction projects, it is common for subcontractors to perform significant portions of the works (Hinze and Tracey 1994). Many general contractors sublet some or all of their work attributable to their lack of capacity to execute specialized jobs in a project, such as electric, plumbing and insulation. As stated by Arditi and Chotibhongs(2005), "day-to-day economic facts have long-established the efficiency of subcontracting practice in the economical usage of available resources".

Many large engineering projects are faced with late completion dates, budget overruns and technical difficulties (Koppenjan *et al*., 2011). Among the reasons given for such project failures include, increasing complexity of projects and the underestimation of this project complexity (Chang and Ive, 2007; Williams, 2005). Many clients have enjoyed

good experiences with contractors, but conversely, many have been subject to extended project durations and cost overruns. Interestingly, research has shown that ninety percent (90%) of construction projects have miscalculated project costs, and sixty percent (60%) of projects culminate in time delays (Flyvbjerg *et al*., 2010). According to Flyvbjerg (2005), the Sydney Opera House, for example, was completed ten years late and cost 15 times more than it was originally projected. In most construction projects, the onus lies on the main contractors to manage the project with respect to tasks including procurement of material and equipment, contract administration, project financing and progress monitoring (Benjaoran, 2009).

Kumaraswamy and Matthews (2000) describe Subcontractors as those who have specialize in the undertaking of a specific work, who may also play the role of representatives of the production system of the contractor organisation in providing services in the areas of materials supply, human resource, equipment hiring, tools and designs . A construction subcontractor is that organisation that enters into a contract with the prime contractor to execute portions of work for the main contractor. In many instances, subcontractors who are hired to carry out specific tasks in construction projects, play a vital role. Usually, the general contractor undertakes the core tasks and engages various specialty subcontractors to execute what is left. Benjaoran (2009) has observed that subcontracting is prevalent in housing and building construction projects than is the case of industrial and engineering projects. This can be attributed to the increasingly complex and specialized nature of buildings and the need for the provision of special services. Contemporary buildings embrace an extensive diversity of facilities installations. Gargets such as those for heating, ventilation and air-conditioning, electricity supply, elevators, fire detection and guards, water supply and drainage, and the like have become orthodox types of facilities installations in buildings. Furthermore,

the use intelligence systems such as those for optimizing performance, sensing and making diagnosis for faults and adapt to changes in working situations. The use of subcontracting therefore helps to maximize the advantage of specialization.

According to Albino and Garavelli (1998), the performance of the main contractor is strongly linked to that of the subcontractors. This concurs with the observation of Mbachu (2008) who asserted that the main contractor and the consultant's ability to achieve a project within the stipulated time, at the quality prescribed and within cost, is contingent, to a large extent, on the subcontractor's performance.

Although it is certainly a benefit for a company to spread work among experts, many problems do tend to arise when combining the efforts of varying subcontractors. As project sizes amplify, the number of hired subcontractors usually increases as well, leading to problems in subcontractor management (Thomas and Flynn, 2011).

Most of the past studies on subcontractors have focused on selection of subcontractor (Fagbende *et al*., 2011), evaluating/monitoring subcontractor' performance (Chamara *et al*., 2015; Yik, 2006; Al-Otaibi and Price, 2010) and Contractor-Subcontractor Relationship (Okunlola, 2015; Obafemi and Roy, 2013). However, developing a subcontractor selection model, monitoring subcontractor's performance or enhanced main contractor-subcontractor relationship would not necessary translate into a successful subcontract works.

This study therefore seeks to develop guidelines for use by main contractor in managing sub-contracts to help improve the time and cost performance of projects.

1.2 PROBLEM STATEMENT

Construction managers continue to struggle in their attempt to achieve projects within the planned cost and schedule. Even though concept of subcontractor management has

been found to yield encouraging outcomes when performed effectively, likewise there is the possibility of disrupting project success if not properly performed (Maturana, 2007). As long as construction management fails to offer the required guidance, the construction industry may not achieve the utmost benefit from subcontractors' work. Many research findings have often linked subcontractors to the causes of project cost and time overruns (Buetey et al, 2014; Koppenjan et al., 2011; Flyvbjerg et al. 2010). Inappropriate assistance from main contractors has been impugned on the subcontractor's inability to perform with regard to project time and Cost (Maturana, 2007). To buttress this point, Thomas and Flynn (2011) have revealed that the benefits for engaging subcontractors is often eroded due to lack of proper management.

However regardless of the recognized benefits and challenges in hiring the services of subcontractors, not much by way of research has focused on subcontractor management. Where attempts have been made in this regard, the focus have been on subcontractor selection and fostering main contractor-subcontractor relationship. The proposal of an appropriate roadmap to managing subcontractors therefore remains elusive.

To overcome challenges faced by Main Contractors (MC) in managing subcontractors, there is the need for the development of guidelines for use by main contractor in managing subcontractors to help improve the performance of projects with respect to time and cost.

1.3 RESEARCH QUESTIONS

1. To what extent is the concept of Subcontracting used in the Ghanaian Building Industry?
2. What are the underlying challenges inherent in managing subcontracts in the Ghanaian Building Industry?

3. What are the factors that affect the Cost and Time performance of Subcontractors in Ghana?

1.4 AIM

The study aims at developing guidelines for main contractor in managing sub-contracts within the constraints of the time and cost.

1.5 OBJECTIVES

The following research objectives aided in the attainment of the general research aim as stated above:

1. To determine the extent to which the concept of Subcontracting is used in the Ghanaian Building Industry;
2. To identify the underlying challenges inherent in managing subcontractors in the Ghanaian Building Industry; and
3. To identify the factors affecting the cost and time performance of subcontractors in the Ghanaian Building Industry.

1.5 SCOPE OF THE RESEARCH

This thesis examines challenges that exist in subcontract management, as well as the best guidelines for managing subcontractors within the constraints of time and cost. Traditionally, the criteria for measuring success of construction projects is the cost, time and quality parameters. This study however is limited to time and cost parameters. This is because, among these constraints, cost and time are inclined to be the most vital and noticeable, mostly perceived as very important because of their direct economic consequences if they are needlessly overrun.

In order to narrow the scope, this study does not embrace all types of construction projects. Mindful of the fact that there is wide variability of subcontract works in construction projects, the study focuses on the management of subcontractors in building development projects only. This is because civil engineering projects are not too labour intensive and involves fewer trades. Consequently, civil engineering contractors do not sublet their work as much as building project contractors.

The extent of this study would be narrowed to Accra, being the city with the largest concentration of contractors and construction professionals. This location has been selected due to its proximity and convenience for the researcher and for the fact that Accra being the capital of Ghana and for that matter most of the operations of these stakeholders is intensive in this regional capital. Target respondents for this study are D1 construction firms in the Greater Accra region, who are registered members of the Association of Building and Civil Engineering Contractors in Ghana and Subcontractors who worked under them. The sub-contractors comprised mainly services engineers (electrical, mechanical, plumbing etc). The study also considered Architectural and Quantity Surveying Consultancy firms in the Greater Accra region who have worked with the above-mentioned group of contractors. The target professionals in these firms comprise of mostly Project managers, Quantity Surveyors (QS), Architects, Civil Engineers and Services Engineers.

1.6 RESEARCH METHODOLOGY

The study adopts primarily quantitative data collection and analysis approach. The methodology used in this study consists of critical review of relevant literature related to Subcontractor management. This helped in the identification of the previous work done, contributions made, criticisms, limitations, current findings and their applications. The

literature review facilitated the development of sound and vital questionnaire, which centers on the aims and objectives of the study to collect data from the field. The initial step of the study focused on a comprehensive review of pertinent literature from books, journals, international conference proceedings and other publications involving subcontract management.

The next phase of the process encompassed the preliminary field survey. The study used snowball sampling in attaining the sample size of the Subcontractors because of lack of a comprehensive database on registered body of subcontractors in Ghana. Additionally, simple random sampling technique was used to select the total number of D1contractors.The third step involved the design of the questionnaires for data collection. The questionnaires contained principally open-ended questions. Prior to the data collection, a pilot of the questionnaires was undertaken. The last stage of the study was dedicated to collection of relevant primary data through questionnaire survey. The data collected from the field survey was then analyzed using the Statistical Package for Social Sciences (SPSS version 20), focusing on descriptive statistics. In all, one hundred and forty (140) questionnaires were administered. From this number, 88 questionnaires were retrieved, representing 62.9 percent responds rate.

1.7 LIMITATION OF THE STUDY

Difficulties faced in the course of conducting the research at the field survey phase were constraining factors in the execution of this study. It took a lot of persuasion to get the target respondents to agree to be part of the survey and this had an impact on the response rate. Besides, the likelihood of sampling and measurement errors and the effects of these errors on the data collected cannot be underestimated.

1.8 SIGNIFICANCE OF RESEARCH

As stated earlier, construction is often a labor-intensive endeavor and requires a wide range specialty subcontractors for the accomplishing projects objectives in the most effectual and cost-effective way. As a result, problems will often arise (Thomas 2005). Project owners usually engage construction managers or general contractors to coordinate the activities of a project and to accomplish project objectives successfully. Construction managers on the other hand, utilize the skills of subcontractors in order to minimize costs and to complete a project within the stipulated time and quality prescribed. One of the responsibilities of the project manager is to deal with any quandary with the purpose to maintain the project on schedule and achieve a return on investment. There is still more room for improvement in the construction management practices and consequent reduction in project schedules and ultimate increase in profits margins. The development of new and improved guidelines for main contractors to manage subcontracts will set as catalyst to enhance relationship between two parties as well as boost project performance. Notwithstanding the fact that subcontracting is applicable in various sectors of the construction industry, such as in infrastructural, civil engineering and building development projects, it is anticipated that findings obtained from this study will be applicable to subcontracting in the other sectors of the construction industry. The findings of this study, when implemented, will lead to closer collaboration between Main Contractors, Project managers and Subcontractors for efficient project execution.

1.9 OUTLINE OF THESIS

The thesis is divided into five (5) inter-reliant chapters, namely: Chapter one is captioned "General Introduction to the Research". The chapter gives the background to the research

and summaries the problem sanctioning the research pursuit. The chapters further provides the research questions, the research aim, the research objectives, and the scope.

Chapter two, on the other hand, contains the literature review which extensively cover previous research efforts. Again, the chapter expansively discusses subcontractor management practices and challenges.

Chapter three addressed the philosophical stance of the researcher and the methods used; research design, sampling technique and the data collection methods adopted.

Chapter four involved data presentation and discussions of the results from the field survey. This chapter also contains the recommended guidelines in the form of flow diagrams and their applications.

Chapter five wraps up the entire research endeavour by summarizing the findings from chapter four. The recommendations for policy, future research, for practical application and future research directions have also be outlined

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents a review of appropriate literature on the subject matter, Subcontractor management. It sets off by documenting the nature of subcontracting in the construction industry, defining subcontracting and subcontractors and their categories. It then presents the challenges in subcontractor management and factors affecting the performance of subcontractors. It also highlights the management of cost and time constraints in subcontracts. The chapter concludes with a discussion of theories to support the phenomenon under study.

2.2 NATURE OF SUBCONTRACTING IN THE CONSTRUCTION INDUSTRY

Projects have become increasingly complex due to their increasing size and use of state-of-the-art technologies (Koppenjan *et al*., 2011). Additionally, many companies have returned to their core competences in order to stay competitive (Andersen, 1999; Aritua *et al*., 2009). Subcontracting is a common practice in the construction industry. McCord and Gunderson (2013) have indicated that on any particular project, general contractors may rely on a number of subcontractors to execute specific works such as construction works, electrical works , mechanical works , drywall, roofing, steel erection and so on. Main contractors in large construction projects have mostly resorted to decomposition of their work by collaborating with various subcontractors. Williams (2005), pointed out that although this working paragon offers many advantages, it also poses new challenges for main contractors in managing their projects successfully. Arguably, the most important of these challenges has become the main contractor’s dependency upon their

subcontractors (Williams, 2005). When a construction firm wins a contract, it is common to subdivide the project and sub-let some portions (Wang and Yung, 2001).

As stated by the Associated General Contractors of America (AGCA), subcontractors are the independent contractors who perform the works, normally for a portion of the works described in the contract document. Subcontractor is defined as one who enters into a subcontract; individual or company that is hired to perform part of the work of general contractor.

Hinze and Tracy (1994) have also defined subcontractors as specialist contractors whose duties on a construction projects, are to embark on specific tasks (cited in Enshassi *et al*., 2008). Fah (2006) defined subcontractor as one who enters into a subcontract; individual or company that is hired to perform part of the work under main contractor and have no relationship with client directly. In addition, he stated that the main contractors transfer risks to subcontractors when they sublet the works to them.

Construction projects are normally awarded to general contractors or prime contractors, who intend sublet their works out to specialize outside firm to perform specific project activities. Main contractors usually undertaken to manage aspects of the project such as contract administration, cash flow management, material and equipment procuring, and monitoring the project progress (Benjaoran, 2009). As stated earlier, studies have established that the general contractor's performance with respect to time, quality and cost is strongly influenced by the performance of subcontractors (Mbachu, 2008; Albino and Garavelli, 1998).

Studies have shown that well-performed sub-contractor can achieve jobs within planed duration with anticipated budget and prescribed quality. In the contrary, a poor-performed sub-contractor results a defective work and therefore consumes additional costs and completion time (Kale and Arditi, 2001; Schaufelberger, 2003; Shaikh, 1999).

2.2.1 DEFINITION OF SUBCONTRACTOR AND SUBCONTRACTING

According to Samuel (2009), subcontractors enter into an agreement with principal contractor to undertake some specific parts of the main contractors' work. To reiterate earlier observation, Hinze and Tracy (1994), have also stated that the subcontractors are specialty contractors appointed to carry out specific tasks on a project (as cited in Enshassi and Shoman, 2008). Furthermore, Fah (2006) defined subcontractor as one who enters into a subcontract; individual or company that is hired to perform part of the work under main contractor but who have no direct contractual relationship with client.

Elazouni and Metwally (2000) have described Subcontracting as the act of general contractors hiring specialty contractors (subcontractors) to help them overcome problems on the jobsite such as the need for special expertise, shortage in resources of the general contractor, and limitation in finances. In another vain, Chiang (2009) have described subcontracting is usually a contractual arrangement in which a main contractor sublets parts of the job to another contractor who may intend sublet it to third party firm. Mbachua (2008) has indicated that Subcontracting is a normal practice on housing and building construction projects than it is the case on engineering and industrial projects.

2.2.2 CATEGORIES OF SUBCONTRACTORS

Subcontractors have been grouped into three different categorizations (Mbachu, 2008). The first category comprises trade subcontractors. They are specialized on specific trades such as paintwork, brickwork, etc. The second category includes specialist subcontractors, which provide specialist services such as electrical, plumbing, insulation etc. The third category is known as labor-only-subcontractors that perform labor-only services (example, skilled artisans). Ng *et al*., (2008) have categorized subcontractors into equipment-based subcontractors (who are specialized plant and equipment dealers),

and labor-based subcontractors (those who are engaged because of result of their specialized labor resources).

Costantino *et al*., (2001) indicated that the benefit to the main contractor for employing only labour-intensive subcontractor lies in the fact that it reduces the cost of mobilization and material purchase. Besides, by avoiding the markup of full subcontracting, the general contractor obtains an economic advantage. However, because of the possibility of quality problems and claims in obtaining the supply of material when labour-only subcontractor is used, some general contractors are in favor of full subcontracting to shift risk and liability.

According to Enshassi and Medoukh (2007), there are two types of subcontracting as specialist subcontracting and volume subcontracting. They have explained that specialist subcontractor is used when the main contractor is not able to execute the work himself. This may be because he/she is not a specialist in the work at hand and so he obtains goods or services, and makes a contract with subcontractor. Volume subcontracting is used when an enterprise appoints a subcontractor because, while technically able to carry out the work, it is overloaded and has to obtain additional capacity from another source or contractors.

According to the contractual perspective, Yik *et al*., (2006) have classified subcontractors as domestic subcontractors and nominated subcontractors. Similarly, Masrom and Asrul (2007) opined that Subcontractors might be nominated, named and domestic subcontractor depending on the contractual arrangement made in a construction project. Whatever the circumstance, the client and his advisors appoint a nominated subcontractor whereas the main contractor does the appointment of a domestic subcontractor. The client appoints Named Subcontractor but the main contractor has oversight responsibility over the named contractor's work and payments. Nominated

subcontractors are described as named subcontractors who go into a contractual arrangement with the principal contractor to execute part of the main contractor's work, supply or fix any materials or goods (Yik *et al*., 2006; Samuel, 2009). Associated General Contractors of America (AGCA) have described domestic subcontractor as the independent contractors who execute the works, normally for a portion of the works described in the contract document. The general categorisation of subcontractors is illustrated in Figure 2.1.

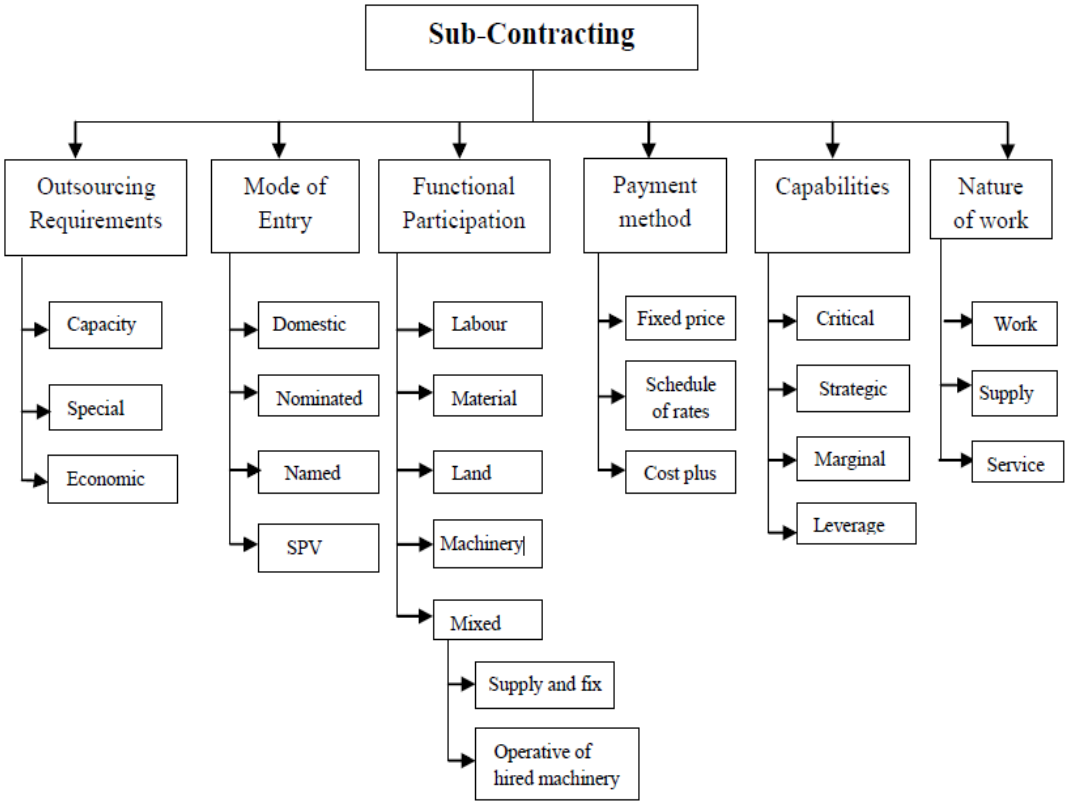


Figure 2. 1: Subcontracting categories

(Yin et al., 2009)

2.2.3 MOTIVATION FOR SUBCONTRACTING IN CONSTRUCTION PROJECTS

Ng et al. (2008a) has noted that the construction organisations rarely execute the work in its entirety without the use of subcontractors at a point in a project. Subcontracting is

used in construction projects primarily for performing specific, pre-determined types of construction works. Traditionally such firms act as trade sub-contractors to a general contractor (Bennett and Ferry, 1990 cited in Enshassi *et al*., 2008). The advantage of subcontracting is that the company performing a task is specialised in that particular type of construction task. There is a further advantage of the subcontractor's competence and legal readiness to perform the relevant work section and to take responsibility for the related warranties. In subcontracting, the main contractor usually does supervision and management of the subcontractor and the main contractor is essentially the party ordering the performance of tasks from that subcontractor (Costantino and Pietroforte, 2001; 2002). Hughes *et al*., 2001 have indicated that multiple layers of subcontracting add enormously to the overall construction budget but the use of subcontractors varies appreciably.

Subcontractors can also save time and money by subletting some aspects of their work, and they often have a series of sub-subcontractors (Arditi and Chotibhongs 2005).

2.3 CHALLENGES INHERENT IN SUBCONTRACTOR MANAGEMENT

According to Maturana (2007), a very momentous way in which the subcontractor management procedure has influenced the construction industry is that it has encouraged specialization and helped in transferring risk from the general contractor to the subcontractor. Maturana (2007) further stated that, subcontractor management has achieved remarkable results when it performed correctly but may also hinder project progress if performed inaccurately.

Poorly implemented subcontractor management responsibility can be attributable to lack of effective planning and coordination. Lack of requisite direction from construction management to subcontractors denies them the prospect to work to the best of their

utmost capability. A project requires that subcontractors and subcontractors work together in an interactive manner; however because of the rather short-term nature of interaction period between them, there is little prospect to develop long-term relationships and trust (Vilasini, 2012).

One of the major challenges that exist when managing subcontractors is that, in most cases, the drive for each party has been to obtain profitability regardless of the adverse effects on other parties, instead of focusing on the overall project goals (Thomas 2005). Management must therefore make a consented effort, throughout a project's life to achieve unification of purpose of all parties involved in the construction process to head for a single undivided goal.

Usdiken (1988) argues that increased sub-contracting may reduce the main contractor's control over the construction process and could lead to cost and time overruns. Non-completion of construction projects have also been attributed to subcontractor delays (Alarcón *et al.*, 2005). Ohnuma, et al., (2000) suggests that the subcontractors' main focus is on work completion with the least attention to material wastages and work quality. This could be because sub-contracted services are paid on the basis of physical production at a fixed price.

In Malaysia, factors contributing to time delays of construction projects have been traced to problems of subcontractor management (Abdul-Rahman *et al*., 2006; Sambasivan and Soon, 2007). According to Sambasivan and Soon (2007), in most mega projects in Malaysia, it is common to find many subcontractors working under the general contractors. Nevertheless, top five causal reasons for project delay have been attributed to subcontractors. Lack of subcontractor skills have been established by Alaghbari *et al*. (2007) in another study, as one of the factors hindering the completion of projects within the stipulated time in construction projects in Malaysia.

Apart from delays, coordinating the activities of subcontractors has been cited as one of the major challenges affect the construction labour productivity (Kadir *et al*., 2005). Notwithstanding disruption to work progress, subcontractors have been recognized as partner of general contractor and material suppliers in construction project are also publicized.

2.3.1 MAIN CONTRACTOR-SUBCONTRACTOR INTERFACE CHALLENGES

Several studies have been carried out on the interface problems. For example, Al-Hammad and Assaf (1992) and Al-Mansouri, (1988), have studied interface problem between designers and contractors. Again, Al-Hammad and Assaf and Hinze and Andres, (1994) focused on interface between contractors and sub-contractors; while Al-Hammad and Al-Hammad, (1996) also studied the interface problem between clients and designers. The uniqueness of each construction project and the large number of project participants such as clients, consultants, main contractors, and subcontractors presents some interface problems. These problems can arise because of different specialties and multiple interrelated workflows as asserted by Irlayici and Tas, (2012). To emphasize this point, Moore *et al*., (1992) noted that because of the involvement of multiple parties in a particular construction project, some interface challenges is inevitable, e.g. lack of cooperation, antagonistic relationship among project stakeholders resulting from lack of efficient communication. Ku (2000) identified five dimensions in analyzing interface management i.e. contract interface; technology interface; monitor interface; execution integration interface and the interacting behaviour in the interface.

Huang *et al*., (2008) has indicated that the most practical and comprehensive to understand interface management in construction projects is the execution integration interface. The main interface problems have been identified and listed as:

a) Site coordination challenges

Subcontractors have blamed their inability to perform site works efficiently and effectively on poor site organization by main contractor. To counter the earlier assertion subcontractors have also accused main contractors of poor site coordination leading to under-utilization of subcontractors (Andy and Andrew, 2010). Studies have shown that such problems can be traced to issues such as project information, working programme, preparation for work place, interface between trades, access to site and plant and material support (Othman, 2002).

b) Contractor's financial challenges

It has been observed that inefficient management, lack of accurate estimates and delayed payments by the client can plunge the main contractor into serious financial problems. Consequently, this may lead to delayed payment from the main contractor to his subcontractor (Al Hammad, 1992).

Othman (2002) has noted that one of the most crucial ingredients in fostering closer relationship between a contractor and his subcontractor in the long-term is timely payment to the latter. Each party is always overly suspicious in all business dealings with the other party due to lack of trust. The relationship between the two could be seriously mired if the main contractor is perceived a poor paymaster (Othman, 2002).

c) Non-adherence to the construction schedule

As part of the contractual agreement signed between the client and the main contractor, the project duration is spelt out and inserted in the contract. The main contractor will schedule his construction activities and that of his subcontractor(s) to meet the identified project duration. If any party delays the execution of his scheduled construction activities, it will have rippling effect on the way forward for the succeeding activities of the subsequent trades (Al Hammad, 1992). According to Sambasivan and Soon (2007), high degree of subcontracting leads to high risk of delays and consequently, inefficiency in the construction industry.

During the construction process, it is common for the main contractor to blame his inability to fulfill the agreed project deadlines on subcontractors or contrariwise. Accordingly, misunderstanding may ensue between the general contractor and subcontractor(s) (Al-Hammad, 1992). Joseph and Proctor (1996) opined that time overruns occur partly due the failure of the contractors to thoroughly appreciate a subcontractor's work sequence. Hence, failure on the part of the main contractor to factor the subcontractor’s work sequences in determining the project schedule.

In another vain, where there are multiple subcontractors involved, conflicts may arise when a subcontractor fail to appreciate the requirements of variant subcontractors whose work may interfere with his or her operations (Joseph and Proctor, 1996).

d) Lack of proper communication

It has been established that the success of construction project in relation to timely completion is significantly affected be the effectiveness of communication between the contractor and his subcontractors. Inappropriate means of sharing and disseminating information among project the parties may seriously impede the headway for work (Al-Hammad, 1992).

Some of the information communicated in construction projects cover issues such as project timelines, objectives and constraints. Lack of explicit and timely communication of relevant information on instructions and requirements from the clients to subcontractors affects their ability to performance to schedule. Making change orders very late in the project and lack of sufficient time for planning prior to project take-off accumulations undue burden on the subcontractor and subsequently culminates into sub-standard outcome, or even unacceptable specifications. According to Huang *et al*. (2008), problems in communication might bring about serious inefficiencies such as improper planning and scheduling and absence of an appropriate information update system.

When contractors poorly communicate information to their subcontractors, it is a recipe for wrongful pricing. Othman (2002), raised concern that main contractors usually mount pressure on the subcontractor to reduce prices and yet essential information that would have aided in the subcontractor's decision-making is held back; making it difficult for proper pricing and working.

e) Lack of Safety

According to Enshassi *et al*. (2008), the rate of accident occurrence involving subcontractors' employees on multiplex construction projects is very high, principally when multiple subcontractors are engaged in one project. On the word of Al-Hammad (1992), non-adherence to health and safety regulations and standards by the contractor or his subcontractor have resulted in injury and even death to workers on construction sites.

f) Insufficient work-drawings or scanty specifications

According to Al-Hammad (1992), the ability to execute the construction works effectively, is contingent on the clarity of working drawings and specifications provided. Working with half-finished or vague drawings will create interpretation difficulties, which could result in wrong judgment that influences negatively on the quality of the project and results in disputes between contractors and subcontractors. On their part, Alinaitwe *et al*. (2007) established that interface challenges between main contractor and subcontractor due to incomplete drawing leads to low productivity.

g) Amendments

It is common for the client to request for an amendment when it becomes necessary to alter the original designs and the specifications. The component cost for executing a specific work section when amendment are made, may be the cause contractor-subcontractor disagreements (Al-Hammad, 1992). To endorse earlier observations, Enshassi *et al*., (2007) pointed out that design modifications and specifications in the course of construction leads to low productivity. The main contractor-subcontractor interface challenges arise out of low productivity.

h) Delay in shop drawings and sample material approval

In construction contracts, the subcontractor is usually required to turn in shop drawings or sample materials for the contractor's endorsement. Delays in the approval of the submitted materials or drawings are because of inefficiency of the contractor. Disagreement may ensue between the contractor and the subcontractor as to who is the cause those delays in the execution of the work (Al-Hammad, 1993). To affirm this,

Huang *et al*., (2008) noted contractor-subcontractor interface problems may arise due to delays in approval because of vague drawing.

i) Materials shortage

Continuous supply of materials to the production process is key sustaining the continuity of the construction work. Any shortage of material is detrimental to progress of the work by either the contractor or his subcontractor, thus conflict may arise between the two parties (Al-Hammad, 1993). Along with the observation by Enshassi *et al.* (2007) and Alinaitwe *et al*., (2007), shortage of material gives rise to main contractor-subcontractor problem interface owing to low productivity.

j) Legal disputes

According to Jannadia *et al*., (2000), disputes are a reality in every construction project and occur due to so many reasons. These legal disputes may arise between project participants, example; between clients and contractors, between the main contractors and subcontractors and even among the subcontractors. These types of disagreements may affect the relationships and negatively impact on performance of the contractor or his subcontractor and thus the overall outcome of the project (Al-Hammad, 1993).

2.3.2 PERCEIVED SUBCONTRACTORS BULLYING

According to Mohamed and Terek (2014), the main contractor and the subcontractor have not always had good rapport between them. To emphasize this point, Proctor (1996) noted that frequent occurrence of disputes on projects have made relationships between contractors and subcontractors increasingly strained due to lack of fairness and misapprehension of one another's opinion. Upon a study by Nur *et al*., (2015), the

potential issues that have been considered to be categorized as subcontractor bullying are:

1. Payment

Sozen and Kucuk (1999) have noted that the main contractor usually suppresses and uses unacceptable tactics to delay payment due the subcontractor for work well executed, until the subcontractor appears due to the lack of funds.

There is usually delayed payment of work done by subcontractor and this leaves the subcontractor with insufficient money to carry on work. According to Fah (2006), usually main contractors employ this strategy to improve their cash flow when payments from the clients are not forthcoming and incomplete. However, some unscrupulous main contractors may exploit smaller subcontractor by delaying payment to them and making unreasonable deductions without regard earlier agreements (Fah, 2006). According to Arditi and Chotibhongs (2005), it is common for small subcontractors to lament about the depressing practices of main contractor and how it possess as a threat to their survival.

2. Troublesome clause in contract

According to Uher and Brand (2008), troublesome clause in subcontracting contract come in the form of payment clause, no damage for delay clauses, flow through clauses, indemnity clauses, additional insured, termination clauses and partial lien waive clauses. These clauses are usually employed by main contractors to strategically relief themselves of any obligation to the subcontractors. What happens in practice is that, with just a mere "letter of intent", subcontractor will often directly proceed to commence work prior to signing the actual contract with the main contractor (Uher, and Brand, 2008).

3. Total imbalance of power

It has been alleged that main contractors have abused their dominant position in the contractual chain to withhold monies due to the sub-contractors by way of spurious abatements, set-offs and counter-claims, with the sole purpose of increasing their own profit margins(*c.f.* Uher, and Brand, 2008). This is largely been attributed to biased clauses in the construction contract. For example, clauses in subcontracts that empower the main contractor to pay the subcontractor only when paid by the client, leaves the subcontractors to adhere strictly to the clauses stipulated in the contract or risk losing next available job.

4. Getting blame for unfortunate events

According to Hurley (2012), the main contractors blame subcontractors in the event of any unfortunate event on site. Thomas (2014) explains further that, this is likely due to the notion that, subcontractors are responsible to maintaining the safety of their construction sites. However, it must be noted that both the main contractor and the subcontractor are jointly accountable. The main contractor is normally the head of the project on site, consequently putting them at the premier authority in maintaining the safety entire construction sites for their works. It has been proposed that main contractor should help nurture subcontractor on a positive self-consideration as regards the imperatives for a safe construction site (Sutherland and Davidson, 1993)

5. Excessive workloads

It is common practice in the construction industry to subject workers to working extra-long hours (Gunning and Cooke, 1996). According to Egan (1998), disproportionate workload leads to pressure and nervousness due to the rigorous working within the time

constraints. Furthermore, Gunning and Cooke noted that construction employees suffer undue stress when they are exposure to unrealistic demands from clients, working with impracticable deadlines, juggling between multiple projects and conflicts within the organization. Alinaitwe *et al*., (2007) noted for instance that, on both private and public sectors projects in the United Kingdom (UK), the client is always exerting excessive pressure on construction teams to deliver projects on time, to quality the stipulated and at the lowest cost.

6. Ambiguities:

The problem in construction project is aggravated by the presence of ambiguities such as unclear scoping and under-defined task objectives. Most construction projects are interrupted due to incomplete specification of the drawing (Huang *et al*., 2008). Problem between the subcontractor and the contractor may be triggered due to unclear drawings provided by the main contractor (Al-Hammad, 1992). The subcontractors may also develop bitter feeling towards the main contractors under this circumstance (Bagilhole *et al*., 2000).

7. Hostile environment:

According to Alterman *et al*., (2008), the prevalence of workplace bullying is high due to its hostile environment. Bagilhole *et al*., (2000) have also noted that the construction industry is also tagged with a macho culture characterized by arguments, conflict, and crisis. (Alterman *et al*., 2008) have reported that workers or employees in this kind of environment are deemed to receive an unpleasant name-calling, constant yelling, threatening or verbal abuse

2.4 FACTORS AFFECTING THE COST AND TIME PERFORMANCE OF SUBCONTRACTORS

Huang and Lu (2011) stated that the services of professional subcontractors are required for every construction project. They have further noted that the quality and performance of the construction projects depended on the performance of the subcontractor workers, and they found in their paper that there several demographic variables affected the level of job performance such as age, education, number of children, payment, marital status, work experience, and work type. Tam et al. (2011) noted that the use of subcontracting system is widely known to provide many advantages to the construction industry in many areas such as better efficiency of subcontractors' work because of their exclusive expertise.

According to Ng and Tang (2010) subcontractors are a vital component of the success of every construction project. The factors affecting the performance of subcontractors are classified, as those related to the project or an organization and on another hand, there are important factors affecting the performance of the subcontractors. These factors include management level leadership, timely completion of project, profit, staff qualification/skill, reputation, payment method, company history, and project procurement method, safety, bidding method, insurance, bond and relationship with main contractors.

Ng *et al*. (2009) noted that subcontractors are considered more capable of maintaining a high quality performance or improving inadequate performance and gain a greater chance of success when they have a good reputation and sound company history. According to Eom *et al*., (2008) subcontractor evaluation and management processes must include factors that will enhance cooperative relationships, especially, developing

cooperative relationships, sharing mutual objectives, improving communication and participating in collaborative work.

Ng *et al*., (2008), have also discussed other factors effecting the management of the subcontractors in construction projects. Such factors include performance of relevant previous projects, quality of workmanship, compliance with regulations, prompt payment to labourers, adherence to programme, regularity and effectiveness of communication with main contractor, adherence to subcontract requirements. Other factors comprise adherence to statutory environmental regulations, number of experienced site supervisory staff, inspection and maintenance of good work environment, number of artisans and laborers, quality of as-built and shop-drawings and capacity to carry out the size of work and so on. The following factors that have been seen as affecting the management, operation and performance of subcontractors in the construction projects will further be discussed.

2.4.1 TECHNICAL AND MANAGERIAL SKILLS

Failure of construction project have been attributed to improper managerial principles at all project members, such as improper focus of the management system, by rewarding the wrong actions and the lack of communication of goals (Hughes (1986, *c.f* Pheng and Chuan, 2006). According to Ng and Tang (2010), one of the most significant success factors that enable the subcontractors to perform their tasks successfully and to achieve the project and organizational goals is managerial and technical skills and the most valued resources of the organization or the construction company is the subcontractor's skills.

Another study by Ng *et al*., (2003) postulated that planning resource efficiently could improve the project delivery time by as much as 45% and lead to about 7% project cost

savings. Poor managerial skills can defeat the organization's objective to achieve a successful project and in many cases can lead to the tarnished image of an organization. Subcontractors must therefore possess the requisite skills to efficiently manage and plan for projects in the most economical manner.

According to Mahamid (2011), poor site management could result from a number of factors including poor management of labour, poor communications between labourers and managers, poor communications between construction parties, poor material management, lack of site manager experience and lack of labour experience.

2.4.2 FINANCIAL CAPABILITIES OF THE MAIN CONTRACTOR AND SUBCONTRACTORS

According to Sears *et al*. (2008), general contractors are found of delaying payment to their subcontractors for completed work. General contractor may have the contractual right to withhold payments for many reasons but this could be a major source of disputes between the subcontractor and general contractor.

Ng *et al*. (2008) have noted that to ensure the survival of subcontractors, they must have a good financial background to demonstrate that they have are in the position to complete the work. Ng and Tang (2010) have also noted that in order to expand their businesses and achieve a growth in revenue, subcontractors must maintain appositive cash flow and a good record of accomplishment of settling liabilities.

As mentioned earlier, Arditi and Chotibhongs (2005) explained that the major cause of disagreements and disputes between main contractor and subcontractors is delayed payments from the main contractors to subcontractors.

To emphasize the earlier point, Ng *et al*., (2008), postulated that the prompt payment to labourers is among the most critical factors affecting construction project success. On the

other hand, delayed and irregular payment of wages adversely affects the morale of the workers. Consequently, this will lead to slow progress of work, poor quality and undesirable delays to the project. Main contractors and subcontractors must therefore take payment issues seriously, and main contractors should enhance relationship with subcontractors and labourers to ensure the success of the project and to achieve good performance.

2.4.3 SUBCONTRACTORS QUALIFICATION AND EXPERIENCE

Ameh and Osegbo (2011) have recommended that project managers should ensure that both nominated and domestic sub-contractors on any project have the necessary experience and plan of work to meet the requirements of the project. Ameh and Osegbo explain further that pre-qualification of the subcontractors would ensure that they have sufficient experience, proficiency and capacity to deliver not only quality work but on time.

Accroding to Kang (2011), the performance and excellence of the subcontractor's project team affect the project outcome with respect to quality and timely delivery, thus a key determinant of a project's economic performance. Ng *et al*. (2003) noted that when incapable or inexperienced subcontractors are employed, the quality of final construction product could be sacrificed.

In another study, Zhengquan (2005) revealed that some contractors have have exposed projects to hidden dangers of irregular contract performance by subletting certain works to undeserving subcontractors in order to preserve special relationships and lower project cost. Due to the awareness of the problems caused by incapable subcontractors in construction projects, the selection of the capable subcontractors to execute the subcontracted tasks successfully and satisfactorily, has become increasing difficult (Ng

et al., 2008). Therefore, main contractors would collaborate with the consultant to invite the subcontractors who have previous relationship or subcontractors who have satisfactorily completed works of similar nature, size and complexity. So the previous experience and performance of relevant projects by subcontractor's is of paramount importance by the contractors and consultant in determining whom to invite to submit a quotation for a subcontract. Arslan *et al*. (2008) advised that the criteria for selecting subcontractors should look beyond bid price. In order to reduce risks and contribute significantly to the overall success of the project, main contractors should consider other factors such as previous experience, financial stability and quality of products. This can eliminate the problem of insufficient finance; inexperienced and incompetent subcontractors

Ng and Tang (2010) have concluded that the skill level of the workers of the subcontractors' construction team has a direct relationship with the quality of completed works achieved in a construction project. According to Mahamid (2013), normally, experience improves both the intellectual and physical capabilities of a labourer and hence improves productivity of the work.

2.4.4 BID SHOPPING

According to Arditi and Chotibhongs (2005), bid shopping is a way of life in the construction industry and explained that the practice of bid shopping by main contractors is considered a serious breach of trust from the subcontractor's perspective. Ng *et al*. (2008) revealed that bid shopping is a common practice in construction subcontracting; some subcontractors may be under pressure to submit unrealistically low subcontract bids and finish their work in a sloppily manner.

Knutson *et al*., (2003) explained that very few general contractors have the capacity or expertise to solely undertake all aspects of a construction project so they usually solicit bids from subcontractors when preparing a bid. Main contractor may go easy on bid shopping or bid chiseling in s settling on which subcontractor to hire for a particular construction project. These practices have seen to be contributory factor leading to poor workmanship and sometimes even the nonperformance of the subcontractor. This is has been identified as one of the key factors affecting subcontractors' performance in the construction projects.

2.4.5 PROJECT MANAGER RELATIONSHIP AND EXPERIENCE

The Project manager is the most important person in the project management of every project and is key to the project success or otherwise (Pheng and Chuan, 2006). To emphasize this point, Avots (1969) as cited by Pheng and Chuan, (2006) enumerated the main reasons for project failure such as the appointment of inexperienced project managers, sudden project termination and lack of top management support. Pheng and Chuan 2006) postulated that the success of a project pivots on the project managers' performance about the achievement of time, cost and quality targets and in another hand they stat that successful project completion can depend to a large extent upon members being able to work together effectively as a project team.

According to Ng and Tang (2010), a good relationship between the project manager and all project participants can also help improve the morale of subcontractors' team. In normally, if workers are willing to work closely together to complete the works in the best possible way, their performance can be enhanced.

Prabhakar (2008) figured out that, the competence of the project manager is in itself a factor in successful delivery of projects and on the other hand, the project manager needs to have competence in those areas that have the most impact on successful outcomes.

2.4.6 EFFECTIVENESS OF COMMUNICATION

Proper communication among all project participants has been cited as vital and crucial to the timely project completion (Mirawati *et al*., 2015; Tam *et al*. (2011). To reiterate this, Tam *et al*., (2011) noted that successful executing of a construction project is subject to effective communication among project participants. They further revealed that the main challenges in communication and coordination during construction include growing errors in communication due to multiple subcontractors, difficulty in pertinent information flow among multi-layer subcontractors, poor communication channel between main contractor and subcontractor; and absence of main contractor's medication on disagreements amid subcontractors.

Again, miscommunication and conflicts between the main contractors, subcontractors, clients and other project participants could negatively affect the overall success of the project (Dossick and Schunk, 2007). In as much as the coordination with the project participants is one of the responsibilities of the main contractor, subcontractors should also improve the relationship with other participants by keeping the them informed of their construction method/sequence and programme to avert or resolve any potential problems in a cooperative manner.

According to Zou and Seo (2006), the inaccurate and untimely communication between project's parties lead to costly progress delays in construction projects. Proper communication and timely information sharing between project participants reduce

errors and time delays and lead to enhanced project efficiency and ultimately improving collaboration and teamwork.

2.4.7 MARKET POSITION

According to Ng *et al*. (2009), market condition is related to the analysis of the market place in which an organization operates or has interest in developing its position. Good market condition gives adequate job opportunities to even fragile subcontractors and can help nurture some potential subcontractors. Skeptically, a poor market would quash some subcontractors with relatively poor performance or poor financial status through intense competition.

2.4.8 CONSTRUCTION PRODUCTIVITY

There exists a general consensus among researchers to define productivity as the ratio of output to input. Ameh and Osegbo (2011) have defined productivity as a ratio of an output value and an input value used to produce the product or service. In construction, productivity is usually defined as output per labor hour, or it is the amount of output produced relative to the amount of resources allocated for a project. According to Enshassi *et al*. (2010), productivity is an important issue in the construction sector and it means cost savings and efficient usage of resources. Mahamid (2013) reiterates that labor productivity plays a vital role in determining the financial success of construction projects, which reflects the high importance of labours in the construction industry. Subsequently, any improvement in labour productivity will contribute a great deal to the project success.

In their research on factors influencing productivity in the construction industry in the Gaza strip, Enshassi *et al*. (2010) concluded that the main factors that are injurious to

labour productivity include scarcity of labour surveillance, lack of labour experience, revision of drawings and specifications during execution, material shortage, lack of labour experience, misapprehension between labour and supervisors. Ameh and Osegbo (2011) also enumerated a number of factors affecting productivity on construction site such as availability of construction materials, poor supervision, inadequate construction materials, inaccurate drawings / specification, lack of skills from the workers, tools/equipment breakdown, delay, weather condition and wages.

Chan *et al*. (2002) noted that productivity consideration at the construction stage of a project enables the contractors to put together the available resources efficiently in order to meet the cost and time targets of the construction projects.

Arditi and Chotibhongs (2005) revealed that a major way to improve site productivity would be to engage subcontractors who are abreast with modern production and construction methods. According to Ng *et al*. (2008), from the perspective of subcontractors, adequate supervision could enhance labour productivity and would ensure that the requirements in the subcontract are duly fulfilled.

2.4.9 COLLABORATION

According to Abdull Rahman *et al*., (2014), collaboration play an important role in the success of the construction projects and the project participants are becoming conscious that knowledge and information sharing is one of the driving factors of a successful contractual relationship. In a study on the importance of collaboration in the construction industry from contractors' perspectives Abdull Rahman identified six important factors that lead to willingness to collaborate among contractors such as; collaboration will encourage teamwork, similar racial collaboration develops cooperation, stimulate

information sharing, improve quality and project complete on time, enhance service quality, and better communication among project members.

Sharing up-to-date information among project participants in the construction industry reduces errors and time delays, thereby facilitating project efficiency and ultimately improving collaboration and teamwork. Increasing collaborative work enhances mutual relationships, also contributing to enhanced levels of cooperation and productivity (Eom *et al*., 2008; Zou and Seo, 2006). Errasti *et al*. (2007) have also noted that collaboration between all project participants have many advantages such as cost and quality savings on the project and project execution could be more efficient if the manufacturability of the project and ease of assembly were taken into account.

2.5 MANAGEMENT OF COST AND TIME CONSTRAINTS IN SUBCONTRACTS

A constraint is defined as a limitation. In every construction projects, cost as well as time is regarded among the limitations that are critically challenging in the production process. In relation to Sambasivan and Soon (2007), time and cost overruns are clearly inter-related, causing disputes, litigation and even complete abandonment of projects. To emphasize this, Al-kharachi and Skitmore (2009) stated that cost issues are significant during production processes in delivery of project at specified time and at quality expected by the client. The project manager is responsible for disseminating the constraint information to project participants, thereby ensuring that everyone involved in production process is in the known as regarding the significance of the project constraints and potential consequences of adjustment to time and cost. According to Roger (2012), in every construction project, completion within the time frame and at budgeted cost specified is one of the most significant factors of which everyone involved

must be cognizant. Thus, slow progress of work causes anxiety among project participants.

Ashar *et al.* (2008) have argued that a project is successful when it is completed at an estimated budgeted cost within the period. Desai and Desale (2013) asserted that a project is successful when it is completed at budgeted cost within a reasonable frame time. Memon *et al.* (2010) emphasize that cost is a driving force for success in building development processes as well as being very important throughout the construction management life cycle. However, budget increase could result in unexpected time schedule delay (Ashar *et al.*, 2008). In Nigeria for instance, Ganiyu and Zubairu (2010) noted that cost has been the major problem confronting the construction industry in delivery of projects at budgeted cost specified. Ganiyu and Zubairu (2010), further recommended the development of analytical cost models that capture the factors affecting cost during building production processes.

According to Fugar and Baah (2010), in a construction project in Ghana, financial group factors ranked highest in among all the factors that caused delay. Desai and Desale (2013), who have argued that delay is a constant problem in private residential projects, support this assertion.

Ganiyu (2010), noted that most building clients are quite aware of economic constraints which have made it obligatory that any available budget should be spent wisely to achieve best economic advantage. Consequently, specified budgeted cost is a constraint to construction, which clearly hinder the production process. Many researchers have liked the causes of delay in building production processes globally to cost issues. For example, Fugar and Baah (2010) argued that cost problems render it difficult for contractors to procure materials for building construction processes in Ghana, explaining

that the material delay factor was ranked the second most important factor that causes construction delay.

According to Nega (2008), one of the major problems, causing a nightmare for construction stakeholders is the inability of a construction firm to complete project at budgeted cost within time frame at quality expected. Building production process completed does not necessarily mean that the client is satisfied with the project delivered. Client's satisfaction depends not just on completion, but also on completion *within* the budgeted cost specified and meeting up with the requirements specified (Nega, 2008). According to Fatoye (2012), the target of any construction firm is to complete project within the anticipated budgeted cost and quality. However, when the construction cost does not match up with the budgeted cost during production process, disputes and further delays arise.

Consequently, Sunday (2010) argues that client and consultant should ensure that all the necessary needs and funding techniques are readily available during the production process.

2.6 COST AND TIME RELATED FACTORS MOST AFFECTED BY SUBCONTRACTOR MANAGEMENT

When a contractor performs falls short of expectation, the outcome is usually defective work that will require additional cost and time to remedy (Schaufelberger, 2003; Kale and Arditi, 2001; Shaikh, 1999). Again, Tam *et al*.(2011) explained the use of subcontracting in an inappropriate manner in the construction projects can lead to increased construction cost because of many reasons such as:

a. additional overheads for managerial staff
b. recurring abortive and corrective work leading to increased construction costs

c. charging additional fees without adding value and

d. increasing construction cost due to more claims and disputes.

Tam *et al*. (2011) further identified five key factors that cause ineffectiveness of the use of sub-contractor in the control of the project time. Those factors include:

a. setting impractical time for the subcontract work,

b. lack of subcontractors' efficiency,

c. subcontractor's delay in responding to instruction because of bureaucracies in communication and

d. delay in solving disputes involving several subcontractors.

O'Brien (1998), has also noted that subcontractor and supplier production amounts to the largest chunk of project cost, so the poor management system of them can increase the total project cost.

Morris *et al*. (2011) explained that because the costs of subcontractor represent a significant portion of the project cost, main contractors would normally do all they can to avoid terminating a subcontractor's contract and try to minimize cost. This is achieved through renegotiating the contract, reducing the scope of the subcontractor's work, providing supplemental staffing, assisting with payroll and directly procuring equipment or materials. Arditi and Chotibhongs (2005) previously mentioned that the use of qualified subcontractors in the available resources or in general the subcontracting system application has proved to be efficient and economical in addition to performing the works more quickly and at lesser cost. Some of the advantages obtained when using the subcontracting as outlined by researchers are:

1. **Flexibility Improvement**: As reported by Inrie apud Brandli (1998), the use of labor subcontracting enhances the flexibility in performing workers' duties, of volume (i.e. number of workers) and leads to reduced fixed costs.

2. **Productivity Increases**: Because generally, the subcontractor is specialized in performing certain works, they turn out a higher output as compared with the company's own labour force. This may be attributable to the effects of replication, the use of work organization methods and learning and concentration (Villacreses, 1994).
3. **Product Quality Improvement**: The use of qualified workers leads to improved quality of end products. Conversely, Brandli (1998) argued that the use of subcontractors creates problems in control and coordination activities and that can give rise to products that are low quality. Brandli (1998) on his part holds the opinion that the subcontractor's performance does not in any way affect the quality of the products.
4. **Prevention of Labor and Equipment idling**: companies rarely have sufficient work to keep their workforce continually busy. This situation applies to the equipment as well; that would be under-utilised.
5. **Flexibility in controlling costs:** According to Eccles (1981), subcontracting on fixed price contracts enables adequate cost control.

2.7 THEORETICAL FOUNDATIONS OF THE RESEARCH

According to Stoner *et al*., (2003) theories are stance with which people make meaning of their world experiences. In the opinion of Yasin (2004), a theory consists of inter-reliant ideas and doctrines, which are methodically gathered for developing a background to a substantial area of knowledge. Theoretical framework has been defined as a configuration that can underpin or support a theory of a research. It outlines the theory that elucidates why the problem under study occurs and serves as a basis for conducting research (Acharyya, 2004). In order to better understand and establish an

appropriate theory (ies) underpinning the concept of subcontractor management, various theories were reviewed.

In the management of any construction project, there exist constraints relating to its scope, cost, and schedule; and the coordination of these constraints is the major challenge faced by construction managers Warburtan (2011). Koskela and Vrijhoef (2000) have argued that without improved theory, improvement in practice cannot be realised. According to Koskela and Howell (2002), theories enable better understanding of an observed behavior and forecasting future behavior. However, Koskela and Howell (2002) have argued that there is no clearly specified theory in construction management. Kim and Ballard (2010), have also argued that the construction industry has neglected management theories, and any attempt at incorporating changes late into a project is often ineffective and expensive (Sterman, 1992). To emphasize this point, Nepal *et al*., (2006) stated that the later the corrective action, the less the ability to influence a project's outcomes. This section therefore explains the theoretical support from the mainstream theories that are strong in their base and can be easily applied to subcontractor management.

There have been debates and comparisons in recent times of several management theories; igniting arguments as to which theory is better. Subcontractor management can be observed through several theories such as the Contingency theory, Management by Results (MBR) theory and Management by Means (MBM) theory. Kim and Ballard (2010), for example, have recommended the adoption of both management MBM and MBR theories to ensure improvements in management strategies that would ensure that projects are completed on schedule and within budget.

2.7.1 RESULT ORIENTED MANAGEMENT OR MANAGEMENT BY RESULTS (MBR) THEORY

The MBR theory is advocated by Drucker (1954). Literally and as the name suggests, the main management concept of MBR targets results or goals. In order to achieve these project goals, a definite ability for attainment of results, systematic supervision, self-assessment and progress reporting is vital. Many researchers have emphasized the need for extensive management of decent planning and control (Project Management Institute, 2008; Nicholas and Steyn, 2012; Davies, 2014). The MBR approach is not laborious and encourages managers to target their efforts towards setting goals for the organization as a whole (Antoni, 2005). In this theory, the focus of management is only on factors like profits and loss. According to Johnson (2000), the application of MBR is valuable for short-term goals where the stakes are low. In an attempt at predicting the likely performance of a project, the system tracks the status and progress of work. This generalized approach incorporates the principle of Earned Value Management (EVM) technique. The Earned Value Management (EVM) is a project control technique, which quantitatively measures the work performance on a particular date (Fleming 1983). Kim and Ballard (2010) postulates that effective use of EVM coupled with good planning, can lead to significant reduction in the occurrence of issues resulting from schedule and cost overruns. Consequently, efforts should be directed at carefully tracking the predicted schedule and cost to keep the project on schedule and within budget. Hinze (2008) has categorized EVM under three primary elements:

a) Basic element

1. BCWS: Budgeted Cost of Work Scheduled
2. BCWP: Budgeted Cost of Work Performed
3. BAC: Budgeted Cost At Completion

4. ACWP : Actual Cost of Work Performed

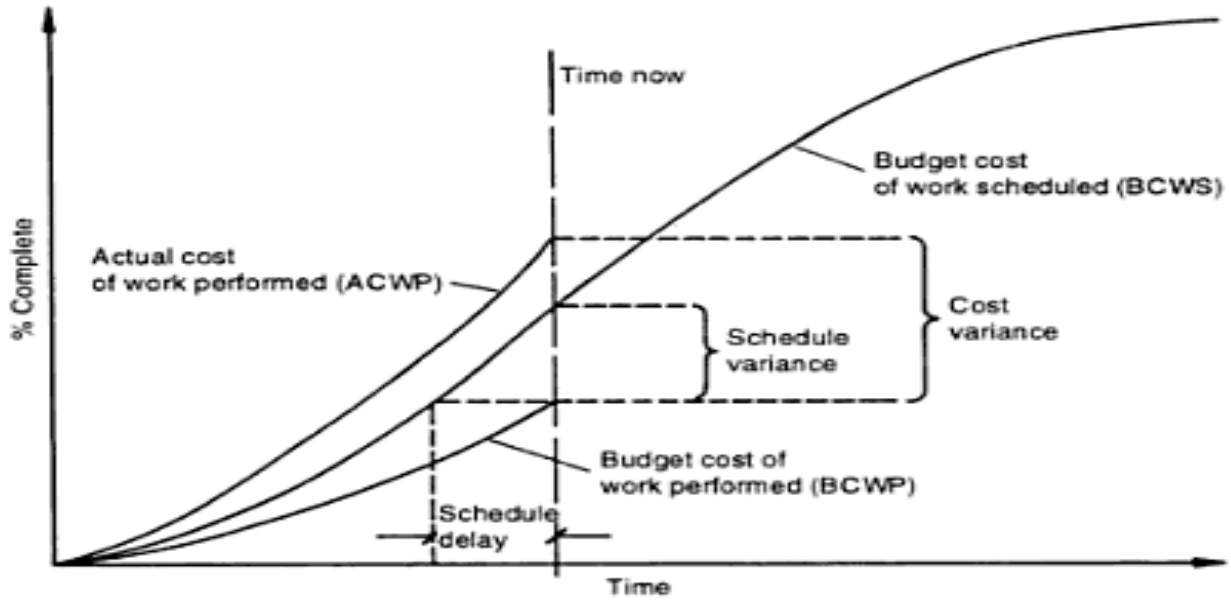
Once these basic elements are established, calculations for resultant variables are done. These are: a) Cost Variance and b) Schedule Variance.

Subsequently, calculations for Cost Performance Index (CPI) and Schedule Performance Index (SPI) are calculated by the following formulae.

The values of SPI and CPI points to whether the project is on schedule and within the budget or vice versa.

According to Kim and Ballard (2000), though Earned Value Management is a well-developed technique for integrating schedule and cost, it is still prone to a number of limitations. Some of these limitations are:

a) The assumption that productivity of an activity has no effect on the performance of another, even if they are mutually dependent.
b) The graphical representation of outcomes only depicts variance between the amount to be spent irrespective of the progress and the actual expense (Kim and Ballard 2000).
c) No provision is made for quality measurement and customer satisfaction; and so, an indication of a project which is under or on budget, ahead of schedule and fully executed scope, it does not necessarily reflect client satisfaction.
d) Although schedule variance (SV) does not show its statistical implications, it is actually a difference in schedule. Furthermore, the SV unit is in dollars terms (rather than weeks or months), making it difficult to determine units for the schedule (Cioffi, 2006).



Element	Item	Acronym
Work planned	Budgeted cost for work scheduled	BCWS
Work accomplished/ earned value	Budgeted cost for work performed	BCWP
Cost of work accomplished	Actual cost of work performed	ACWP
Work authorized	Budgeted cost at completion	BAC
Estimate of final cost	Estimated cost at completion	EAC
Cost variance	Cost variance (BCWP minus ACWP)	CV
Schedule variance	Schedule variance (BCWP minus BCWS)	SV
At-completion variance	At-completion variance (BAC minus EAC)	ACV

Figure 2. 2 Variance Analysis for EVM curve (Kim and Ballard 2000)

To conclude, the MBR theory is an appropriate method in developing a guideline for managing subcontractors when cost and time are of utmost concern. This is because it advocates for systematic supervision, self-assessment and progress reporting as very vital, in order to achieve these project goals. The focus on loss reduction ensures that

profit is maximized and hence the project cost and time is kept within the prescribed limits.

2.7.2 MEANS ORIENTED MANAGEMENT/ MANAGEMENT BY MEANS (MBM) THEORY

Management by means, on the other hand, is developed and steered by core values and principles rather than by explicit predetermined targets. Rather than finances, this emerging theory focuses on resources for the attainment of success in the long-term, through improvement in procedures, methods, methodologies and their interconnections (Johnson, 2000). According to Kim and Ballard (2010), many people have misconstrued this to mean lack of attention to financial discipline. However it can be assured that once these goals are aligned for the long term, desired financial conditions would naturally be achieved. Kim and Ballard further stated that, MBM philosophy is to be maintained from the very beginning of the process where the management team makes every effort to adhere to disciplined practice, which drives the commitment for how work is done and coordinated. MBM as a generalized term incorporates the Last Planner System (LPS) developed by Ballard (2000). In the last planner, crews are allocated work by the field supervisor, thereby allowing the conversations between the site management and the trade supervisor at proper level of detail to occur, preventing holdbacks of critical issues on site.

LPS is a cooperative tactic to manage complex and uncertain project-based production system that allows problems to be noticed and dealt with at the source to prevent delays and increase the rate of workflow (Mossman, 2012). LPS is applicable in all situations that involve coordination between humans (Ballard 2000 *c.f.* Mossman, 2012), as is the case with subcontractor management.

It is a planning and monitoring tool that controls the construction procedure using the lean construction principles such as pull scheduling, just-in-time (JIT) delivery and value stream mapping (VSM) (Porwal, 2010). It improves reliability in planning and reduces the negative impacts caused by variability by checking the Percentage of Plan Completed (PPC) in a short-term period through promoting a series of actions (Gonzalez *et al*. 2008).

Planned Percent Complete (PPC) is established by dividing the number of tasks completed as planned by the total number of tasks planned for the particular period (Ballard, 2000).Thus, an increase in planning reliability allows construction managers to achieve more control and stabilization of the complex and dynamic nature of construction projects. Rather than focusing on how much of the work is completed, the measure of reliability in lean construction depends upon whether planned work is done.

Consequently, if work is performed correctly to completion as scheduled, it is counted as "1" and the tasks, which failed to complete as projected, are marked as "0". Subsequently, the 1's are summed up and divided by total number of tasks planned for that particular week. A PPC closer to 100% is considered high reliability, whereas lower PPC depicts unreliable planning (Ballard, 2000). Numerous research reports and academic papers have proven that improved workflow reliability and reduction in project duration and cost have been achieved with the use of last planner method (Ballard et al. 2007; Kim and Jang, 2005; Johansen and Porter, 2003; Fiallo and Revelo, 2002).

According to Johnson (2006), though MBR and MBM have different concepts and goals, but they both lead to better performance.

The LPS produces an enabling atmosphere and enhances production process, and leads to a reduction in inconsistency and assuring certainty at the same time. Generally, tasks are able to start and complete as planned due to the environment of trust between

subcontractors and main contractors due to the element of all-inclusiveness in planning integrated within the project environment.

2.7.3 THE THEORY OF CONSTRAINTS

Goldratt developed the Theory of Constraints (TOC) at the early stages of the eighties in his book titled 'The Goal'. It is a organizations based management idea for continuously promoting improvement in a system's performance by targeting principal challenges hindering the system from accomplishing its objective (Inman *et al*., 2009; Gupta and Kline, 2008; Kim *et al*., 2008; Fredendall *et al*., 2002; Mabin and Baldestone, 2003; Simatupang *et al*., 2004). The TOC methodology is Systems Thinking centered and therefore, it considers the totality of the system's performance rather than concentrating on achieving improvement in the performance of tasks individually (Taylor and Churchwell, 2004; Mabin and Balderstone, 2003; Gupta *et al*., 2002; Scoggin *et al*., 2003).

The TOC establishes that in any system there exist features called "constraints" which inhibit its performance (Gupta and Kline, 2008; Schaefers *et al*., 2004; Simatupang *et al*., 2004). TOC realizes that absence will result in an improbable productivity: increase without bounds or eventually go to zero (Goldratt, 1984 cited in Leach, 1999).

The underlying belief of TOC is that every system has at least one constraint (Mabin and Baldestone, 2003; Schaefers *et al*., 2004; Simatupang *et al*., 2004) and it is only by enhancing the results of that constraint that the results of the entire system can be improved. The constraints in a system may be physical (example, equipment, skilled workforce or raw materials), policy (if the organisational policies falls short of the revolutions occurring in the operational setting) or behavioural (prevailing organizational

culture). According to Rahman (1998), policy constraints abound in most organisations compared to physical constraints.

The TOC empowers managers in detecting the system constraints and device methods to do away with them (Simatupang *et al*., 2004).

As stated in Goldratt and Cox, there are five basic steps in the TOC continuous improvement process. These steps are Identify, Exploit, Subordinate and Elevate (Lechler *et al*., 2005, Leach, 1999).

a) **Identify the system constraint:** The constraint in a system is the part of the system that hampers the achievement of its objective. To manage a project successfully to achieve the expected results, it is important to recognize the system's weakest link. The constraint, otherwise referred to as bottleneck in a production environment, must be identified in this step. The term "link" can denote the systems "resource or workstation that is the bottleneck".

b) **Exploit the system constraint:** In order to prevent costly delays in the system, exploitation is done by maximizing the use of existing resources to improve the system. If for instance the constraint is an equipment, make the most use of it at all time.

c) **Second everything else to the system constraint:** As soon as the constraint has been identified and exploited, the planning decisions have to be subordinated to the constraint to allow for workflow without difficulty. Re-assigning surplus capacity in non-constrained resources to constrained resources will help reduce the uncertainty in meeting deadlines.

d) **Elevate the system constraint:** If the overall performance of the system is not improved, or does meet the desired expectations after applying the above-mentioned steps, then the next step is to intensify the overall system capacity

starting with the bottleneck. The main difference between this step and the step "**b**" is that step "**d**" requires additional investment in terms of time, money or effort. Techniques for elevating systems constraints include management-training, investment in additional resources, Information Techchnology (IT) etc.

e) If a new constraint surfaces, go through the previous steps; not allowing inertia to become the constraint. Increase in the capacity in the step "**d**" might lead to change in the system's constraint. Accordingly, the process needs to be repeated to identify any possible new constraint.

There is a wide unanimity among researchers (*e.g*. Inman *et al*., 2009; Lin *et al*., 2009; Watson *et al*., 2007; Inman *et al*., 2009; Gupta *et al*., 2002; Gardner *et al*., 1993) that, the application of the TOC leads to momentous improvement in organizational performance. It has also been established that the use of the TOC improves due date delivery performance (Watson and Patti, 2008; Wahlers and Cox, 1994; Darlington, 1995; Mabin and Balderstone, 2003).

Theory of Constraints has, however, been criticized on a number of issues. Koljonen and Reid (1999) point to the failure of the TOC to appreciate the revolving nature of contemporary organisational atmosphere as the main weakness. They have bemoaned the linearity and the static nature of the relationships among a system's components as portrayed in the Theory of Constraints' logic trees for failing to fully represent the dynamic complication in today's organisations. The aurhors have therefore suggested the pairing of the Theory of Constraints' logic trees with System Dynamics Modelling techniques towards reinforcing the TOC procedure. In another observation, Watson *et al.* (2007) noted that lack of top-level management backing and pledge to ensure the sustainability of the TOC. In their opinion, substantial length of time required for training to master the usage has triggered the delegation of implementation of the TOC

by many top-level managers to mid-level managers. Moreover, Goldratt (1990) postulated that the success of the TOC process depends to a large extent on the collective enthusiasm of all members in the organisation for the Theory of Constraints. Goldratt foresees that to generate appreciable level of enthusiasm among members in an organization can only be realised if the members consciously "own the organization".

2.7.4 CONTINGENCY THEORY

The contingency theory (Luthans, 1973) was an alternative response to the classical school that advocated for universal principles of "one single way" to organize and manage (Donaldson and Hilmer, 1998; Weill and Olson, 1989; Hanisch and Wald, 2012). The theory stressess the need for flexibility and advocates the absence of any one best way to organise or manage organizations but rather, management decisions should be built on situational and contextual factors. Daft (2000) argues that management's should be able to study and ascertain the precise features of the situation and then come up with answers to deal with these eventualities. To support this argument, Sauser *et al.,* (2009) stated that the contingency theory affords the opportunity for industry stakeholders to frequently re-examine project characteristics and tailor project management exercise to fit different construction project. In support of the contingency theory, many researchers have refuted the rigid claim of 'one size fits all' that was assumed to apply for all types of project in previous project management practice (Shenhar and Dvir, 2004; Sauser *et al.,* 2009; Shenhar, 2001). The contingency theory postulates that, diverse external conditions exist in organisations and hence, in all cases, project management practice need dissimilar operational features (Sauser *et al.,* 2009; Shenhar, 2001). Consequently, goodness of fit between structural and environmental

variables on the project influences the achievement of organizational effectiveness (Sauser *et al.*, 2009; Shenhar, 2001).

According to Shenhar (2001 cited by Kwofie, 2015) organic organisation thrives well mostly in turbulent energetic project setting whiles rigid organisations succeed within a steady and more stable project atmosphere. On his part, Youker (2002) puts forward that projects share highly comparable features when they are grouped based on their product and similar methodologies based on the features is more appropriate than general methodologies.

To support earlier assertions, Crawford *et al.* (2005) using the classical theory of contingency in project management admitted that advancing project management concept based on categorization of project is more beneficial to organisations. Certainly, the classical theory of contingency school strongly uphold the believe that there exist different project environments as is the case with subcontracts and so the management methods should be different (Sauser *et al.*, 2009).

However, the contingency theory has been criticized on a number of issues including a clear definition of the environment for the organization. Besides, the peculiarity between organization and its environment is not necessarily as distinct in practice as contingency theory suggest as big businesses can create their own environments (Mullins, 2007).

Notwithstanding these criticisms and limitations, Mullins (2007) maintains that the contingency theory draws attention to the possibilities of different structures for different activities of the organization and varying structures based on nature of projects, the economy and the cyclical nature of specific industry such as construction.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter explicates in detail, how the research was executed (methodology) to achieve the study's aim and objectives. According to Fellows and Liu (2008) in any scientific investigation, research methodology encompasses the main beliefs and procedures of rational thought processes, which apply to the research. Mackenzie and Knipe (2006) also explained that the methodology shapes the overall approach to the research linked to the paradigm or theoretical framework, including the methods. The authors further explain that the methods refer to systematic modes, procedures or tools used for collection and analysis of data in any research effort. Hence, this section specifically presents the following: philosophical point of the research, framework for the study, design of research instrument, data collection and data analysis.

3.2 PHILOSOPHICAL UNDERPINNING ADOPTED FOR THE RESEARCH

The research phenomenon under study and its corresponding research questions dictates the type of philosophical stance to be adopted (Pollack, 2007; Remenyi and Williams, 1998). For this research, the position adopted at the ontological level was positivism. The research questions posed in Chapter 1, lend themselves with measurement and therefore in order to allow for objective measurements, it makes sense to adopt positivism stance for the phenomenon being studied (i.e. the extent to which subcontracting is used and challenges inherent in subcontract management). By adopting positivism, the factors affecting the cost and time performance of subcontractors and the effects of subcontractor management on project time and costs can be viewed as a "realities" which can then be observed and assessed objectively.

As explained earlier, positivism depends on precise and objective measure and it is usually characterized by quantitative data collection. Subcontractor management related issues exist in reality and beyond the reach of influence of the researcher. These issues could be viewed as objective realities and not constructions of the researcher. Hence, the objectivist ontological stance was taken.

3.3 RESEARCH DESIGN

Research design is a coherent plan of how the information required in providing the most suitable answers towards the achievement of the research objectives and research questions in a study, plus showing the process for data is collection and analysis (Cresswell, 2009). According to Marczyk *et al.*,(2005 *c.f.* Kwofie, 2015), the adoption of appropriate research design and methodology, draws boundaries for the study and also presents a consistent process to fulfilling the research objectives and questions. The research design also influences the choice of an appropriate and suitable data collection and analysis instrument, on the way to responding to the research questions (Yin, 2009).

According to Bryman (2004), there are five main types of research design usually employed in research. They include experimental, cross-sectional, longitudinal, case study and comparative designs. In relation to research methods in the construction industry, Fellows and Liu (2008), identified four types of research design as explanatory, exploratory, descriptive and predictive. Furthermore, Saunders et al. (2009) opined that the two main design options to any research endeavor are the ‘deductive’ and inductive designs.

According to Baxter and Jack (2008), the deductive research design can also refer to as ‘quantitative design. It uses mathematical and statistical procedures to assemble and scrutinize data, to categorize facts and the underlying interactions among variables in

order to test propositions and come up with conclusions (Naoum 2002; Neuman 2003; Creswell, 2009). In the opinion of Naoum (2007), the use of the deductive research design is aims at testing or verifying a theory rather than developing it. According to Saunders et al, (2009), such a design lends itself well with scientific research approach and invlves the arduous testing of the theory to either confirm or modify it. The deductive approach mainly employs survey questionnaire for data collection and statistical tests for data analysis in order to generalize or draw conclusions (Oppenheim, 2003; Cresswell, 2009). According to Cavana *et al*., (2001), deductive reasoning helps to position the research in related theories, establish understanding and subsequently determine the results through empirical data.

However, the inductive research design also known as 'qualitative design' (Baxter and Jack, 2008; Neuman 2003) pivots on the systematic collection of data, analysis of the data and subsequent formation of a theory (Saunders *et al.*, 2009).

This study therefore employed a deductive research design, characterized by descriptive and explanatory elements based on the research objectives. Secondary data was sourced from literature and the Association of Building and Civil Engineering Contractors of Ghana (ABCECG). In addition, primary data was gathered from key stakeholders in the field under study. The study sort to establish the relationship between variables; it focused on studying the problem in subcontractor management in order to elucidate on the relationship between identified variables.

Descriptive research is usually used to portray 'an accurate profile of persons, events or situations' Robson (2002) as cited in Saunders (2009). This study further describes the present circumstances relating to subcontracting in general and the management of subcontractors in particular.

3.4 RESEARCH APPROACH

A research approach can be described as the means by which the research objectives can be interrogated (Naoum, 2007 *c.f.* Eghan, 2014). However, the approach to follow is influenced by the purpose of the study and the type and extent of availability of the information being sought (Biggam, 2008 *c.f.* Eghan, 2014).

This research used mainly quantitative approach to collect and analyse data in the form of numbers. Quantitative research approach seeks to gather information aimed at describing a phenomenon involving a larger number of participants and to study relationships between facts and relationships how those facts align to theories and the findings of past researches (Fellows and Liu, 2008). According to Rubin and Babbie (2005 *c.f.* de Vos *et al*., 2011), quantitative data analysis can be viewed as the procedure by which researchers translate data to the form of numbers and analyze it statistically. The authors further stated that the advantage is in the reduction of data to an intelligible and interpretable form to allow the relations of research problems to be analyzed and tested, and reasonable conclusions made. The data is therefore tangible, solid and consistent; they are measurements of concrete, countable, sensate characteristics of the world (Bouma and Atkinson, 1995; Naoum, 2007; Biggam, 2008; Fellows and Liu, 2008; Vanderstoep and Johnston, 2009) *c.f.* Eghan (2014).

3.5 RESEARCH PROCESS

According to Fellows and Liu (2008) there is no one rigid procedure for conducting research and hence the process must therefore be flexible. The research process adopted for this research involved an in-depth review of extant literature on subcontract management, identification of the main theories and further development of the

theoretical foundations and collection and analysis of empirical data to meet the research objectives.

The first stage of the study focused on a comprehensive review of relevant literature from books, journals, conference proceedings and other publications relating to subcontract management. The identification of the research problem and subsequently, the development of the research aim and objectives followed.

The second stage of the process comprised the preliminary field survey. It was initiated with the sample selection. The revelations from the preliminary survey significantly influenced the questionnaires design and structure.

The third stage involved the design of the data collection instruments; mainly questionnaires. The questionnaires comprised primarily open-ended questions. A pilot of the questionnaires was undertaken before the actual data collection. The feedback from the piloting aided in the drafting of the main set of questionnaires for the respondents.

The climax of the study was mainly used to the collection of appropriate primary data using survey questionnaire. The data collected from the field survey was then analyzed using the Statistical Package for Social Sciences (SPSS version 17), focusing on descriptive statistics, t-tests and factor analysis techniques. Figure 3.1 represents a summary of the research process.

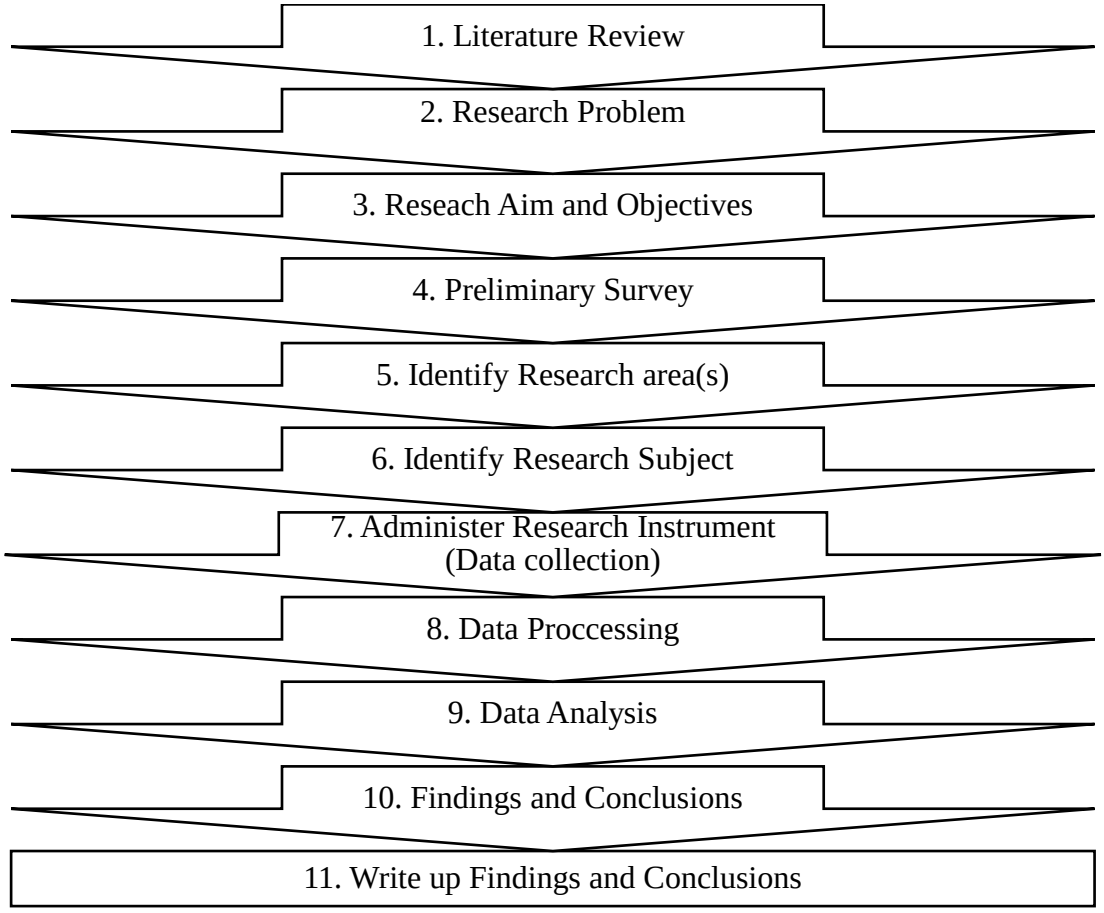


Figure 3. 1: Summary of the research process

3.6 DATA COLLECTION AND INSTRUMENTS

According to Fellows and Liu (2008 *c.f.* Eghan, 2014), in any research endeavor it is particularly necessary to consider the data required, sources of the data and how the data will be collected, right from the onset, particularly the planning stage of the research. To emphasize this point, Leedy and Ormrod (2005) noted that the viability of a research depends largely on the availability of sufficient data to support it. This section provides information on how data was obtained for the preliminary survey. It also presents the sampling technique and procedure for sample selection as well as the instruments of data collection for the field survey. The instrument employed in the research data collection was primarily questionnaires.

3.6.1 QUESTIONNAIRE DESIGN

Subsequent to an extensive review of literature relating to the topic, a detailed close-ended questionnaire was developed in order to attain the aim and objectives of the research. The questions were aligned in accordance to the objectives of the study and designed such that, respondents only had to tick the description which they thought was appropriate. According to Saunders *et al.*, (2009), in closed-ended questions, the respondent is allowed to select an answer from a number of alternative answers provided by the researcher. They further stated that closed-ended questions are very popular because they provide a greater uniformity of responses and are easy to process. Some of the questions used in the questionnaire design were excerpted from previous research related to subcontract management, such as Flynn (2009) and Shehada (2015).

The likert scale with scores ranging from 1-5 was employed. According to (Wuensch, 2005), the Likert-type scale is a psychometric scale commonly employed in the design of questionnaires. Burns and Burns, (2008) also explained that when responding to a Likert questionnaire item, respondents specify their level of agreement or disagreement on a symmetric scale range that expresses their opinions on listed issues. Creswell (2005 *c.f.* Adesi, 2014) further stated that quantitative researchers use both ordinal and interval scales; interval scales however, provide the most variation of responses and lend themselves to stronger statistical analysis. On their part, Cohen et al. (2007) opined that the use of Likert scale gives the researcher the opportunity to build differences, measure attitudes, and generate hard data on the respondents; it also provide information such as frequency, flexible responses and linkage between opinion and quantity. To emphasize the earlier points, Kapadia-Kundu and Dyalchand (2007) noted that the Likert scale is a five point response scale used to measure responses to a set of statements; and permits the measurement of degrees of difference but not the specific amount of difference.

The questionnaire comprised of five sections; section one was made up of four questions on general background information of respondents and company, section two had four questions on the extent to which subcontracting is used and section three sought to identify the challenges inherent in subcontract management. Section four contained questions on factors affecting the cost and time performance of subcontractors and questions in section five addressed the effect of subcontractor management on project time and cost. The length of the questionnaire covered one side of A4 paper of eight pages as provided in the Appendix.

3.6.2 QUESTIONNAIRE PILOTING

According to Dawson (2009) a pilot study is a test of the questionnaires in order to identify any probable amendments prior to the start of the main study, and is usually carried-out on people who will be taking part in the main study.

Ngulube (2005a) further advised that questionnaire should only be ready for administration when it has undergone pre-testing.

After the questions were prepared and arranged, a pilot trial of the questionnaire was done on researcher's fellow graduate students to check the precision, consistency and relevance of the questions asked. Subsequently, the necessary alterations were made to streamline final version in accordance with the objectives of the study prior to formal administration of the questionnaire.

3.6.3 QUESTIONNAIRE DISTRIBUTION AND ADMINISTRATION

The questionnaires were hand delivered to respondents and retrieved personally by the researcher. This ensured that the questionnaires got to the intended recipients and aided in improving the response rate. According to Frazer and Lawley (2000), there are four

approaches to administering questionnaire: by mail; personally administered questionnaire; telephone questionnaire; and internet questionnaire. The questionnaires were self-administered by respondents such as Project Managers, Quantity Surveyors, Structural Engineers, and Architects of the sampled construction firms; comprising of the Main contractor and the Subcontractor organisation;. The respondents usually complete self-administered questionnaires by themselves (Saunders et al, 2009). Some of the respondents completed and returned the questionnaires instantly whiles the rest of the questionnaires were retrieved subsequently.

3.7 SAMPLING TECHNIQUES

Saunders *et al*., (2009) has noted that when it is impossible to collect data from the whole population for a study within the stipulated time, a researcher must select a sample. The authors further stated that sampling saves time, and should be considered as the best option when the researcher is constrained with time (Dawson, 2002). According to Fellows and Liu (2008), the objective of sampling is to allow practical means by which the data collection process is undertaken to achieve a good representation of the sampled population.

3.7.1 SAMPLING TECHNIQUE ADOPTED

This survey covered D1 construction firms in the Greater Accra region, who are registered members of the Association of Building and Civil Engineering Contractors in Ghana and Subcontractors who worked under them.

The study used snowball sampling in attaining the sample size of the Subcontractors because of lack of a comprehensive database on registered body of subcontractors in Ghana. The research initially contacted one respondent in the required category, who in

turn gave the name of another subject, who also provided the name of a third, and so on. This made it possible to identify hard-to-reach respondents. In addition, simple random sampling technique was used to select the total number of D1K1contractors from the register of the Ministry of Water Resources Works and Housing (MWRWH). In simple random sampling, every unit had an equal chance of being selected (Frankel and Wallen, 2006).

3.8 SAMPLE SIZE DETERMINATION

The sample size for any research endeavor can be determined using various methods. These methods include applying censuring when dealing with relatively smaller population, adoption of statistical formulae, by means of well-recognized tables for determining sample tables and the application of a sample size of studies which have similar characteristics to what is being studied (Israel, 1992). The sample size should constitute a true representation of the target population.

A list of contractors available to the researcher indicated that there were one hundred and thirty-two (132) D1 contractors, who were actively in operation and in good standing in the Greater-Accra region (MWRWH *c.f.* Baapiri, 2015**)**. Therefore, the popular Kish formula (Kish, 1965) was used to determine the minimum acceptable sample size for this study.

Sample size; $\boldsymbol{n} = \frac{n1}{(1+n1/N)}$ (Kish, 1965)

Where

n = Sample Size

$n1 = S^2/ V^2$

S = Maximum standard deviation in the population element (Total error = 0.1at a confidence level of 95%)

V = Standard error of sampling distribution = 0.05

P = The proportion of the population elements that belong to the defined class.

S2 = P (1-P) = 0.5(1-0.5) = 0.25

$V^2 = 0.05^2 = 0.0025$

N = Population size

$n1 = \frac{0.25}{0.0025} = 100$

$$\boldsymbol{n} = \frac{100}{1 + (100/132)}$$

$\boldsymbol{n} = 57$

The sample size formula provides the minimum number of responses to be sampled. Researchers such as Cochran (1963), and Israel (1992) usually added 10% and 30% respectively to the sample size to make up for unreachable respondents and for non-response. The sample size for the D1K1 contractors was therefore increased by 30% accordingly as follows:

$\boldsymbol{n} = \frac{130}{100} \times 57 = 74$

3.9 DATA ANALYSIS

Data preparation was the initial step to convert raw date into structured format that are more appropriate for the analysis. Tasks in this stage will include data editing, data coding and data entry. The questionnaires returned were first cleaned and checked for completeness. They were then coded and fed into Statistical Package for Social Science (SPSS) version 20 and then transported into the Microsoft Excel 2010 for analysis using descriptive statistical tools and measures namely mean and standard deviation, tables and Relative Importance Index (RII).

Apart from the demographic data respondents, relative importance index employed to rank each section to determine the significant factors. In keeping with the observation by Enshassi *et al.,* (2007) who noted that analysis of data on Likert scale 1-5, the request of Importance Index is also appropriate. Unlike the mean that could be impacted by extreme values (outliers), variables with high significant effect could be observed using relative index which evaluate each variable in relative to other variables. Also, average ranking of each variable was done using mean scores with their standard deviation.

3.10 RESEARCH ETHICS

According to McMillan and Schuhmacher (2006 *c.f.* Gabula, 2012) ethics in relation to conduct of research aims at protecting the rights and welfare of the participants at the same time. As part of ethical consideration in the conduct of this research, respondents did not have to provide their names on the questionnaire in order to maintain their anonymity. The confidentiality of the respondents' identity was maintained and protected; whiles, participation was voluntary. Respondents were assured that the information provided was strictly for academic purposes. The researcher was objective and adhered to the general code of ethics for management sciences researchers. Prior to filling the questionnaire, the researcher briefed the participants on the objectives of the research. According to Durrheim and Wassennar (1999) briefing involves explaining to research participants on the nature and purpose of the study at the beginning and at the end of the study.

3.11 RESPONDS RATE

From table 3.1, a total of one hundred and forty (140) questionnaires were sent to the field to administer. Out of this, 88 were received accounting for 62.9 percent responds rate which is very encouraging for this study.

Information given were collected from consultants of which 13 out of 20 responded constituting 65 percent, 40 main contractors representing 66.67 percent of 60 questionnaires administered and subcontractors 58.33 percent being 35 respondents out of 60 questionnaires. The professionals for this research work were carefully selected to provide the detailed information needed.

Table 3. 1: Response Rate

TYPE OF RESPONDENTS	NUMBER OF RESPONDENTS CONTACTED	QUESTIONNAIRES RETURNED	PERCENT
Main Contractors	60	40	66.67
Sub-Contractors	60	35	58.33
Consultants	20	13	65.00
Total	140	88	62.86

3.12 RELIABILITY AND VALIDITY

The trustworthiness of a research results is pivoted on two key testing methods. They include reliability and validity (Saunders et al, 2009). Subjecting the research outcomes to testing guarantees that the findings of the study can survive stringent scrutiny, and can be substantiated as being valid and reliable.

3.12.1 RELIABILITY

Saunders et al (2009) defines reliability as the degree to which the data collection techniques would produce unswerving findings. So as to determine the reliability of the data collection instrument used, two main methods are promoted by Cohen *et al*. (2007); the split half coefficient and the Cronbach's alpha coefficient. This study embraced the latter (Cronbach's alpha coefficient in SPSS, Version 20) which provides the extent of the internal consistency among the variables (Cohen *et al*. 2007). Cronbach's alpha is the most popular measure of true reliability of a survey (Hinton et al, 2005). According to Hinton *et al*. (2005), Cronbach's alpha is the most common measure of research reliability. Bryman and Crammer (1990) as cited in Saunders *et al*. (2009) advocates that a reliability value of 0.7 is deemed acceptable. The results of the reliability test is attached as an appendix (Appendix B)

3.12.2 VALIDITY

Validity on the other hand addresses the credibility of research findings (Struwig and Stead, 2007). Along with Kumar (2011), the rationality that buttresses the design of research tools and the data assembled by means of research instruments, conglomerate to form the basis for concluding on the validity of research instruments. For the purpose of this study, the construct validity was used. According to Fisher (2010) construct validity refers to the extent to which the functioning measures essentially reflect the variables they are set out to measure. This is accomplished by the presenting the chronological proof events that occasioned the formulation of the research questions and objectives, through the realization of the research data to the achieving the objectives. A detailed and vigorous research design was adopted to certify that the anticipated variables were measured.

MISSING VARIABLE

This is whereby questions are not answered by the respondent either intentional or not. It also includes the respondents given answer which is not relevant to the research at hand. Total of 968 variables were answered from all the 88 questionnaires received. Table 3.2 below shows the number of questions answered in this case called valid and the number not answered called missing number. In all 78.51 per cent of the questions were answered correctively and hence was useful for the analysis.

Table 3. 2: Missing variables

	Valid		Missing	
	Count	Percent	Count	Percent
Type of Organization	88	100	0	.0
Professional Background	87	98.9	1	1.1
Years of Experience	88	100	0	.0
Speciality	43	48.9	45	51.1
Type Of Subcontract Project	43	48.9	45	51.1
Allow subcontract to Further Subcontract	27	30.7	61	69.3
Prefer to Nominate Subcontractors	38	43.2	50	56.8
Frequency Of Subcontracting Projects	87	98.9	1	1.1
No. of Subcontract Projects	85	96.6	3	3.4
Percentage Subcontract Works	86	97.7	2	2.3
Beneficial Principles Of Subcontractor	88	100	0	.0
TOTAL	**760**	**78.51**	**208**	**21.49**

CHAPTER FOUR

DATA ANALYSIS AND RESULTS DISCUSSION

4.1 INTRODUCTION

This chapter contains the analysis of the results as obtained from the survey conducted for this study. It highlights the background of the respondents and analysis of results from the field which are based on the study objectives. Data analysis for the study was undertaken using SPSS and Microsoft Excel. Descriptive statistics method which took the form of percentages and frequency distributions were used to analyze the background information of the respondents which include type of organization, professional background, years of experience in the profession and type of subcontract projects. The profile of respondents for the study was very important because their level of knowledge and experience was relevant in determining the credibility of the research findings as a whole.

Relative Importance Indices of the potential challenges associated with subcontractor management, factors affecting the cost and time performance of subcontractors and the effects of subcontractor management on project time and cost were calculated. Correlation test was also conducted to assess how one factor impacts on the other.

4.2 BACKGROUND INFORMATION

4.2.1 PROFESSIONAL BACKGROUND OF RESPONDENTS

The figure 4.1 shows the various professional backgrounds of respondents. The study revealed that 22 percent of respondents were Architects and Quantity Surveyor whereas respondents who were Civil and or Structural Engineer accounted for 23 percent. The rest of the respondents (33%) who represented the majority were Construction Project Managers. This means that respondents for the survey are evenly distributed in terms of

their professional background, with the slight majority being the construction project managers. The project manager has the responsibility of ensuring that the project objectives are met within all the project constraints (Chiu, 2010). Projects may have different objectives but the total success of each project depends largely on the project manager who steers the affairs of the project regularly (Shenhar and Dvir, 2007). From the above observations, it implies that responses from project managers was very important to the validity of this research.

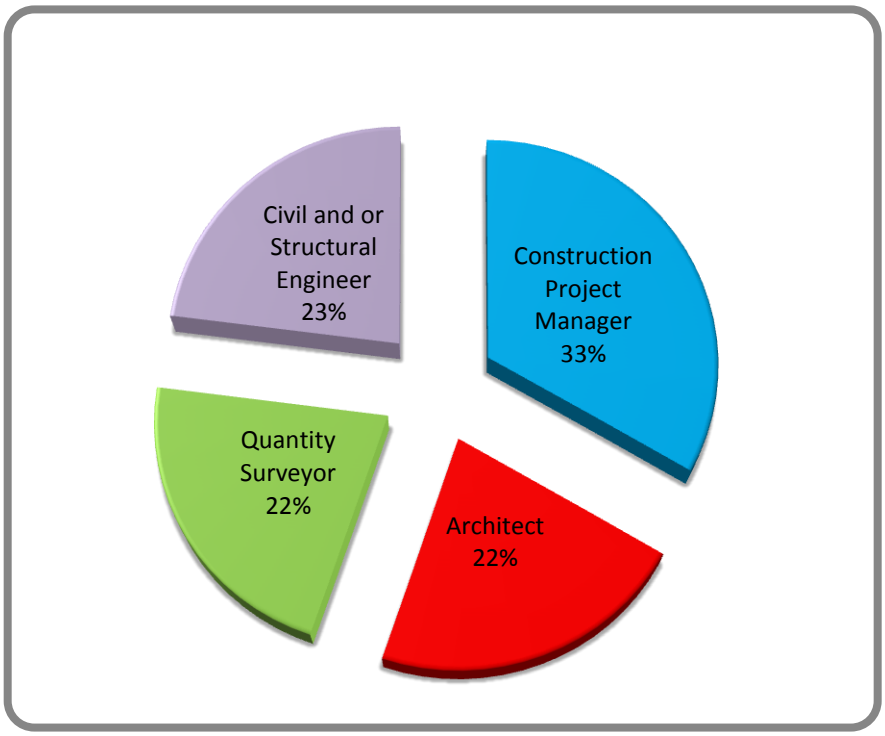


Figure 4. 1: Professional Background

Source: Field Survey, 2016

4.2.2 YEAR OF EXPERIENCE OF PROFESSION

Figure 4.2 illustrates the years of experience of respondents in their respective professions. The study revealed that 45.5 percent of respondents have been in industry between 6 years to 10 years; another 45.5 percent have had 11 to 15 years' experience in the industry whereas respondents who have been in the industry 16 years and above

accounted for 9%. The data collected showed that most of the respondents representing 54 percent had had more than a decade's experience in the GCI. All things being equal, the number of years respondents have been practicing in their profession will affect the quality of responses that will be given and hence increase the validity of this research findings.

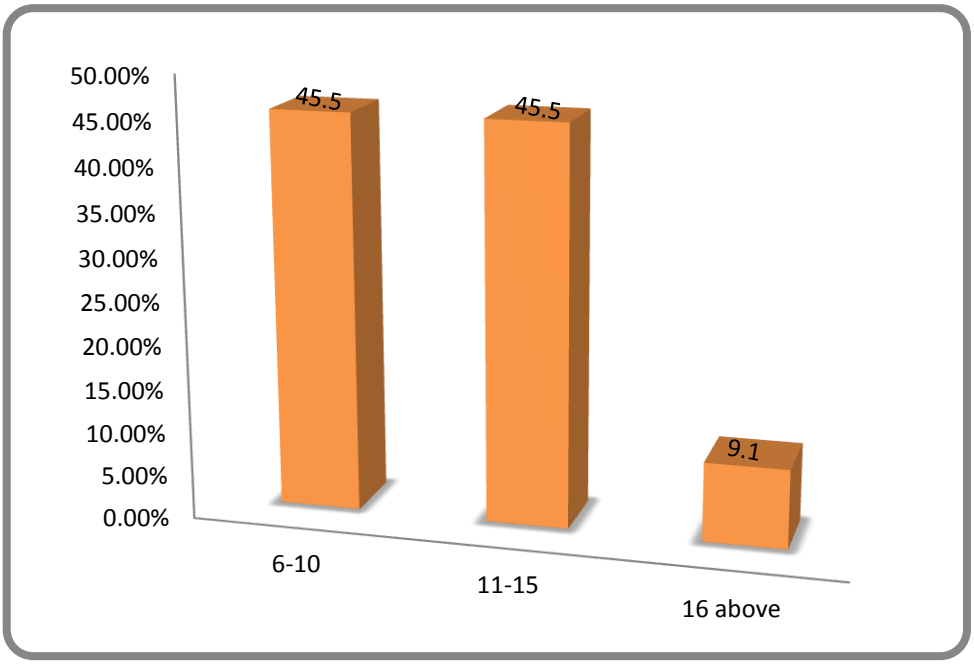


Figure 4. 2: Year of Experience

Source: Field Survey, 2016

4.2.3 SPECIALITY OF RESPONDENTS

Respondents to this question were subcontractors in the construction industry. From figure 4.3, it was realised that 2.3 percent of respondents were specialists in Mechanical and Plumbing works respectively, 14 percent of respondents had specialities in Glazing whiles respondents with Building construction specialities represented 81.4 percent. This portrays that majority of the respondents have building work as their main focus of specialisation. That is, the respondents are involved in the main construction of the building; from foundations to roof level. The specialty of the research respondents in this

work portrays variability of responses and thus information is representative of a wider spectrum of the GCI stakeholders' views.

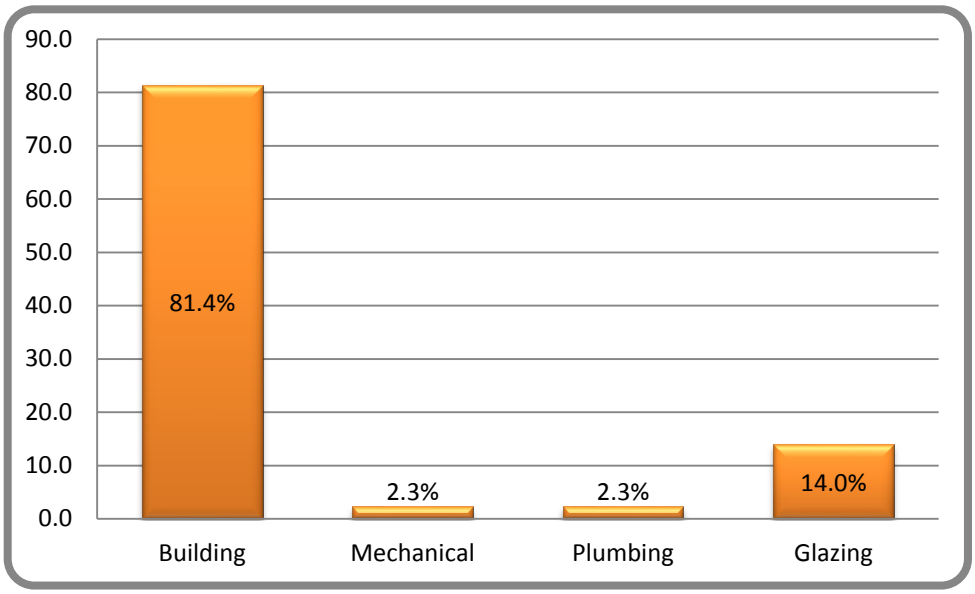


Figure 4. 3: Speciality of Respondents

Source: Field Survey, 2016

4.2.4 TYPE OF SUBCONTRACTOR PROJECT

Five types of projects often executed by subcontractors were identified. They are Commercial or official buildings, Government Office buildings, Hotel/Retails/ Shopping centre, Residential developments and Hospitals.

Figure 4.4 shows that commercial or official building was the type of project that are mostly sublet to subcontractors with 90.7 of respondents indicating that they undertook such projects, whiles 2.3 percent of responds indicated that the other type of projects they undertook were Government buildings, Hotel/ retail or shopping centre, Residential developments and Hospitals respectively. This is an indication that this work captured the opinion of parties involved in multiplicity of subcontract works and hence the findings can be useful across wide range of subcontract projects.

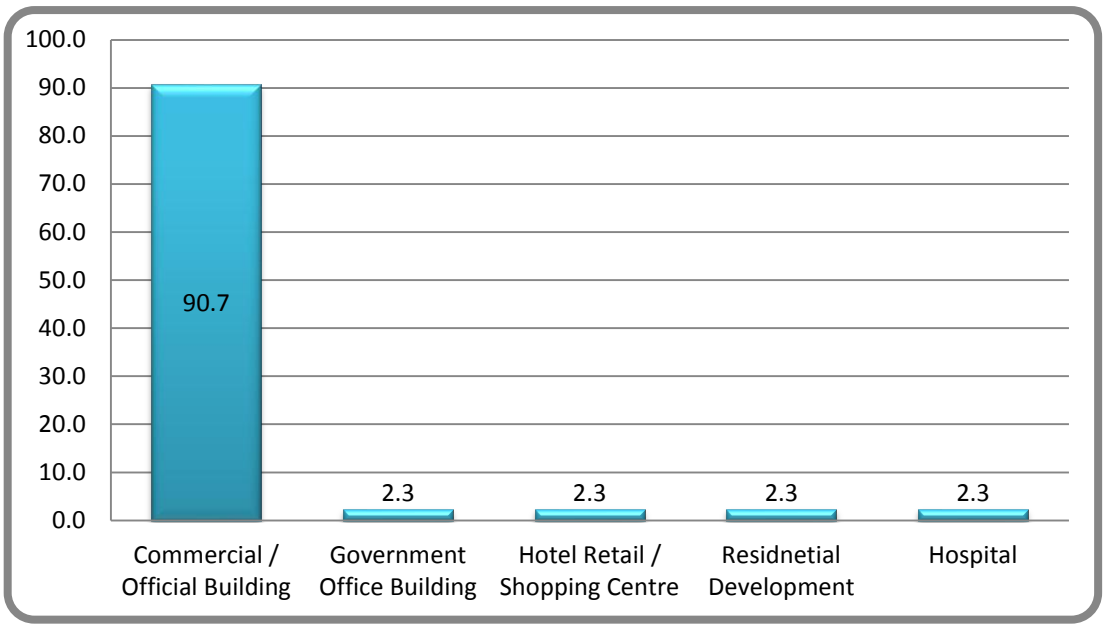


Figure 4. 4: Type of Subcontractor Project

Source: Field Survey, 2016

4.2.5 ALLOWING SUBCONTRACTORS TO FURTHER SUBLET WORK

Data were also gathered from main contractors concerning their approval for subcontractors to further sublet portions of the works given to them.

Table 4.1 depicts that only 11.36 percent of respondents would allow their subcontractors to further engage other subcontractors, whereas 88.64 percent of respondents indicated that they never allow part of their projects to be given to subcontractors by the original subcontractor. This means that majority of main contractors do not allow further subcontracting of projects by the original subcontractors. This could partly due to the fact that unlike other jurisdictions, the use of subcontracting in the Ghanaian construction industry has not matured to a point of accepting idea of "further subcontracting".

Table 4. 1: Allow Subcontract to Further Subcontractors

Do you allow subcontractors to further subcontract out the work you assign them?	Frequency	Percent
Yes	10	11.36
No	78	88.64
Total	88	100.0

Source: Field Survey, 2016

4.2.6 MAIN CONTRACTORS' PREFERENCE FOR SUBCONTRACTORS

Main contractors were asked to indicate their preference for the type of subcontractor they would rather like to work with in particular projects. The study revealed from figure 4.5 that 34 percent of respondents preferred nominated subcontractors whereas 66 percent of respondents indicated that they preferred to have domestic subcontractors. This means that domestic subcontractors are preferred to nominated subcontractors. The main contractors explained that the reason behind their preference is due to less likelihood of disputes/risk because of previous working relationship with the subcontractor.

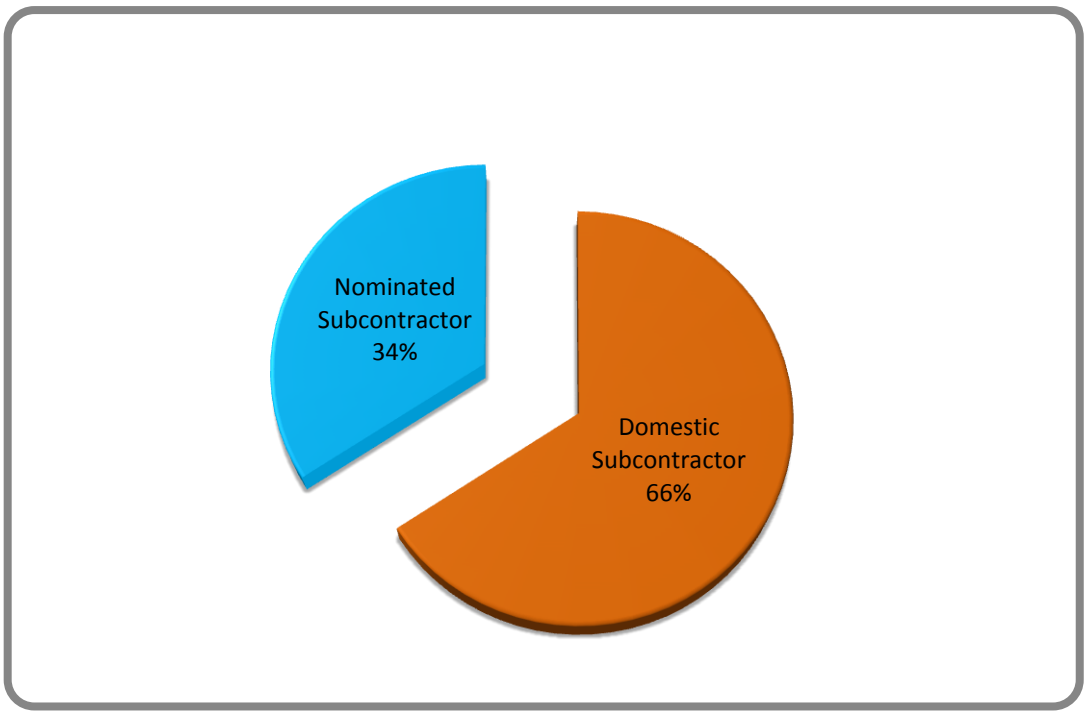


Figure 4. 5: Domestic against nominated subcontractor

Source: Field Survey, 2016

4.3 EXTENT OF SUBCONTRACTING PRACTICE IN THE BUILDING INDUSTRY

This section sort to identify the extent to which subcontracting is used in the building industry in Ghana.

4.3.1 Frequency of subcontracting practice in Building Construction Project

The survey results is summarised in figure 4.6 and indicates that 52.9 percent of respondents said that subcontracting was frequently used, whilst 47.1 percent of respondents stated that subcontracting practice in building construction projects was a very frequent occurrence. Though moderately frequent, less frequent and not frequently practice were available options for respondents, none of the respondents thought that

subcontracting practice was in such low frequencies in the building construction industry. This is consistence with observation by Mbachua (2008) who indicated that Subcontracting is used much more extensively on housing and building construction projects.

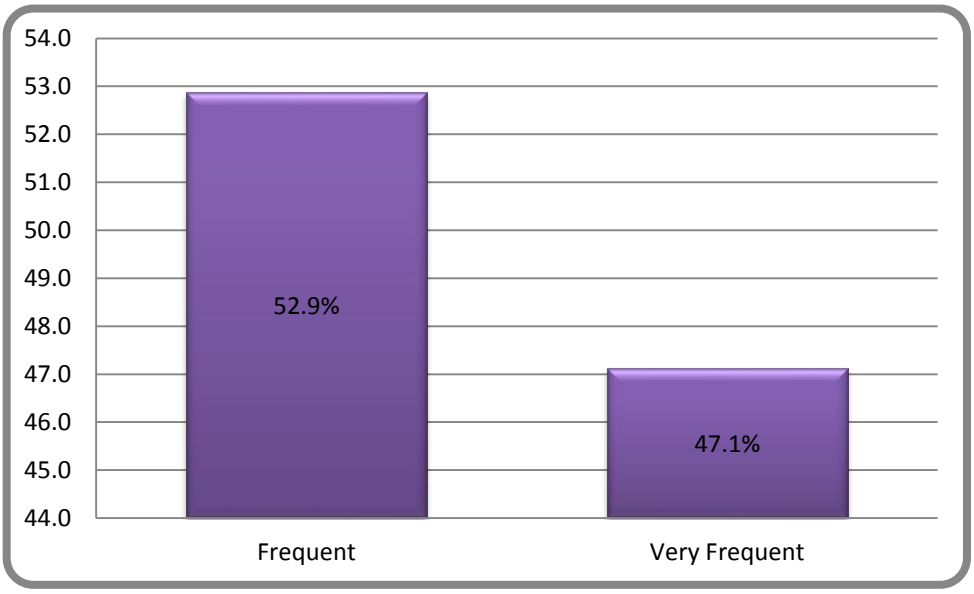


Figure 4. 6: Frequency of subcontracting in Building Construction Project

Source: Field Survey, 2016

4.3.2 NUMBER OF SUBCONTRACTING PROJECTS IN PAST 5 YEARS

Figure 4.7 stipulates how many subcontract projects that respondents have been involved in the last five years. It can be observed that 61.2%, which represents majority of respondents indicated that they had undertaken 6 – 10 subcontract projects in the last five years, 5.9% of respondents indicated the number of projects undertaken in the last five years were between 1 - 5 contracts, 23.5% of respondents had been involved in 11 – 15 the last five years, whilst 9.4%. of respondents who stated that in the last five years they have undertaking more than 15 projects. This depicts that in the last five years majority (91.4%) of respondents have been involved in more than five subcontract projects.

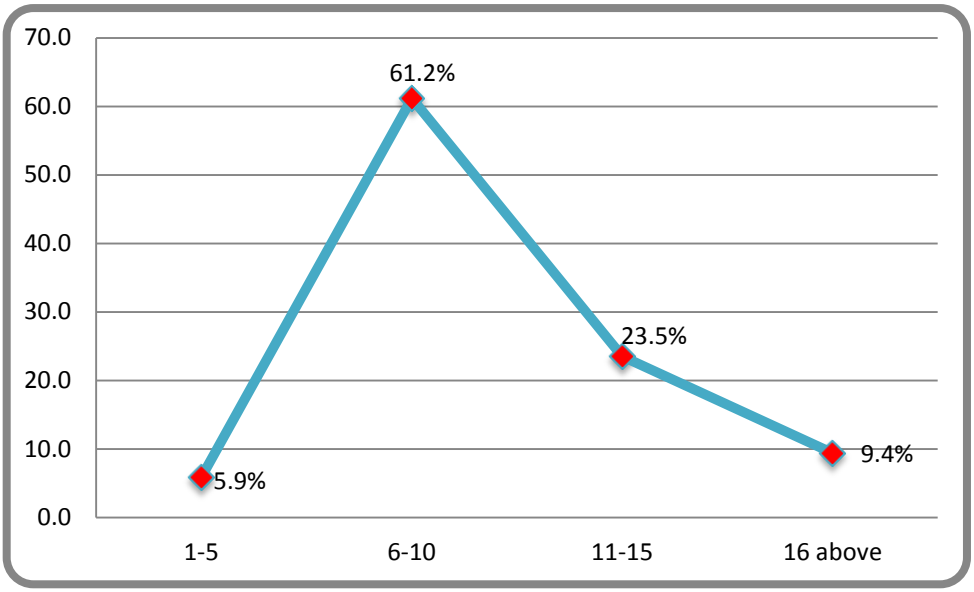


Figure 4. 7: Number of Subcontracting Projects been involved in last 5 years

Source: Field Survey, 2016

4.3.4 PERCENTAGE OF WORKS USUALLY SUBCONTRACTED

Figure 4.8 illustrates the percentage or the volume of projects usually subcontracted. It was realised that 3.5 percent of respondents indicated that the percentage of work or projects usually subcontracted does not exceed 10%, 52.3 percent of respondents said that percentage of work that is subcontracted is between 11% and 20%, 43 percent of indicated that the percentage of subcontracted works was between 11% and 30% whiles the rest of the respondents who constituted 1.2 percent said that the volume of works given as subcontracts was between 31% – 40%. This clearly revealed that 96.5 percent of respondents were of the view that mostly 11 – 40 percent of building construction works is usually outsourced to subcontractors. This affirms the observations of many research reports in other jurisdiction which revealed that subcontracting is used to execute significant portions of construction work (Abbasianjahromi, 2013; Hartmann, 2009; Ng *et al*., 2008a and 2008b; Arditi and Chotibhongs, 2005 and Wang and Liu,

2005). Forty percent of construction works is still very significant and therefore the role of subcontracting in the Ghanaian construction must receive a lot of attention.

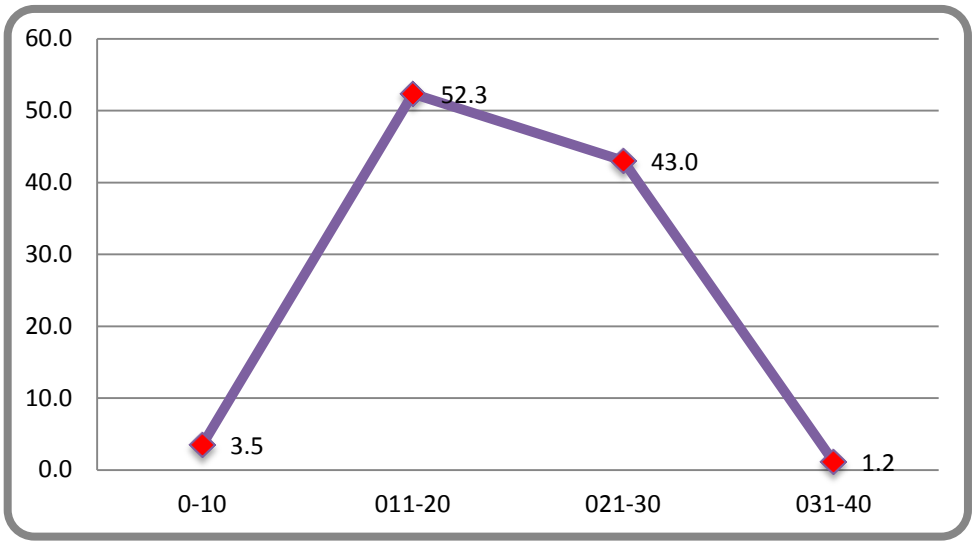


Figure 4. 8: Percentage of Works Usually Subcontracted

Source: Field Survey, 2016

4.3.5 BENEFIT OF SUBCONTRACTOR MANAGEMENT

Figure 4.9 shows the benefits derived from the fundamental principle of subcontractor management. It was observed that 19.3% of respondents indicated that managing the subcontractor is beneficial whilst 80.7% of respondents reiterated that it is very beneficial endeavour. All the respondents were of the view that it is beneficial to address fundamental principles of subcontracting management.

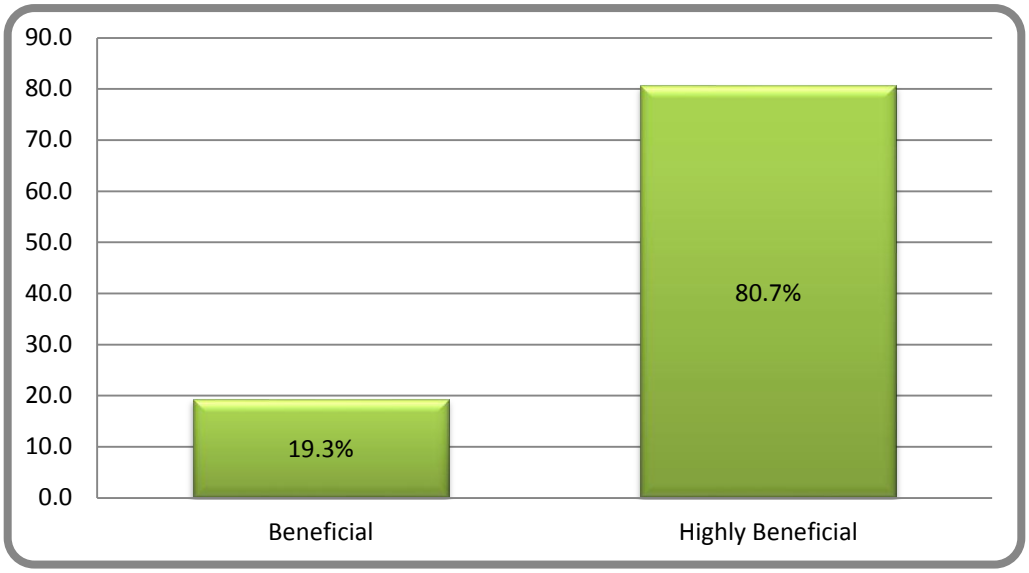


Figure 4. 9: Benefit of the Principles of Subcontractor Management

Source: Field Survey, 2016

4.4 CHALLENGES IN SUBCONTRACTOR MANAGEMENT

According to Maturana (2007), in as much as subcontractor management has been yielding better outcomes, there is also the tendency for challenges to be encounted.

Table 4.2 illustrates the challenges encountered in subcontractor management during construction projects. The study discovered with a Relative Importance Index (RII=0.978) that non-adherence to schedule attached to a project is the key challenge encountered in subcontractor management whereas site coordination challenges (RII=0.920) is the second most significant challenge in the management of subcontractors. The research hitherto observed in the ranking manner that the other subcontractor management challenges included contractors financial challenges, lack of safety materials, lack of proper communication, incomplete work-drawings or specifications, shortages of construction materials, legal disputes, delay in shop drawings and amendments in that order. This stipulates "amendments" as the lowest on the rank with RII of 0.740 being the least significant challenge in managing subcontractors.

In order to meet the project schedule, the main contractor has to schedule his construction work to that of the subcontractor. As asserted to by Al Hammad (1992), delay in the carrying out scheduled construction activities will have far reaching implication on making headway for other activities. Joseph and Proctor (1996), who noted that lack of appreciation of the work sequence of the subcontractor results in time overruns, support this observation. This section of the work has identified a number of challenges associated with subcontractor management and hence, has reinforced the relevance of the related research objective.

Table 4. 2: Ranking of challenges in subcontractor Management

No.	Challenges	Score	Mean	SD	RII	Rank
1	Legal Disputes	484	4.07	.365	0.8067	**8**
2	Shortage of Construction Material	513	4.31	.488	0.8550	**7**
3	Delay in Shop Drawings	474	3.92	.485	0.7900	**9**
4	Amendments	444	3.73	.643	0.7400	**10**
5	Incomplete Work-drawings or Specifications	524	4.40	.617	0.8733	**6**
6	Lack of Safety	544	4.53	.502	0.9067	**4**
7	Site Coordination Challenges	552	4.60	.515	0.9200	**2**
8	Lack of Proper Communication	529	4.42	.661	0.8817	**5**
9	Non-Adherence to Schedule	587	4.89	.413	0.9783	**1**
10	Contractor's Financial Challenges	545	4.54	.524	0.9083	**3**

Source: Field Survey, 2016

4.5 FACTORS AFFECTING THE COST AND TIME PERFORMANCE OF SUBCONTRACTORS

Table 4.3 illustrates the factors that affect the cost and performance of subcontractors during construction projects. The study revealed that these factors were categorised into

six main areas. The first category was the project related factors. The specific factors under project related factors that affect the cost and time performance of subcontractors, in order of RII ranking, included: many execution obstacles, no contingency budget, increase in fundamental changes, increase in scope of work, remote site location, government policy, project complexity, and densely populated site. Under these project related factors, a project which is shrouded with many execution obstacles with an RII value of 0.957, is the most significant factor which influence cost and time performance of subcontractors. The factor respondents rated as least significant impacting on performance of subcontractors relative to cost and time of when considering project related factors, with an RII of 0.640 was the densely populated site.

The second category of factors that affect the cost and time performance of subcontractors is the Contract Documents and Management Related Factors. The specific contract documents and management related factors are ranked based on RII and are as follows: Clear understanding of contract objective and requirement, adherence to subcontract requirements, the quality and clarity of design drawing, payment methods, insurance terms, clarity of contract between contractors and subcontractors, compliance with regulations, delays in adoption of change orders, subcontractor assisting main contractors in pricing, subcontractors ID preference, competitive selection of subcontractors and lowest bid price implement. Respondents considered selection of subcontractor based on lowest bid price as the least importance (RII=0.597) whilst clear understanding of contract documents is of most importance to respondents that influence cost and time performance of subcontractors.

The third categorisation of factor influencing cost and time performance of subcontractors is the Factors Pertaining to Project Staff in general. The specific factors pertaining to project staff include: lack of efficiency, qualified supervisory staff, moral support, conduct of training courses and number of craftsmen and labourers in the project in that ranking manner. The factor which immerged to be the most important to respondents that affect cost and time performance of subcontractors is lack of efficiency (RII=0.925) and the factor of least importance to respondents is conduct of training courses to project staff (RII=0.738).

The fourth set of factor that has influence on cost and time performance of subcontractors is the Factors Pertaining to Project Managers. It was established that manager's personality and experience (RII=0.997) is the key factor affecting cost and time performance of subcontractors whereas Management level leadership (0.995) is the second most important factor considered to affecting cost and time performance of the subcontractors. Also, regular and effective communication and coordination of main contractor and subcontractors (RII=0.990) was noted to be the third most important factor when it comes to cost and time performance of subcontractors. It was discovered that Regular and Effective Communication was the next most important factor whereas salary of managers (RII=0.763) was the least significant factor that respondents mentioned to affecting cost and time performance of subcontractors. In this set of factors, the highly ranked factors influencing cost and time performance of subcontractors are Manager's personality and experience and Management level leadership.

The fifth category of factors that influence the cost and time performance of subcontractors is the Factors Related to Main Contractors. The specific factors that were

considered under factors related to main contractors were ranked based on RII and the order is as follows: Practical & Technical ability of Main Contractors (RII=1), Commitment of Main Contractors with Project schedule (RII=0.998), Controlling & follow up of Subcontractor's work (RII=0.988), Provision of work plan to Subcontractors before work commences (RII=0.983), Previous experience and reputation (RII=0.978), Financial facilitation to Subcontractors (RII=0.902), Ability in dealing with Uncertainties (RII=0.893), Contractors performance of relevant previous projects (RII=0.877), the Relationship with subcontractor (RII=0.867), Ensuring that subcontractor's price fit to quality (RII=0.867), lack of trust (RII=0.860), Provide Subcontractor with location Services (RII=0.857), Financial ability & strength (RII=0.817), Ability in bearing risk (RII=0.813) and Bearing responsibility in case of accidents (RII=0.788). In this category, the study observed that Practical & Technical ability of Main Contractors is the most importance factor that respondents considered to affect cost and time performance of subcontractors. When the technical capability of the main contractor is in doubt it has a serious implication on the project outcome in terms of cost and time.

The last category of factor found to influence cost and performance of subcontractors is the Factors Related to Subcontractors. Under the this category, the related variables include: the Extent of subcontractors commitment to project schedule, Extent of subcontractors commitment to Specifications, Subcontractor familiarity with work, Practical & Technical ability, Close control over the Cost by Subcontractors, Previous experience, Performance of relevant previous projects, Financial ability & strength, Provision of adequate project information, Prompt payment to Labourers and Size of subcontractor's staff. Respondents reiterated that the key variable that relates to the Subcontractors which influenced cost and time performance of subcontractors is the

Extent of subcontractor's commitment to schedule with an RII=1.000 whereas the least among the factors is the Size of Subcontractors Staff with RII=0.8000.

Table 4. 3: Ranking of Factors affecting Cost and Time performance of subcontractors

		Factors	Score	Mean	SD	RII	Rank
1	*Project Related Factors*	Densely Populated Place	384	3.20	.506	0.6400	8
		Large Project	435	3.61	.513	0.7250	7
		Additional Work Increase	476	3.98	.502	0.7933	4
		Remote Location	460	3.83	.522	0.7667	5
		No Contingency Budget	531	4.45	.524	0.8850	2
		Fundamental Changes Increase	484	4.00	.401	0.8067	3
		Many Execution Obstacles	574	4.78	.419	0.9567	1
		Government Policy	453	3.20	.506	0.7550	6
2	*Contract Documents and Management Related Factors*	Lowest Bid Price Implement	358	3.80	.549	0.5967	12
		Competitive Strategy Selection of Subcontractors	366	3.01	.711	0.6100	11
		Assist Main Contractors in Pricing	444	3.06	.657	0.7400	9
		Subcontractors ID Preferred	420	3.69	.594	0.7000	10
		Clear Understanding	569	3.52	.819	0.9483	1
		Clarity of Contract	467	4.76	.547	0.7783	6
		Delays in Adoption of change	451	3.89	.633	0.7517	8
		Compliance with Regulations	456	3.77	.615	0.7600	7
		Adherence to Subcontract	566	3.81	.522	0.9433	2
		Quality and Clarity of Design Drawing	555	4.78	.470	0.9250	3
		Payment Method	515	4.61	.537	0.8583	4
		Insurance Terms	500	4.26	.536	0.8333	5
3	*Factors Pertaining to Project Staff In General*	Lack of Efficiency	599	4.99	.108	0.9983	1
		Morally Support	485	4.07	.629	0.8083	3
		Preparation of Training Courses	469	3.91	.328	0.7817	4
		Work On-site	443	3.70	.559	0.7383	6
		Number of Craftsmen and Labourers	453	3.78	.773	0.7550	5
		Qualified Supervisory Staff	595	4.96	.187	0.9917	2

4	*Factors Pertaining To Project Manager*	Manager Personality	597	4.96	.241	0.9950	2
		Salary of Managers	458	3.85	.630	0.7633	5
		Management Level Leadership	594	4.95	.219	0.9900	3
		Regular and Effective Communication	586	4.95	.263	0.9767	4
		Managers Recognition of Construction	598	4.98	.152	0.9967	1
5	*Factors Related To Main Contractors*	Previous Experience	587	4.89	.321	0.9783	5
		Practical & Technical Ability of Main Contractors	600	5.00	0.000	1.0000	1
		Contractors Performance	526	4.35	.628	0.8767	8
		Financial Ability & Strength	490	4.05	.405	0.8167	13
		Ability in Dealing with Uncertainty	536	4.47	.502	0.8933	7
		Controlling & Follow up of Subcontractors	593	4.94	.235	0.9883	3
		Financial Facilitation to Subcontractors	541	4.51	.503	0.9017	6
		Main Contractor give Subcontractors Work Plan	590	4.92	.274	0.9833	4
		Provide Subcontractors Location Services	514	4.25	.638	0.8567	12
		Make Sure Subcontractors Price Fit to Quality	520	4.33	.473	0.8667	10
		Commitment of Main Contractors with Project Schedule	599	4.99	.108	0.9983	2
		Ability in Bearing risk	488	4.10	.481	0.8133	14
		Bearing Responsibility in Case of Accidents	473	3.92	.589	0.7883	15
		Relationship With Subcontractor	520	4.33	.474	0.8667	9
		Lack of Trust	516	4.30	.461	0.8600	11
6	*Factors Related To Subcontractors*	Size of Subcontractors Staff	480	4.00	.444	0.8000	11
		Previous Experience	563	4.72	.501	0.9383	6
		Practical & Technical Ability	575	4.79	.409	0.9583	4
		Financial Ability & Strength	518	4.30	.510	0.8633	8
		Performance of Relevant Previous Projects	543	4.52	.610	0.9050	7
		Subcontractor Familiarity with Work	585	4.37	.676	0.9750	3
		Extent of Subcontractors Commitment to	596	4.97	.185	0.9933	2

		Specifications					
		Extent of Subcontractors Commitment to Schedule	600	5.00	0.000	1.0000	1
		Close Control Over the Cost by Subcontractors	574	4.78	.417	0.9567	5
		Prompt Payment to Labourers	500	4.16	.457	0.8333	10
		Provide Adequate Information	501	4.17	.513	0.8350	9

Source: Field Survey, 2016.

Table 4. 4: Correlation; Project Related Factors

		Densely Populated Place	Large Project	Additional Work Increase	Remote Location	No Contingency Budget	Fundamental Changes Increase	Many Execution Obstacles	Government Policy
Densely Populated Place	Pearson Corr.	1	.352**	.244*	.038	.091	.057	-.195*	.312**
	Sig. (1-tailed)		.000	.011	.370	.203	.300	.037	.002
Large Project	Pearson Corr.	.352**	1	.233*	.005	-.069	.168	-.308**	-.072
	Sig. (1-tailed)	.000		.014	.483	.264	.059	.002	.256
Additional Work Increase	Pearson Corr.	.244*	.233*	1	.424**	.261**	.285**	-.038	.405**
	Sig. (1-tailed)	.011	.014		.000	.008	.004	.364	.000
Remote Location	Pearson Corr.	.038	.005	.424**	1	.605**	.576**	.349**	-.274**
	Sig. (1-tailed)	.370	.483	.000		.000	.000	.001	.008
No Contingency Budget	Pearson Corr.	.091	-.069	.261**	.605**	1	.245*	.262**	-.170
	Sig. (1-tailed)	.203	.264	.008	.000		.011	.008	.061
Fundamental Changes Increase	Pearson Corr.	.057	.168	.285**	.576**	.245*	1	.192*	-.251**
	Sig. (1-tailed)	.300	.059	.004	.000	.011		.039	.010
Many Execution Obstacles	Pearson Corr.	-.195*	-.308**	-.038	.349**	.262**	.192*	1	-.233*
	Sig. (1-tailed)	.037	.002	.364	.001	.008	.039		.017
Government Policy	Pearson Corr.	.312**	-.072	.405**	-.274**	-.170	-.251**	-.233*	1
	Sig. (1-tailed)	.002	.256	.000	.008	.061	.010	.017	

Source: SPSS Output from Field Survey, 2016.

A relationship was established in table 4.4 in connection with project related factors that affect the cost and time performance of subcontractors using Pearson's Correlation. It was discovered that the factor densely populated place has a correlation with large projects, additional work increase, many execution obstacles and government policy with the significance values of 0.000, 0.011, 0.037 and 0.002 respectively. This means that a project manager needs to be cognisant with these factors because inability to control one of these factors has could trigger further problems. Also, large project was found to have relationship with densely populated place (0.000), additional work increase (0.014), and many execution obstacles (0.002). Anytime subcontractors encounter large project situation, efforts must be made to control the introduction of factors like densely populated place, many execution obstacle and addition work increase. The factor "additional work increase" was revealed to be correlated with densely populated place (0.011), large project (0.014), remote location (0.000), no contingency budget (0.008), fundamental changes increase (0.004) and government policy (0.000). The relationships established among these factors are weak correlation. This means that the factors do not have much influence on each other in an event one factor is found to affecting cost and performance of projects and vice versa. More so, the study established that there is relationship between remote location and additional work, no contingency plan, fundamental changes increase, many execution obstacles and government policy with significant values of 0.000, 0.000, 0.000, 0.001 and 0.008 correspondingly. This means that whenever remote location is the main factor influencing cost and performance of subcontractors, there is a likelihood that the aforementioned could also be generated especially no contingency budget and fundamental changes increase because they have higher correlation values. Furthermore, no contingency budget was found to be correlated with additional work increase (0.003), remote location (0.000), fundamental

changes increase (0.011) and many execution obstacles (0.008). Moreover, fundamental changes increase has relationship additional work increase (0.004), remote location (0.000), no contingency budget (0.011) and government policy (0.010). The study realised that there is relationship between many execution obstacles and large project (0.002), remote location (0.001), no contingency budget (0.008), many execution obstacles (0.039) and government policy (0.017).

Lastly, government policy was found to have a correlation with densely populated place (0.002), additional work increase (0.000), remote location (0.008), fundamental changes increase (0.010) and many execution obstacles (0.017).

Table 4. 5: Correlation of Factors Pertaining to Project Manager

		Manager Personality	Salary of Managers	Management Level Leadership	Regular and Effective Communication	Managers Recognition of Construction
Manager Personality	Pearson Correlation	1	-.292	-.025	-.016	-.023
	Sig. (1-tailed)		.004	.414	.441	.417
Salary of Managers	Pearson Correlation	-.292	1	-.421	-.124	.085
	Sig. (1-tailed)	.004		.000	.133	.223
Management Level Leadership	Pearson Correlation	-.025	-.421	1	.170	-.038
	Sig. (1-tailed)	.414	.000		.069	.372
Regular and Effective Communication	Pearson Correlation	-.016	-.124	.170	1	-.029
	Sig. (1-tailed)	.441	.133	.069		.399
Managers Recognition of Construction	Pearson Correlation	-.023	.085	-.038	-.029	1
	Sig. (1-tailed)	.417	.223	.372	.399	

Source: SPSS Output from Field Survey, 2016

Table 4.5 illustrates correlation of factors pertaining to project managers with respect project cost and time performance of subcontractors. It was established that the manager personality has a correlation with salary of staff with significant value of 0.004. The extent of correlation between manager personality and salary of managers is a weak negative correlation. Also, it was discovered that salaries of managers has relationship with the manager's personality and management level leadership with level of significance of 0.004 and 0.000 respectively. This implies that when there is a challenge with salary of managers then managers personality and their level of leadership management may be suffered although the correlation existing between these variables are weak negative correlation.

More so, management level leadership was found to have correlation with salary of managers (0.000). This means that when management level leadership is influencing the cost and performance of the project of subcontractors then the salary of managers challenges is likely to be encountered though the relationship between the variables are weak negative correlation. It is interesting to note that, regular and effective communication and managers' recognition of construction factors/variables were found to have no significant influence on none of the factors and also do not correlate with any of the factors. This means that the two factors are independent of the factors pertaining to project managers affecting the cost and performance of subcontractors.

4.6 COST AND TIME RELATED FACTORS MOST AFFECTED BY SUBCONTRACTOR MANAGEMENT

Table 4.6 illustrates the effects of subcontractor management on project cost and time. The study observed that the most significant effect of subcontractor management on project cost and time was the time needed to rectify defects (RII=0.995). When the

management of subcontractors is diligently executed, the occurrence of defects is reduced and hence shorter periods for correcting defects and less cost of making good those defects. On the other hand, inappropriate subcontractor management leads to defective work which requires additional time and cost in order to rectify the defects. The second most significant factor respondents indicated was the time needed to implement variation orders (RII=0.985). The rest of the effects of subcontractors management on project cost and time are encapsulated in order of relative importance as planned time for project construction, Waste rate of materials, Profit rate of projects, Project labour cost, Cost of variation orders, Materials & equipment cost and Overhead percentage of projects. The factor respondents considered as having the least effect is the overhead percentage of projects (RII=0.862).

Table 4. 6: Ranking of cost and time related factors most affected by subcontractor management

No.	Effects	Score	Mean	SD	RII	Rank
1	Profit Rate of Project	583	4.86	.347	0.9717	**5**
2	Material & Equipment Cost	533	4.40	.559	0.8883	**8**
3	Project Labour Cost	544	4.53	.502	0.9067	**6**
4	Waste Rate of Materials	583	4.86	.347	0.9717	**4**
5	Cost of Variation Orders	537	4.44	.659	0.8950	**7**
6	Planned Time for Project Construction	591	4.95	.260	0.9850	**3**
7	Time Needed to Implement Variation Orders	591	4.92	.313	0.9850	**2**
8	Time Required to Rectify Defects	597	4.97	.239	0.9950	**1**
9	Overhead Percentage of Project	517	4.31	.559	0.8617	**9**

Source: Field Survey, 2016

Table 4.7 illustrates correlation of effects of subcontractor management on saving projects cost and time. It was observed that the profit rate of a project has a correlation with materials & equipment cost, project labour cost, and waste rate of materials with

significant values of 0.000 for each of the factors. This implies that in order to manage profit rate of a project to save cost and time, it is important for project management to control the materials & equipment, project labour cost, and waste rate of materials. The study established that there is relationship between materials & equipment cost and profit rate of project (0.000), project labour cost (0.000), waste rate of materials (0.000), and time needed to Implement Variation Orders (0.025). The study revealed that in order to save project cost and time with respect to materials & equipment, it is imperative to take into consideration the profit rate of project, project labour cost, waste rate materials and the time needed to implement variation orders. It was realised that project labour cost has a correlation with profit rate of project (0.000), materials & equipment cost (0.000), cost of variation orders (0.001) and overheads percentage of project (0.000). The study found that the waste rate of materials has a relationship with profit rate of project (0.000), materials & equipment cost (0.000), cost of variation orders (0.006), and overheads percentage of project (0.000). Cost of variation orders was found to have correlation with project labour cost, waste of materials and overheads percentage of project with its significant values of 0.001, 0.006 and 0.000. The researcher also discovered that the plan time for project construction has a significant influence on time needed to implement variation orders (0.000) and time required to rectify projects (0.000). More so, the time needed to implement variation orders was found to have a significant relationship with the plan time for project construction (0.000) and the time needed to rectify defects (0.000). Furthermore, the study established that there is significant relationship between the time needed to rectify defects and the time necessary to implement variation orders and the plan time for project construction with its significant values being 0.000 each affecting project cost and time. This means that the time needed to rectify project defects has influence on the time needed to implement

variation orders and plan time for project construction to saving project cost and time. Lastly, there is a significant correlation between overhead percentages of project and project labour cost, waste rate of materials, and cost variation orders with significant values being 0.000 in each case.

Table 4. 7 Correlation of effects of subcontract management on projects cost and time

		A	B	C	D	E	F	G	H	I
Profit Rate of Project (A)	Pearson Corr	1	.469	.357	.517	.114	-.071	-.103	.082	.091
	Sig. (1-tailed)		.000	.000	.000	.147	.256	.170	.224	.202
Material & Equipment Cost (B)	Pearson Corr	.469	1	.434	.349	.054	-.111	-.211	.018	.000
	Sig. (1-tailed)	.000		.000	.000	.310	.153	.025	.434	.498
Project Labour Cost (C)	Pearson Corr	.357	.434	1	.090	-.319	-.079	-.096	-.040	-.354
	Sig. (1-tailed)	.000	.000		.204	.001	.234	.188	.356	.000
Waste Rate of Materials (D)	Pearson Corr	.517	.349	.090	1	.266	-.071	-.103	-.058	.405
	Sig. (1-tailed)	.000	.000	.204		.006	.256	.170	.296	.000
Cost of Variation Orders (E)	Pearson Corr	.114	.054	-.319	.266	1	.118	.172	.023	.351
	Sig. (1-tailed)	.147	.310	.001	.006		.137	.055	.417	.000
Planned Time for Project Construction (F)	Pearson Corr	-.071	-.111	-.079	-.071	.118	1	.668	.724	.021
	Sig. (1-tailed)	.256	.153	.234	.256	.137		.000	.000	.425
Time Needed to Implement Variation Orders (G)	Pearson Correlation	-.103	-.211	-.096	-.103	.172	.668	1	.585	-.054
	Sig. (1-tailed)	.170	.025	.188	.170	.055	.000		.000	.312
Time Needed to Rectify Defects (H)	Pearson Corr	.082	.018	-.040	-.058	.023	.724	.585	1	.170
	Sig. (1-tailed)	.224	.434	.356	.296	.417	.000	.000		.058
Overhead Percentage of Project (I)	Pearson Corr	.091	.000	-.354	.405	.351	.021	-.054	.170	1
	Sig. (1-tailed)	.202	.498	.000	.000	.000	.425	.312	.058	

Source: SPSS Output from Field Survey, 2016

4.7 RECOMMENDATION OF GUIDELINES

The need to recommend guidelines for subcontractor management to enhance the performance of subcontract projects within cost and time constraints was the drive behind this study. It was envisaged that proposal of appropriate guidelines to aid construction managers was beneficial in many ways and situations and theories supporting this cause were well established. The outcomes from the analysis of the data, as presented in the preceding sections of this chapter are converged into a set of specific recommendations in the form a flow diagrams.

4.7.1 PURPOSE AND SCOPE OF THE GUIDELINES

The purpose of this subcontractor management chart is to provide practical guide on how best to manage subcontractor within the constrictions of time and cost so as to improve the cost and time performance of subcontractors. These guidelines apply to all types of building construction subcontractors and subcontract works. It is must be to noted that the issues outlined in this guideline may vary depending on the magnitude of subcontracting and the size of the subcontractor organisation. For example, if the main contractor only has one subcontractor for a relatively small construction project for a short-term, then it may not be necessary to implement all of the procedures outlined. Nonetheless, this guideline affords an opportunity for main contractors to tailor to their own needs.

4.7.2 ASSUMPTIONS OF THE GUIDELINE

This guideline has been developed on the premise of a number of assumptions as follows:

1. That the subcontractor has already gone through the evaluation process and

been selected for the project.

2. The Subcontractor is under the management of the main contractor.
3. The main stages of the management process are the pre-execution phase, the execution phase and the project closure phase of the subcontract work.

4.7.3 SUBCONTRACTOR MANAGEMENT ENVIRONMENT

Figure 4.10 portrays the simple connection that exists between the main contractor, the subcontractor and the environment within which they operate. The responsibility of the main contractor is to manage the subcontractor to perform the subcontract task agreed upon with the main contractor within the constraints of time and cost. The main issues surrounding the environment are Time, Cost, Resources, Risks and Health and Safety, with communication as the main link for the project parties to exist and function effectively.

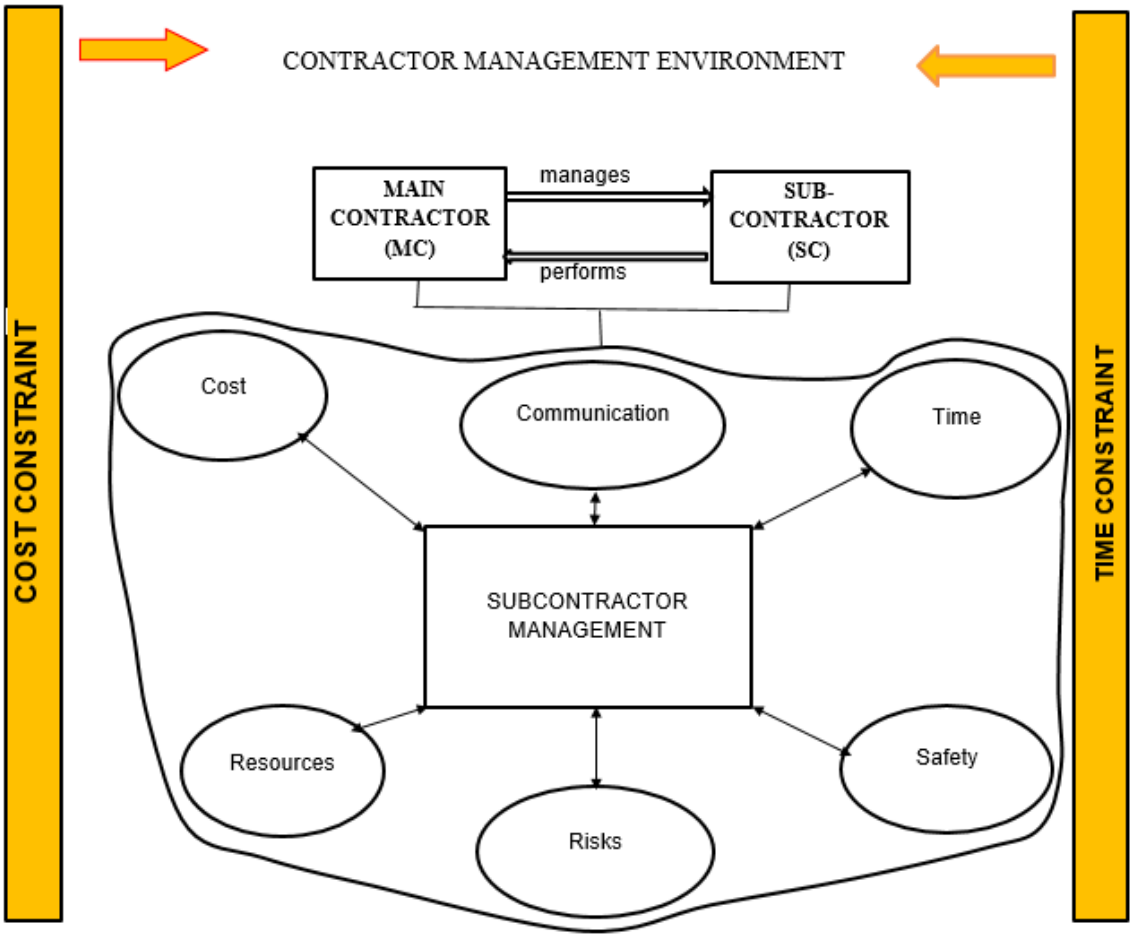


Figure 4. 10 Subcontractor management environment

4.7.4 PRE-EXECUTION PHASE

Figure 4.11 below depicts the processes involved at the pre-execution phase. The first important step in the management process is to identify the characteristics of the subcontractor in order to develop a management strategy to suit the type of subcontractor. The characteristics include subcontractor's skills and knowledge, among others. Ones these characteristics have been identified, the main contractor would have to come up with a management strategy to handle the subcontractor. It is important to request for the subcontractor's own work plan to see how best to integrate it with that of the main contractor. The main component of the subcontractor management process at the pre-execution phase is the Subcontractor Induction or Forum. At the induction, both

the main contractor and subcontractor discuss key issues relating to the project at hand are discussed and any clarifications made for a smooth take-off of the subcontract work.

The first issues addressed here include a clear definition of the scope of work and any possible setbacks during the project execution and how to handle those challenges. The parties must also discuss issues concerning project resources readiness for the project and any foreseen difficulties in the resource acquisition or prospects for alternative sources. The documentation should also be a subject of discussion at this state so that both the main contractor and main contractor are clear on the documents for the project and an opportunity for any party to raise issues for clarification. The next important step at this stage is to deliberate on the project objectives and constraints; which in this case is time and cost.

The second subject of discussion at the induction is to outline responsibilities of both parties. The dialogs should point out who has to do what and at what time or period. The discussions should emphasize the room for continuous improvement on all that has to be done. There should be an opportunity for innovation so that the subcontractor(s) is not restricted so much to the contract and be denied the opportunity to bring his innovative ideas to bear during the project execution.

Another subject of deliberations at the induction is the payment and reimbursement plans for both the main contractor and the subcontractor as agreed between the main contractor and the client's consultants. The periodic payment schedules that should include the procedure for claims submittals and approval and retention requirements must be established and agreed. The main contractor should ascertain the subcontractor's pre-finance plan to include the sources and alternative arrangements and advise the subcontractor contractor on alternative sources of these pre-finance, payment bonds, guarantees and insurances.

Again, it is important for the main contractor to outline the performance requirements of the subcontractor and the assessment parameters. The criteria for performance assessment should include how materials are management and usage on site, coordination of site activities and methods employed in the construction process.

Besides, communication, which is an important aspect of the construction stage, must be discussed. The dialogs issues should address the most appropriate mode of communication, the need for periodic progress reporting and welfare of employees to avert any industrial unrest during the construction process. It is important to emphasize the need for mostly, formal communication as opposed to informal to prevent misunderstanding and possible disputes.

Finally, the induction process should also discuss the risks associated with the project; their likelihood and plans to manage those risks. There should be deliberations of likely hazards, safety rules and procedures. When all these discussion are done, it is important for the main contractor to assure the subcontractor of continues support and cooperation and to let the subcontractor know that they are in the project together and that they will accomplish together.

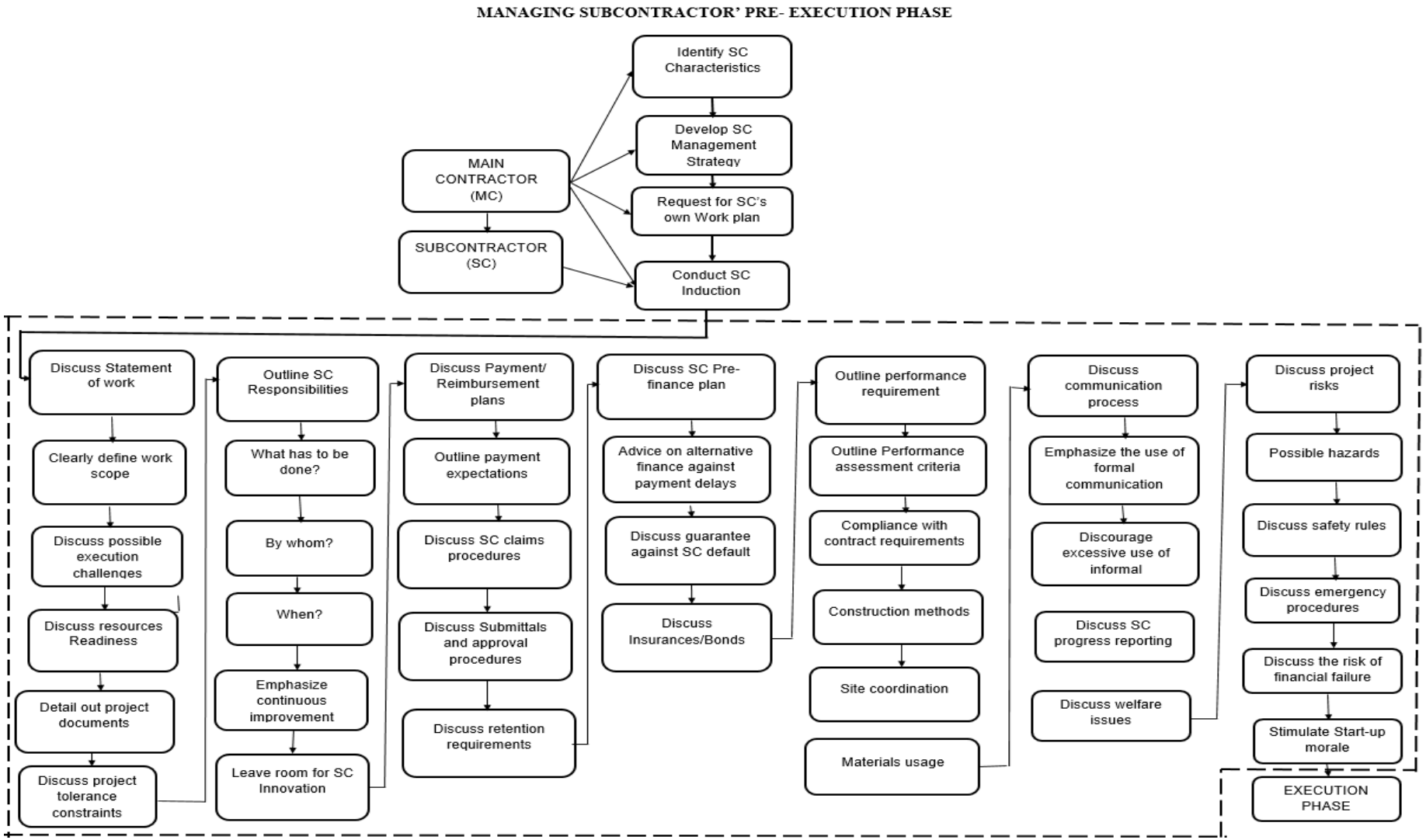


Figure 4. 11: Subcontractor management at pre-execution phase

4.7.5 EXECUTION PHASE

Figure 4.12 below illustrates the execution phase of the subcontractor management process. The Main contractor's major tasks at the execution phase is mainly monitoring and controlling the subcontractor's work and instituting corrective actions.

The first activity at this stage is to assess the layout of the subcontractor's project site. The assessment should cover the positioning of essential resources for the project, provision for movement of materials, equipment and labour and siting of welfare facilities. The main contractor should also check resources such as materials and plant to ensure their conformance to specification. The main contractor must also ensure that the subcontractor has fully satisfied the labour requirement for the project at hand. More especially, the core competencies required for the project must be in place to ensure the smooth execution of the project. Necessary steps must be initiated to address any shortfalls in this regard before the subcontract project takes off.

When the project starts, the main contractor should conduct regular performance evaluation to ascertain the extent to which the subcontractor is working within cost, ahead of schedule and compliance with safety practices on site. Any performance challenges in the execution process must be identified very early and the necessary corrective action initiated to deal with such drawbacks. One significant warning sign that should be looked out for is the over reliance on the project floats (flexibilities). Good performing Subcontractor should be rewarded for their efforts and non-performing subcontractors chastised for underperformance. In all these processes, it is important to build strategic relationships to encourage more cooperative working amongst construction parties, especially, between the main contractors and the subcontractors. The main contractor should endevour to offer training support to the subcontractor's workforce.

The main contractor should write progress reports on the subcontractor's work to cover pertinent issues relating to resource adequacy and utilisation, construction methods, site coordination and effectiveness of subcontractor's supervision. This report must be an agenda for discussion at site meetings in order to map up strategies to deal with any issues that could threaten the successful completion of the project within cost and at the stipulated time.

The main contractor must also initiate and follow up on any payment for subcontractor's work in a timely manner to prevent the plunging the subcontractor into financial crisis and consequent delay to the project. The main contractor should also look out for signs of subcontractor insolvency and take steps to forestall.

The final part of subcontractor management process is the project closure stage. At this stage, the main contractor conducts a review of the subcontractor's work and ensures that all agreements between the main contractor and the subcontractor is terminated. The main contractor must then write the final reports on the subcontract project and declare the project closed.

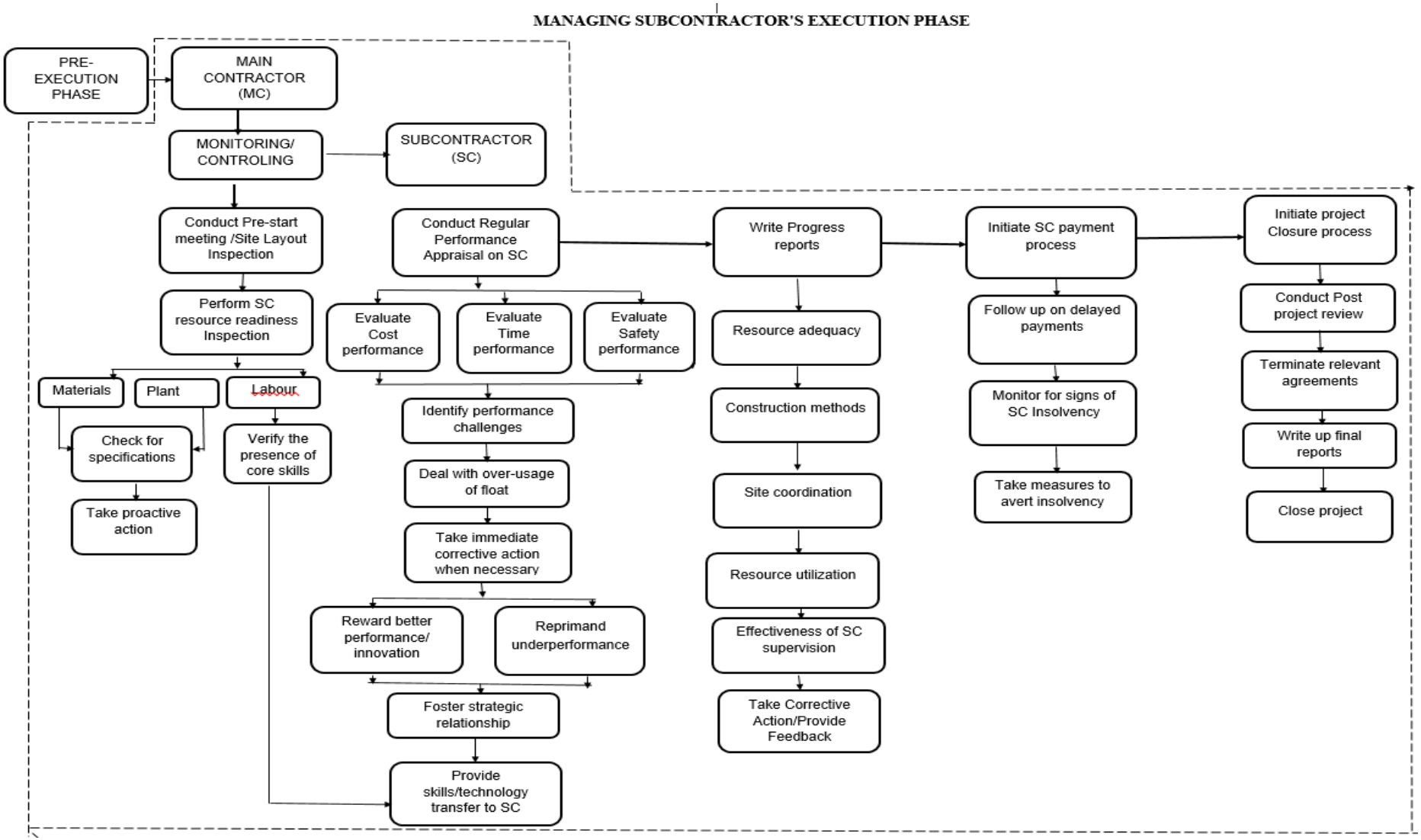


Figure 4.12: Subcontractor management process at the execution phase

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The key attention of the research was to develop guidelines to support the management of subcontracts within the critical constraints of time and cost in construction projects in Ghana; starting from the worldwide overview of subcontract management knowledge and research data. The aim and objectives set out for this study have been achieved by completing the preceding four steps discoursed previously in this study. This chapter reconsiders the objectives and research the questions as outlined earlier to establish the extent to which they have been realised considering the various stages of the research. The limitations of this research are also outlined and then recommendation of realistic guidelines tailored to the Ghanaian construction sector has also been made. The chapter further pointed to areas where further research is required within the body of knowledge and that can be undertaken reference to the limitations and findings of this study.

5.2 SUMMARY OF FINDINGS

This section summarizes the key findings from the research. In order to put it in perspective, the main findings of the research are categorized under their respective research objectives as follows:

5.2.1 EXTENT TO WHICH THE CONCEPT OF SUBCONTRACTING IS USED IN THE GHANAIAN BUILDING INDUSTRY

This was successfully achieved through a questionnaire survey in the study area, eliciting pertinent data to meet the objective. The findings revealed that subcontracting is a common occurrence in building projects in Ghana. This showed that significant portions

(as much as 40 percent) of projects/works are outsourced to subcontractors. The projects often executed by subcontractors include Commercial or official buildings, Government buildings, Hotel/Retails/ Shopping centre, Residential developments and Hospitals. These subcontractors are mostly specialists in Mechanical and Plumbing, Glazing and Building construction.

5.2.2 CHALLENGES INHERENT IN MANAGING SUBCONTRACTORS IN THE GHANAIAN BUILDING INDUSTRY

This objective was mainly achieved through extensive literature review and more specifically questionnaire survey and analysis. Ten (10) main challenges innate in subcontractor management was identified. The five topmost challenges included lack of Safety, Site Coordination Challenges, Lack of Proper Communication, Non-Adherence to Schedule and Contractor's Financial Challenges.

5.2.3 FACTORS AFFECTING THE COST AND TIME PERFORMANCE OF SUBCONTRACTORS IN THE GHANAIAN BUILDING INDUSTRY

This objective was achieved through RII and mean score questionnaire survey and analysis of factors which were identified from literature. The study identified fifty-one (51) factors, which were grouped under six main headings namely: Project related factors, Contract documents and Management related factors, Factors pertaining to project staff in general, Factors pertaining to project manager, Factors related to main contractors and Factors related to subcontractors. These factors were evaluated by use of likert scale: 1-5 to rate the level of importance of each identified factor. For this, a mean score analysis was used in the evaluation each group of factors. The study established that the key factors affecting cost and time performance of subcontractors included:

Extent of subcontractor's commitment to schedule, Practical and technical ability of Main Contractors, Project Manager's recognition of the other construction activities related to subcontractors tasks, Lack of efficiency, Clear understanding of the contract conditions, requirements and project objectives and Many project execution obstacles.

5.2.4 COST AND TIME RELATED FACTORS MOST AFFECTED BY SUBCONTRACTOR MANAGEMENT

In order achieved this objective, construct spawned from the first literature was developed into questionnaires, which was administered to 88 respondents, which involved main contractors, subcontractors and consultants in the construction industry. Evaluation was by the use of likert scale: 1-5 to rate the level of importance of each identified variables. The study established that the four cost and time related factors most affected by subcontractor management are: Waste rate of materials, Planned time for project construction, Time needed to implement variation orders and Time required to rectify defects.

5.2.5 GUIDELINES FOR MANAGING SUBCONTRACTOR' WORKS AIMED AT ENHANCING THE TIME AND COST PERFORMANCE OF BUILDING PROJECTS.

The research developed guidelines in the form of flow charts, in response to the identified deficiencies in managing subcontracts when cost and time are the main constraints. The developed guideline addresses key issues such as planning, execution and control processes of subcontract projects.

5.3 CONCLUSION

Based on the findings the following conclusions are drawn:

1. Subcontracting is a common occurrence in building projects in Ghana. Significant portions (as much as 40 percent) of projects/works are usually outsourced.
2. The main challenges in the management of subcontractors include Lack of Safety, Site Coordination Challenges, Lack of Proper Communication, Non-Adherence to Schedule and Contractor's Financial Challenges.
3. The factors affecting cost and time performance of subcontractors are: Extent of SC's commitment to schedule, Practical and technical ability of MC, PM's recognition of the other construction activities related to subcontractors tasks, Lack of efficiency and Clarity of contract conditions and project objectives.
4. Cost and Time related factors most affected by SCM are Time required to rectify defects, Waste rate of materials, planned time for project construction and Time needed to implement variation orders.

5.4 RECOMMENDATIONS FOR INDUSTRY

In the light of the findings of the research, the following recommendations are proposed:

- The MWRWH should consider a separate registration of subcontractors into various categories, distinct from the existing categorization contractors. This would help in the capacity building of the subcontractors in their various specialties and aid clients as well as main contractors in making informed decision about the registered subcontractors to facilitate the selection of reliable subcontractors for their projects.

- Project managers must not adopt ‘brick and mortar’ approach to subcontractor management; the management approach adopted must be tailored to suit the job at hand.
- The adoption of tools and practices from other management fields such as operations management to augment the existing construction management strategies would be very helpful.
- Main contractors should pay attention to helping build the technical capacity of subcontractors in relation to project planning, scope management and project cost and time management.
- Clients should do due diligence in the selection of main contractors and subcontractors for their project, paying attention not only to tender prices but more importantly, the previous performance, technical and financial capacities of the bidders. The involvement of the main contractor in selecting subcontractors is particularly essential even if the subcontractor is nominated.

5.5 LIMITATIONS OF THE RESEARCH

The research was not without challenges, as is the case almost every research endeavor. The limitation of this research is in relation to the sample selection, which was limited to Accra Metropolis due fact that majority of the research target operated in this capital city.

Although respondents’ background represented a wide spectrum of construction works, it still did not cover all types of subcontract works in construction projects. Thus, views presented here represent those categories of contractors sampled.

5.6 SUGGESTIONS OF POSSIBLE NEW RESEARCH AREAS

Due to the differences of stance between positivist and constructionist and because this research adopted a positivist stance, there is the need for development and validation of a subcontractor management model; adopting a constructionist.

The study was conducted in a one geographic region, and it would therefore be necessary to extent the scope of future research on the subject to cover a wider area.

REFERENCES

Abbasianjahromi, H., Rajaie, H. and Shakeri, E. (2013). A framework for subcontractor selection in the construction industry. Journal of Civil Engineering and Management, 19(2): 158-168.

Abdull-Rahman, S.H., Endut, I.R., Faisol, N. and Paydar, S. (2014), The Importance of Collaboration in Construction Industry from Contractors‟ Perspectives, Procedia - Social and Behavioral Sciences, Vol.129, pp. 414 – 421.

Abdul-Rahman, H. Berawi, M. A. Berawi, A. R. Mohamed, O. Othman, M.and Yahya, I.A. (2006) "Delay mitigation in the Malaysian construction industry," *Journal of construction engineering and management*, vol. 132, p. 125,.

Acharya, A.(2004) 'How ideas spread: whose norms matter? Norm localization and institutional change in Asian regionalism', International Organization 58(2): 239–75.

Adesi (2014) A generic framework for consultancy services pricing in ghana: the case of quantity surveying practice, Unpublished MPhil. Thesis KNUST.

Aggarwal, SC. (1985). MRP, JIT, OPT, FMS? *Harvard Business Review* 63(5): 8-16.

Alarcón, L. F., Diethelm, S., Rojo, O., and Calderon, R. (2005). Assessing the impacts of implementing lean construction *International Group for Lean Construction.* Symposium conducted at the meeting of the International Group for Lean Construction,(IGLC)-13, Sydney, Australia

Albino, V., Gravelli, A. (1998). A Neural Network Application to Subcontractor Rating in Construction Firms, *International Journal of Project Management*, 16 (1): 9-14.

Al-Kharashi, A., and Skitmore, M. (2009). Causes of delays in Saudi Arabianpublic sector construction projects.Construction Management and Economics,27(1). pp. 3-23. www.eprints.qut.edu.au Accessed 4/9/2012.

Alinaitwe, H. M.; Mwakali, J. A.; Hansson, B. (2007). Factors affecting the productivity of building craftsmen studies of Uganda, Journal of Civil Engineering and Management 13(3): 169–176.

Al-Hammad, A and Al-Hammad, I. (1996) Interface Problems between Building Owners Designers. *Journal of Performance of Construction Facilities*, ASCE, 10(3), pp. 123-126

Al-Hammad, A., S. Assaf and 1992. Design-construction interface problems in Saudi Arabia. Build Res.and Information, 20(1): 60-63.

Al-Mansouri, O (1988). *The Relationship between the Designer and the Contractor in Saudi Arabia*. PhD thesis, University of Reading, Reading U.K

Alinaitwe, H.M., K. Widen, J. Mwakali and Hansson B. (2007). Innovation Barriers and Enablers that affect Productivity in Uganda Building Industry. Journal of Construction in Developing Countries, ISSN 1823-6499, 12(1): 59-76.

Al-Otaibi, M and Price, A D F (2010) Analysis and evaluation of criteria for pre-selecting contractors in the Saudi Arabian construction sector. In: Egbu, C. (Ed) Procs 26th Annual ARCOM Conference, 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, 1141-1148.

Alterman, T., Grosch, J. Chen, X. Chrislip, D. Muntaner, C. Petersen, M.R. Krieg, E. (2008). Examining associations between job characteristics and health: Linking data from the Occupational Information Network (O*NET) to two US National Health Surveys J Occup Environ Med., 50(12): 1401-1413.

Ameh, O.J. and Osegbo, E.E. (2011), Study of Relationship between Time Overrun and Productivity on Construction Sites, International Journal of Construction Supply Chain Management, Vol.1, pp.56-67.

Anaman, A.K. and Osei-Amponsah, C. (2007), Analysis of the causality links between the growth of the construction industry and the growth of the macro- economy in Ghana, Institute of Economic Affairs, Accra, Ghana, *Construction Management and Economics. pp. 951-954*

Andersen, P. (1999). Organizing international technological collaboration in subcontractor relationships: and investigation of the knowledge stickiness problem. *Research Policy , 28* (1), 625- 642.

Andy, K.W. and Andrew, D. F., (2010). Optimizing the time performance of subcontractors in the building projects. *Australasian journal of construction economics and building,* 10 (1/2), 90-100.

Antoni, C. (2005). "*Management by objectives - an effective tool for teamwork?."* Int. J. Human Resource Management 16(2), 174-184.

Antwi, S.K., Hamza, K., & Bavon, S.W. (2015). Examining the Effectiveness of Electronic Payment System in Ghana: The Case of e-ZWICH in the Tamale Metropolis.*Research Journal of Finance and Accounting, 6*(2),163-177.

Arditi, D. and Chotibhongs, R. (2005). Issues in Subcontracting Practice, *Journal of Construction Engineering and Management*, 131 (8): 866-876.

Artto, K., Eloranta, K. and Jaakko, K., (2008). Subcontracors' business relationships as risk sources in project networks. *An International Journal of Managing Projects in Business*, 1(1), 88-105.

Aritua, B., Smith, N., & Brower, D. (2009). Construction client multi-projects - a complex adaptive systems perspective. *International Journal of Project Management , 27* (1), 72-79.

Arslan, G., Kivrak, S., Birgonul, M.T., Dikmen, I. (2008). Improving subcontractor selection process in construction projects: web-based subcontractor evaluation system (WEBSES). Automation in Construction 17 (4), 480–488.

Avots, I. (1983). Cost-relevance analysis for overrun control. International Journal of Project Management, 1, 142-148.

Azhar, N., Farooqui, R. U. & Ahmed, S. M. (2008). Cost Overrun Factors in Construction Industry of Pakistan. In *First International Conference on Construction In Developing Countries (ICCIDC–I), Advancing and Integrating Construction Education, Research & Practice,* 499-508.

Baapiri, G.A. (2015) Contractors' Assessment of Professional Services Quality: The Case of Quantity Surveying Firms in Ghana , Unpublished MPhil. Thesis KNUST

Bagilhole, B.M., Dainty A.R.J. and Neale, R.H. (2000). Women in the construction industry in the UK: A cultural discord? Journal of Women and Minorities in Science and Engineering, 6: 73-86.

Balderstone, S.J., Davies, J. and Mabin, V.J. (2005). The theory of constraints: a methodology apart? – a comparison with selected OR/MS methodologies. *Omega – International Journal of Management Science* 33(6): 506-524.

Balderstone, S.J. (1999). Increasing user confidence in System Dynamics models through use of an established set of logic rules to enhance Forrester and Senge's validation tests. In: Systems Thinking for the Next Millennium eds. Cavana, RY, Vennix, JAM, Rouwette, EAJA, Stevenson- Wright, M and Candlish J,. *Proceedings of the 17th International Conference of the System Dynamics Society and 5th Australian and New Zealand Systems Conference*, 1-9. The System Dynamics Society, Wellington, New Zealand.

Ballard, G., Kim, Y., Jang, J., and Liu, M. (2007). *"Implementing lean at the project level."* Construction Industry Institute, Austin, TX.

Ballard, G. (2000) (thesis).*"The Last Planner System of production control."* University of Birmingham, Birmingham, United Kingdom.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544-559.

Retrieved from http://www.nova.edu/ssss/QR/QR13-4/baxter.pdf

Benjaoran, V. (2009). A cost control system development: A collaborative approach for small and medium-sized contractors. *International Journal of project Managemant, 27(3), 270-277.*

Bennett J. and Ferry, D. "Specialist Contractors: a review of issues raised by their new role in building," *Construction Management and Economics*, vol. 22, no. 5, pp. 521–532, 1990

Biggam, J. (2007a). 'Re-thinking dissertation supervision practices: collaborative learning through learner circles', in Proceedings of the International Association for Technology, Education and Development (INTED, Valencia, Spain

Bouma, G. D. and Atkinson, G. B. J. (1995) A Handbook of Science Social Research. 2nd. ed. London: Oxford University Press.

Bryman, A. (2008). Social research methods (3r d ed.). Oxford: Oxf ord University Press.

Bryman, A. (2004). *Social Research Methods*, pp. 291-379, pp. 62-107.

Bryman, A. (2001) Social Research Methods. Oxford, Oxford University Press.

Buertey, J. I., Mizzah A. K. and Adjei-Kumi**, T.** (2014). "Delays to Large Construction Projects in Ghana: A Risk Overview." *Journal of Civil Engineering and Architecture*, 8 (3): 367-377 ISSN: 1934 7359.

Burns, A. and Burns, R. (2008). Basic Marketing Research (Second ed.). New Jersey: Pearson Education. p. 250. ISBN 978-0-13-205958-9.

Cavana, R., Delahaye, B., and Sekaran, U. (2001) Applied Business Research: Qualitative and Quantitative Methods, (3rd ed.) John Wiley & Sons Australia, Ltd,.

Chamara1, H.W.L. K. Waidyasekara, G.A.S and Harshini, M. *(2015) Evaluating Subcontractor Performance in Construction Industry. 6th International Conference on Structural Engineering and Construction Management 2015, Kandy, Sri Lanka, 11th-13th December 2015*

Chang, C., & Ive, G. (2007). The hold-up problem in the management of construction projects: A casestudy of the channel tunnel. *International Journal of Project Management , 25* (4), 394-404.

Chan, A.P.C., Scott, D. and Lam, E.W.M. (2002) Framework of Success Criteria for Design/Build Projects, Journal of Management in Engineering, Vol. 18, pp. 120-128.

Chan, D.W.M and Kumaraswamy, M.M. (2002), Compressing Construction Duration: Lessons Learned from Hong Kong Building Projects, International Journal of Project Management, Vol. 20, No. 1, pp. 23-35.

Chiang, Y. H. (2009) "Subcontracting and its ramifications: A survey of the building industry in Hong Kong," *International Journal of Project Management*, vol. 27, pp. 80–88.

Chiu, Y. C. (2010). *An Introduction to the History of Project Management: From the Earliest Times to A.D. 1900.* Delft: Eburon Academic Publishers.

Christou, E. Valachis, I, and Anastasiadou, (2008). "Research Methodology in Hospitality Industry: The role of the Inquiry Paradigms". Available on *http://www.ul.edu.lb/fthm/papers/3rd%20Axis/Methodology%20greece.doc*

Cioffi, D.F. (2006). "*Completing projects according to plans: an earned-value improvement index."* The Journal of the Operational Research Society, 57, 290–295.

Cohen, L., Manion, L. & Morrison, K. (2007) Research Methods in Education. 6th edn. London: Routledge.

Costantino, N. Pietroforte, and R.and Hamil A. (2001). *Subcontracting in commercial and residential construction: an empirical investigation.* Construction Management and Economics, vol. **19**: p. 439-447.

Crawford, L., Hobbs, B., and Turner, J.R. (2005) 'Project Categorizations Systems: aligning capability with strategy for better results'. Project Management Institute, chanslib [Online]. Available at: http://chans.lib.chalmers.se (Accessed: 18/6/2015).

Creswell, J. (2009) 'Research Design: Qualitative, Quantitative, and Mixed Methods Approaches', 3rd edn., California: SAGE Publications, Inc.

Crotty, M., (1998). *The foundations of social research: Meaning and perspective in the research process*. London: Sage publications.

Davies, A. (2014). Innovation and Project Management. In M. Dogdson, D. Gann, & N. Phillips (Eds.), *The Oxford Handbook of Innovation Management.* New York: Oxford University Press.

Daft,R.L.(2000). Organization Theory and Design. (7th ed.) South-Western College Publishing, Thomson Learning. U.S.A.

Darlington, J. 1995. Optimising production resources. *Management Accounting* 3(4): 57-60.

Dawson, C. W. (2009) *Projects in computing and information systems: a student's guide*. 2nd ed. Harlow: Addison-Wesley.

Dawson, T.L. (2002). New tools, new insights: Kohlberg's moral reasoni ng stages revisited. International Journal of Behavior Development, 26, 154-166.

Desai, M. C. & Desale, S. V. (2013). Study Factors Affecting of Delay in Residential Construction Project for Nashik city. *International Journal of Latest Trends in Engineering and Technology (IJLTET), 2:* 115-124.

De Vos, A.S.; Strydom, H.; Fouché, C.B. and Delport, C.S.L. (2005). *Research at grass roots for the social sciences and human service professions.* 3rd edition. Pretoria: Van Schaik Publishers.

Donaldson, L., & Hilmer, F. G. (1998). Management Redeemed: The Case Against Fads that Harm Management. *Organizational Dynamics*, *26*(4), 7-20.

Dossick, C. S. PE, M.and Schunk, T. K. (2007) "Subcontractor schedule control method," *Journal of Construction Engineering and Management*, vol. 133, p. 262,

Drucker, P. F. (1954), "The practice of management". Harper & Brothers Publishers,New York, USA.

Durrheim, K. and Wassenaar, D. (1999). Putting design into practice: writing and evaluating research proposals. In M. Terre Blanche & K. Durrheim (Eds.), Research in practice: applied methods for the social sciences. Cape Town: University of Cape Town Press.54-71.

Egan J. (1998). *Rethinking Construction: the report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction. London: Department of the Environment, Transport and the Regions.*

Egan (2014) Maintenance management of educational infrastructure in Ghana: Development of a framework for senior high schools, Unpublished MPhil. Thesis KNUST.

Elazouni, A.M and Metwally, F. G. (2000). "D-SUB: Decision support system for subcontracting construction works," *Journal of construction engineering and management*, vol. 126, pp. 191–200,

Enshassi, A., Choudhry, R.M., Mayer, P.E. and Shoman, Y. (2008), Safety Performance of Subcontractors in the Palestinian Construction Industry. Journal of Construction in Developing Countries, Vol. 13, No. 1.

Enshassi, A. and Medoukh, Z. (2007), The Contractor–Subcontractor Relationship: The General Contracto's View.

Enshassi, A., Mayer, P.E., Mohamed, S., and El-Masri, F. (2007), Perception of Construction Managers Towards Safety in Palestine, The International Journal of Construction Management, pp. 41-51

Enshassi, A., Mohamed, S. and Mayer, P.E. (2010), Factors Affecting Labour Productivity in Building Projects in, Journal of Civil Engineering and Management, Vol.13, pp.245-254.

Enshassi, A.; Mohamed, S.; Abu Mustafa, Z.; Mayer, P. E. (2007). Factors affecting labor productivity in building projects in the Gaza Strip, Journal of Civil Engineering and Management 13(4): 245–254.

Eom, C. Yun, S.and Paek, J. (2008). "Subcontractor evaluation and management framework for strategic partnering," *Journal of Construction Engineering and Management*, vol. 134, pp. 842-851,

Errasti, A., Beach, R., Oyarbide, A. and Santos, J. (2007). A process for Developing Partnerships with Subcontractors in the Construction Industry: An Empirical Study. International Journal of Project Management, Vol. 25, pp. 250-256.

Fagbenle, O. I., Makinde, F. A. and Oluwunmi, A. O. (2011) Factors Influencing Construction Clients'/Contractors' Choice of Subcontractors in Nigeria, *Journal of Sustainable Development*, 4(2), 254-259.

Fah, C.J. (2006), A study of Domestic Subcontractor, Retrieved from www.efka.utm. retrieved on 15-10-2014

Fatoye, E. O. (2012). Contributing Factors of Delay in the Nigeria Construction industry. A Project Cost Prediction Model using Principal Component Comprehensive Analysis with Other Selected Countries. *4th West Africa Built Environment Research (WABER) Conference* 24-26 July, Abuja Nigeria, 575-587.

Fellows, R., and Liu, A. (2008), Research Methods for Construction. Wiley- Blackwell Ltd, UK.

Fredendall, LD, Patterson, JW, Lenhartz, C, and Mitchell, BC. (2002). What should be changed? A comparison of cause and effect diagrams and current reality tree shows which will bring optimum results when making improvements. *Quality Progress* 35(1): 50-59.

Fiallo, C.and Revelo, V. (2002). *"Applying the last planner control system to a construction project: A case study in Quito, Equador."* Proc. 2002, 10th Annual Conference of the International Group for Lean Construction, IGLC, Gramado, Brazil.

Filstead, W.J. (1979). Qualitative Methods: A Needed Perspective in Evaluation Research. In T.D. Cook & C.S. Reichardt (Eds.), Qualitative and Quantitative Methods in Evaluation Research (pp. 33-48). Beverly Hills: Sage.

Fleming, Q. (1983). "*Put earned value into your management control system."* Horizons, Inc., Worthington, OH.

Flyvbjerg, B., Holm, M. S., Buhl, S. (2010) Underestimating Costs in Public Works Projects: Error or lie? *Journal of the American Planning Association* (Chicago: American Planning Association) 68 (3), pp. 279–295.

Flybjerg, B. (2005) *Policy and Planning for Large Infrastructure Projects: Problems, causes, cures.* World Bank Publications, pp. 4–5.

Ford, J.R., Jepson, M., Bryman, A., Keil, E.T., Bresnen, M. and Beardsworth, A., (1983). Management of recruitment in the construction industry. *International Journal of Project Management*, 1, 76 - 82.

Frankel, J.R., & Wallen, N.E. (2006). How to design and evaluate research in education. New York: McGraw-Hill.

Frazer, L & Lawley, M. (2000), *Questionnaire design administration*, John Wiley & Sons Australia, Ltd, Brisbane, New York, Chichester, Weinheim, Singapore, Toronto.

Fugar, F. D. & Agyakwah-Baah, A. B. (2010). Delays in Building Construction Projects in Ghana. *Australasian Journal of Construction Economics and Building, 10*(1/2): 128.

Gabula, Z. H. (2012). Factors influencing the construction project success rates of reconstruction development programme (RDP) Housing projects in the Eastern Cape: A quality perspective: A census study. M. Tech, Durban University of Technology.

Ganiyu, B. O. & Zubairu, I. K. (2010). Project Cost Prediction Model using Principal Component Regression for Public Building Projects in Nigeria. *Journal of Building Performance ISSN*, *1*(1).

Gardiner, S.C., Blackstone Jr., J.H., Gardiner, L.R., (1993). Drum-buffer-rope and buffer management: impact on production management study and practices. International Journal of Operations and Production Management 13 (6), 68–78.

Goldratt, EM. (1990). *What is This Thing Called Theory of Constraints and How Should it be Implemented?* North River Press, New York, USA.

Goldratt, E.M., Cox, J. (1984). The Goal. Croton-on-Hudson,The North River Press, NY.

Gonzalez, V. Alarcon, L. F. and Mundaca, F.(2008). “Planning & Control”. 19(5), 461-474.

Grix, J. (2004). The foundations of research. London: Palgrave Macmillan.

Gunning, J.G. and E. Cooke, (1996). The influence of occupational stress on construction professionals. Building research and information, 24(4): 213-221.

Gupta, M and Kline, J. (2008). Managing a community mental health agency: A Theory of Constraints based framework. *Total Quality Management* 19(3): 281–294.

Gupta, M, Ko, H-J and Min, H, (2002). Theory of Constraints-based performance measures and five focussing steps in a job-shop manufacturing environment. *International Journal of Production Research* 40(4): 907-990.

Mahamid, I. (2013), Principal Factors Impacting Labor Productivity of Public Construction Projects in Palestine: Contractors‟ Perspective, International Journal of Architecture, Engineering and Construction, Vol. 2, No 3, pp. 194-202

Hanisch, B., A. Wald. (2012). A bibliometric view on the use of contingency theory in project management research. Project Management Journal, 43(3): 4-23

Hartmann, A., (2010). Subcontractor procurement in construction the interplay of price and trust. *An International Journal*, 15(5), 354-355.

Hesse-Biber, Sharlene Nagy, & Leavy, Patricia. (2006). The practice of qualitative research. Thousand Oaks, CA: Sage.

Hinton, P.R., Brownlow, C., McMurray, I., & Cozens, B. (2005) *SPSS explained, Routledge Taylor & Francis Group, New York USA*

Hinze, J. W (2008). *“Construction planning and scheduling”* Upper Saddle River, New Jersey, USA.

Hinze, J. and Tracey, A. (1994). The Contractor-Subcontractor Relationship: The Subcontractor's View, *Journal of Construction Engineering andManagement*,120 (2): 274-287.

Hirschheim, R., Klein, H., and Lyytinen, K. (1995). Information Systems Development and Data Modeling: Conceptual and Philosophical Foundations, Cambridge University Press, Cam-bridge.

Huang, R.Y., Huang, C.T. Lin H. and Ku, W.H. (2008). Factor analysis of interface problems among construction parties—a case study of MRT. Journal of Marine Science and Technology, 16(1): 52-63.

Hughes, W., et al., *The impact and supply configurations on the costs of tendering in the construction industry,* in *CIB World Building Congress*2001, CIB: Wellington, New Zealand.

Hurley, J., (2012). Construction Giants ‗Bullying' Small Businesses. Telegraph. Retrieved from http://www.telegraph.co.uk/finance/yourbusiness/9603972/Construction-giants-bullying-small-businesses.html

Inman, R.A., Sale, M.L. and Green , K.W. (2009). Analysis of the relationships among TOC use, TOC outcomes, and organisational performance. *International Journal of Operations and Production Management* 29(4): 341-356.

Irlayici, P. and Tas, E. (2012). The Use of Information Technology on Gaining Competitive Advantage in Turkish Contractor Firms. *World Applied Sciences Journal*,18 (2), pp 274-285

Glenn D. (1992). Sampling the Evidence of Extension Program Impact. Program Evaluation and Organizational Development, IFAS, University of Florida. PEOD-5. October.

Jannadia, M. O., et al. (2000). Contractual methods for dispute avoidance and resolution (DAR). International Journal of Project Management, 18 (1), 41-49.

Johansen, E. and Porter, G.(2003). *"An experience of introducing last planner into a UK construction project."* Proc. 2003, 11th Annual Conference of the International Group for Lean Construction, IGLC, Blacksburg, VA.

Johnson, H.T. (2006). *"Management by Means Brings Management to Life".* Encuentro de Excelencia Centro Humano de Liderazgo Juarez, Mexico.

Johnson, H. T. (2000). *"Profit beyond measure: Extraordinary results through attention to work and people."* In Broams A. (Ed.), New York, USA.

Kale S. and Arditi, D. , (2001) "General contractors' relationships with subcontractors: a strategic asset," *Construction Management and Economics*, vol. 19, no. 5, pp. 541–549.

Kadir, A.M.R., Lee, W.O., Jaafar, M.S., Sapuan, M., Ali, A.A.A. (2005. *Factor affecting construction labour productivity for Malaysian residential projects*. Structural Survey, Vol. 23 No. 1, 2005, 42-54

Kapadia-Kundu, N. and Dyalchand, A. (2007) The Pachod Paisa Scale: A numeric response scale for the health and social Sciences. *Demography India 2007. 36: 2. 303-313*

Kim, Y. and Ballard, G. (2010). *"Management Thinking in the Earned Value Method System and the Last Planner System."* Journal of Management in Engineering, 26(4), 223-228.

Kim, S, Mabin, VJ and Davies, J. (2008). The theory of constraints thinking processes: retrospect and prospect. *International Journal of Operations & Production Management* 28(2): 155-184.

Kim, Y. and Jang, J. (2005). *"Case study: An application of last planner to heavy civil construction in Korea."* Proc. 2005, 13th Annual Conference of the International Group for Lean Construction, IGLC, Sydney, Australia.

Kish, L. (1965). Survey Sampling, John Wiley & Sons Inc., NY, US,.

Kissi (2013) Empirical understanding of the status of professional project management practices in the Ghanaian building industry, Unpublished MPhil. Thesis KNUST.

Knutson, K., Schexnayder, C. J., Fiori, C., Mayo, R. E., (2003), Construction Management Fundamentals. Boston, MA: McGraw-Hill, Inc.

Koetting, J. R. (1996). Philosophy, research, and education. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 1137-1147). New York: Simon & Schuster Macmillan.

Koljonen, EL and Reid, RA. (1999). Using system dynamics models to validate thinking process logic models. *Constraints Management Symposium Proceedings*, 67-76. APICS, Virginia, USA.

Koppenjan, J., Veeneman, W., van der Voort, H., ten Heuvelhof, E., & Leijten, M. (2011). Competing mangement approaches in large engineering projects: The Dutch RandstadRail project. *International Journal of Project Management* (29), 740-750.

Koskela, L., & Howell, G. (2002). *The theory of project management: explanation to novel methods*. International Group of Lean Construction annual conference, Gramado, Brazil.

Koskela, L., & Vrijhoef, R. (2000). *The prevalent theory of construction is a hindrance for innovation.* International Group of Lean Construction annual conference, Brighton, USA.

Kreuge, L.W and Neuman, William L. (2003). Social Work Research Methods. Boston, Massachusetts: Pearson Education Inc.

Ku, W. H (2000). *A Study of Establishing Lessons-Learned Database for Contractor*. Masters Thesis, National Taiwan University

Kumar, R. (2011). *Research methodology – A step by step guide for beginners, 3rd ed. Sage publications, 11-199.*

Kumaraswamy, M. and Matthews, J. (2000).Improved Subcontractor Selection Employing Partnering Principles, *Journal of Management in Engineering*, 16:47-58.

Kwofie T. E. (2015). 'Contribution of Unique Features of Mass Housing Projects to Project Team Communication Performance. PhD Thesis, KNUST

Leach, L.P., (1999). Critical chain project management improves project performance. Project Management Journal 30 (2), 39.

Lechler, T., Ronen, B. and Stohr, E.A. (2005). Final Report, "NASA Strategic Multi-project Resource Management 'CC-Lite'," *NASA CPMR Project Report, Phase 1*

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design* (8th ed.). Upper Saddle River, NJ: Prentice Hall.

Leng, G. Thomas, M. M. Prasad, G. (2005) An approach for on-line extraction of fuzzy rules using a self-organising fuzzy neural network, Fuzzy Sets and Systems 150 (2) pp.211–243

Lin, P-C, Lee, W-Y and Lee, M-Y. (2009). Exploring problems and undesired effects in the construction development process: the case study of a small-to medium-sized developer in Taiwan. *Journal of Construction Engineering and Management* 135(7): 560-569.

Lock, D. (2007) *Project management* (9th ed.), Gower Publishing, Ltd.

Luthans F (1973), "The Contingency Theory of Management : A path out of the jungle", Business Horizons, Volume 16, June 1973, pp 62-72.

Mabin, VJ and Balderstone, S.J. (2003). The performance of the theory of constraints methodology: Analysis and discussion of successful TOC applications. *International Journal of Operations &Production Management* 23(6): 568-595.

Mbachu, J. (2008) "Conceptual framework for the assessment of subcontractors' eligibility and performance in the construction industry," *Construction Management and Economics*, vol. 26, pp. 471–484.

Mbachu, J. and Nkadu, R, (2006). Conceptual framework for assessment of client needs and satisfaction in the building development process.*Construction Management and Economics, 24(1), 31-44.*

Mack, L. (2010)The Philosophical Underpinnings of Educational Research. Polyglossia Volume 19, October 2010(accessed: 12 May 2014) from http://rcube.ritsumei.ac.jp/bitstream/10367/1887/1/1-Polyglossia19_The%20Philosophical%20Underpinnings%20of%20Educational%20Research.pdf

Mackenzie, N. & Knipe, S. (2006), Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research*, Vol.16, No. 2, pp 193-205

Marczyk, Geoffrey R., Dematteo, David & Festinger, David. (2005). *Essentials of research design and methodology*. Hoboken, NJ: Wiley. (highly recommended, comprehensive and accessible)

Marshall, C., Rossman, G. (2006) *Designing qualitative research*, 4th edition.

Masrom, N., and Asrul, M. (2007). *Nature of delay in nominated subcontracting* (Master thesis). University Teknologi Malaysia, Faculty of Built Environment. Retrieved from http://eprints.utm.my/4439/.

McMillan, J. and Schumacher, S. (2006) *Research in Education: Evidence-Based Inquiry*, 6th edn, Pearson, Boston.

Mahamid, I. (2013), Principal Factors Impacting Labor Productivity of Public Construction Projects in Palestine: Contractors‟ Perspective, International Journal of Architecture, Engineering and Construction, Vol. 2, No 3, pp. 194-202.

Mahamid, I. (2011) 'Risk Matrix for Factors Affecting Time Delay in Road Construction Projects: Owners' Perspective', Engineering, Construction and Architectural Management, 8(6), 609 –617

Mason, J. (2004) *Qualitative researching*, 2nd edition.

Maturana, S., Alarcón, L. F., Gazmuri, P., and Vrsalovic, M. (2007). On-site subcontractor evaluation method based on lean principles and partnering practices. *Journal of Management in Engineering*, *23*(2), 67.

Maylor, H. (2010) *Project Management.* (4th ed.) Essex, England: Prentice Hall, financial times.

Mbachua, J., (2008). Conceptual framework for the assessment of subcontractors' eligibility and performance in the construction industry. *Journal of construction management and economic*, 26(5), 471- 473.

Gunderson, David E. & Cherf, Rick, W. (2012). General Contractors' Perceptions of Subcontractor's
Competencies and Attributes: A Pacific Northwest Study. *Proceedings of the48th Annual Associated Schools of Construction International Conference*. Birmingham City University, Birmingham, United Kingdom.

Memon, A. H., Rahman, I. A. & Azis, A. A. A. (2011). Preliminary Study on Conservative Factors Leading to Construction Cost Overrun. *International Journal of Sustainable Construction Engineering and Technology*, 57-70.

Mirawati, N.A., Othman, S.N. and Risyawati, M.I. (2015), Supplier-Contractor Partnering Impact on Construction Performance: A Study on Malaysian Construction Industry, Journal of Economics, Business and Management, Vol. 3,

Mohamed, M.M., and I.E. Terek, (2014). Analyzing delay causes in Egyptian construction projects. Journal of Advanced Research, 5(1): 49-55.

Moore, C., Mosley, D. and Slagle, M. (1992). Partnering Guidelines for Win-Win Project Management, *Project Management Journal*. 22(1), pp. 18-21.

Morris, P., Crawford, L., Hodgson, D., Shepherd, M., & Thomas, J. (2011). Exploring the role of formal bodies of knowledge in defining a profession - The case of project management. *International Journal of Project Management , 24*, 710-721.

Mossman, A. (2012). *Last Planner: Collaborative Conversations for Predictable Design and Construction Delivery*. Unpublished note.

Mullins, L.J. (2007) Management and Organizational Behaviour (8th Edition). Pearson Education: Upper Saddle River: New Jersey.

Naoum, S. G. (2007), *Dissertation Research and Writing for Construction Students*, Elsevier Ltd, Oxford, UK

Naoum, S. G. (2002) Dissertation research and writing for construction students, Oxford: Butterworth-Heinemann.

Nepal, M., Park, M., and Son, B.(2006). *"Effects of schedule pressure on construction performance."* Journal of Construction Engineering and Management*."* 132(2),182–188.

Nega, F. (2008). Causes and Effects of Cost Overrun on Public Building Construction Projects in Ethiopia. Unpublished Doctoral Dissertation, Addis Ababa University.

Neuman,W . L. (2003) Social research mnethodsq: ualitative and quantitative approaches, Boston: Pearson Education, Inc.

Ng, S. T., Tang, Z., and Palaneeswaran, E. (2009) Factors contributing to the success of equipment-intensive subcontractors in construction. *"International Journal of Project Management"*, **27**(7), 736-744.

Ng, S., Luu, C. and Chu, A. (2008a).Delineating Criteria for Subcontractors Registration Considering Divergence in Skill Base and Scales, *International Journal of ProjectManagement*, 26: 448-456.

Ng, S., Tang, Z. and Palaneeswaran, E. (2008b). Factors Contributing to the Success of Equipment-intensive Subcontractors in Construction, *International Journal ofProject Management*, DOI:10.1016/j.ijpman. 2008. 09.006.

Ng, S.T., Skitmore, M. and Chung, W.F. (2003), Ten Basic Factors to Identify Suitable Subcontractors for Construction Projects, CIB TG 23 International Conference.

Ngulube, P. (2005a). Research procedure used by Master of Information Studies students at the University of Natal in the period 1982-2002 with special reference to their sam-pling techniques and survey response rate: a methodological discourse. *The Interna-tional Information and Library Revie* 37:127-143.

Nicholas, J. M., & Steyn, H. (2012). Project management for engineering, business, and technology (4th ed.). New York: Routledge.

Obafemi, A. A., & Roy, M. (2013). Improving the Collaboration between Main Contractors and Subcontractors within traditional construction procurement. *Journal of Construction Engineering*, 11.

O"Brien, W.J. (1998), Construction Supply-Chain Management: A Vision for Advanced Coordination, Costing, and Control

Ohnuma, D. K., Pereira, S. R., and Cardoso, F. F. (2000, April 24 – 27). The Role of the Subcontractors in the Competitiveness of Building Companies and the Integration of Value Chains Symposium conducted at the meeting of the Proceedings of the CIB W92 Procurement System Symposium, Santiago, Chile.

Okunlola, O. S. (2015). The Effect of Contractor-Subcontractor Relationship on Construction Duration in Nigeria: International Journal of Civil Engineering and Construction Science 2015; 2(3): 16-23

Oppenheim, A. N. (2003) Questionnaire design, interviewing and attitude Measurement London: Continuum.

Osei-Hwedie (2011) Strategic issues of innovative financing of infrastructure project delivery, Unpublished MPhil. Thesis KNUST.

Othman, M. R. (2007), Forging Main and Subcontractor Relationship for Successful Projects. Available at: http://rakan1.jkr.gov.my/csfj/editor/files/Files/Projek/Lessions Learned/MAINandSUB_2.pdf (assessed January, 2014)

Pheng, L.S. and Chuan, Q.T. (2006), Environmental Factors and Work Performance of Project Managers in the Construction Industry, International Journal of Project Management, Vol.24, pp. 24–37.

PMI, (2008) 'A guide to the project management body of knowledge', Project Management Institute, Pennsylvania, Third Edition, USA.

Porwal, V. (2010) (Thesis) *"Identification and analysis of the residual and/or emerging problems of Last Planner® System when used in construction projects."* Master of Science in Construction Management, Texas A & M University, College station, Texas, USA.

Prabhakar, G.P. (2008), What is Project Success: A Literature Review, International Journal of Business and Management, Vol.3, No.9.

Proctor, J. R. (1996). "Golden rule of contractor-subcontractor relations."Pract. *Periodical on Struct. Des. and Constr*., 1(1), 12–14.

Rahman, S. 1998. Theory of constraints: A review of the philosophy and its applications. *International Journal of Operations & Production Management* 18(4): 336-355.

Reid, R.A. and Koljonen, E.L. (1999). Validating a manufacturing paradigm: a system dynamics approach. In: eds. Farrington, PA, Nembhard, HB, Sturrock, DT and Evans, GW, *Proceedings of the 1999 Winter Simulation Conference*, 759-765. ACM, New York, USA.

Remenyi, D. Williams, B. Money, A. and Swartz, E. (1998), *Doing Research in Business and Management. An Introduction to Process and Method*, London: Sage.

Roger, J. (2012). *Opportunity Lost Mismanagement of the Close-Out Phase of Construction Projects.* College Purdue University.

Rubin, A. & Babbie, E.R. (2005). Research methods for social work. New York: Thomson Brooks/Cole.

Runeson, G. (1997) The role of theory in construction management research: comment. Construction Management and Economics, 15, 299-302

Sambasivan, M. and Soon, Y. W. (2007). "Causes and effects of delays in Malaysian construction industry," International Journal of Project Management, vol. 25, pp. 517–526.

Samuel, L. (2009). Subcontract and supply enquiries in the tender process of contractors. *Journal of construction management and economic,* 27(12), 1220-1221.

Saunders, M., Lewis, P., and Thornhill, A. (2009) Research methods for business students. 5th edn. Harlow: Prentice Hall.

Sauser, B. J., Reilly, R. R. and Shenhar, A. J. (2009), Why projects fail? How contingency theory can provide new insights – A comparative analysis of NASA's Mars

Schaufelberger, J.E. Causes of subcontractor business failure and strategies to prevent failure, Proceedings of the Construction Research Congress, Honolulu, HI, 2003, pp. 593–599.

Schaefers, J, Aggoune, R, Becker, F and Fabbri, R. (2004). TOC-based planning and scheduling model. *International Journal of Production Research* 42(13): 2639-2649.

Scoggin, J.M, Segelhorst, R.J and Reid, R.A. (2003). Applying the TOC thinking process in manufacturing: a case study. *International Journal of Production Research* 41(4): 767-797.

Seymour, D. E., & Rooke, J. A. (1995) The culture of the industry and culture of research, *Construction Management and Economics*, 13:511-523.

Shaikh, N.M. (1999). How to select the proper subcontractor — Part 1, Hydrocarbon Processing 78 (6) pp.91–97.

Shenhar, A. J., & Dvir, D. (2007). *Reinventing Project Management: The Diamond Approach to Successful Growth and Innovation.* Massachussets: Harvard Business Press.

Shenhar A. J and Dvir D. (2004) How projects differ, and what to do about it. In: Morris PWG, Pinto JK, editors. The Wiley guide to managing projects. Hoboken, NJ: Wiley and Sons; 2004. p. 1265–86.

Shenhar A. J. (2001) One size does not fit all projects: exploring classical contingency domains. Management Science; 47(3), pp. 394–414.

Simatupang, T.M. Wright, A.C. and Sridharan, R. (2004). Applying the theory of constraints to supply chain collaboration. *Supply Chain Management: An International Journal* 9(1): 57-70.

Sterman, J. D. (1992). "*System Dynamics Modeling for Project Management."* MIT Sloan School of Management.

Stoner James A. F., Freeman R. Edward, and Gilbert, Jr. Daniel R. (2003) Management (New Delhi: Prentice-Hall of India), Sixth Edition.

Streubert, H., & Carpenter, D. (1999). Qualitative research in nursing: Advancing the humanistic perspective (2nd ed.). Philadelphia: Lippincott Williams & Wilkins.

Struwig, F. & Stead, G. (2007). *Planning, designing and reporting research.* Pearson education, 158-189.

Taylor, L.J. and Churchwell, L. 2004. Goldratt's thinking process applied to the budget constraints of a Texas MHMR facility. *Journal of Health and Human Services Administration* 26(4): 415-437.

Thomas, H. R. and Flynn, C. J. (2011) "Fundamental principles of subcontractor management," Practice Periodical on Structural Design and Construction, vol. 16, no. 3, pp. 106–111

Thomas, G. and Mike T.(2005). Construction Partnering & Integrated Team-working. Malden, MA: Blackwell Publishing.

Usdiken, Z. S. B. (1988). Strategies and boundaries: subcontracting in construction. *Strategic Management Journal, 9*(6), 633-637

Vanderstoep, S., & Johnston, D. (2009). *Research Methods for Everyday Life: Blending Qualitative and Quantitative Approaches*. San Francisco, CA: Jossey-Bass.

Vilasini, N., Neitzert, R., Rotimi, B. & Windapo, O. *(2012). A framework for subcontractor integration in alliance contracts. International Journal of Construction Supply Chain Management. 2(1): 17-33*

Wahlers, JL and Cox, JF. (1994). Competitive factors and performance measurement: applying the theory of constraints to meet customer needs. *International Journal of Production Economics* 37(2-3): 229-240.

Warburtan ,R.D.H. (2011). "*A time-dependent earned value model for software projects."* International Journal of Project Management. 29(8), 1082-1090.

Wang, D. Yung, K.L. Ip, W.H. (2001). A heuristic genetic algorithm for subcontractor selection in a global manufacturing environment, IEEE Transactions on Systems, Man and Cybernetics. Part C, Applications and Reviews 31 (2) pp.189–198.

Wang, W. and Liu, J. (2005). Factor-based Path Analysis to Support Subcontractor Management, *International Journal of Project Management*, 23: 109-120.

Watson, KJ and Patti, A. (2008). A comparison of JIT and TOC buffering philosophies on system performance with unplanned machine downtime. *International Journal of Production Research* 46(7): 1869-1885.

Watson, K. J., Blackstone, J. H. and Gardiner, S. C. (2007) "The evolution of a management philosophy: The theory of constraints." *Journal of Operations Management*, pp. 387-402.

Weill, P. and Olson, M. H. (1989) Managing Investment in information technology: Mini case examples and implications MIS Quarterly 13 (1), pp. 3-17.

Williams, T. (2005). Assessing and moving on from the dominant project management discourse in the licht of project overruns. *IEEE Transactions on Engineering Management , 52* (4), 497-508.

Yasin, O. (2004) Modern Management Theories and Practices A paper presented at the 15th East African Central Banking Course, held on 12th July 2004, at Kenya School of Monetary Studies. http://www.sawaedy.com/pic/pdf/8807-UNPAN025765.pd

Yin, R. K. (2009). Case study research: Design and methods (4th ed). Thousand Oaks, CA: Sage.

Yin, H., Wang, Z., Yu, J., Ji, Z., and Ni, H. (2009). Application of DEA Cross-evaluation Model in Project Dynamic Alliance Subcontractors Selection Symposium conducted at the meeting of the IEEE conference in Intelligent Systems and Applications (ISA) Wuhan, China May 23-24. Retrieved from http://ieeexplore.ieee.org

Yik, F.W.H., Lai J.H.K., Chan K.T. and Yiu E.C.Y. (2006). Problems with specialist subcontracting in the construction industry. *Building services engineering research and technology*, 27(3), 183-193.

Youker R. (2002) The difference between different types of projects (Revised). In: Proceedings of PMI 30th annual seminar and symposium. Philadelphia, PA; 2002 http://www.maxwideman.com/guests/index.htm (Accessed on: 14/10/2015)

Zhengquan, L. (2005). How to prevent compensation claims from subcontractors in general project contracting [J].Construction Economy, 2005(4): 71-73

APPENDICES

Appendix A

Survey Questionnaires

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI.

FACULTY OF ARTS AND BUILT ENVIRONMENT

DEPARTMENT BUILDING TECHNOLOGY

Survey Questionnaire

TOPIC:

DEVELOPING GUIDELINES FOR MANAGING SUB-CONTRACTORS WITHIN THE CONSTRAINTS OF COS AND TIME

My name is Richard Kadan, a final year Mhil. student of the Department of Building Technology, Kwame Nkrumah University of Science and Technology (KNUST). This research is being conducted as part of the requirements for the award of an MPhil. in Construction Management. The information you provide will therefore be used for academic purposes only and will be treated with optimum confidentiality.

The objectives of the study are to : determine the extent to which the concept of subcontracting is used in the Building Industry; identify the underlying challenges inherent in managing Subcontractors; identify factors affecting the cost and time performance of subcontractors; determine the effects of application of subcontracting system on project time and costs; and propose guidelines for managing Subcontractor' works aimed at enhancing the Time and Cost Performance of Building projects.

Researcher's Tel: 0244101788, *E-mail*: richardiho@yahoo.com

Section One: Respondent General Information

1. What type of organization do you belong?

Consultant ( )
Main Contractor ( )
Subcontractor ( )

2. What is your professional background?

Construction Project Manager ( )
Architect ( )
Quantity Surveyor ( )
Civil and/or Structural Engineer ( )
Other(please specify) ( )

3. How long have you been working in the category of organization chosen in question 1 above?

1 – 5 years ( )
6 – 10 ( )
11 – 15 years ( )
16 years and above ( )

For the Subcontractor

4. What is your Specialty

Building ( )
Mechanical ( )
Plumbing and Drainage Tilling ( )
Electrical ( )
Glazing ( )
Others ( )

5. Type of subcontract Project

Commercial/Office Building ( )	Government Office Building ( )
Hotel Retail / Shopping Centre ( )	Residential Development( )
Hospital ( )	School ( )
Market ( )	Library ( )
Sports Centre ( )	Others (please specify ( )

For the Main Contractor

6. Do you allow subcontractors to further subcontract out the work you assign them?

Yes ( ) No ( )

7. Do you prefer to have nominated subcontractors or your own domestic subcontractors to undertake specialist works in building projects?

Domestic subcontractor ( )

Nominated subcontractor ( )

Section Two: EXTENT TO WHICH THE CONCEPT OF SUBCONTRACTING IS USED IN THE BUILDING INDUSTRY

8. How frequent is subcontracting practice in building construction projects?

Not Frequent ( )

Less Frequent ( )

Moderately Frequent ( )

Frequent ( )

Very Frequent ( )

9. How many subcontract projects have you been involved in within the last five years?

1 - 5 ( )

6 - 10 ( )

11 - 15 ( )

16 and above ( )

10. On average what percentage of work is usually subcontracted?

0- 10% ( )

11- 20% ( )

21- 30% ( )

31- 40% ( )

Above 50% ( )

11 How beneficial is the Fundamental Principles of Subcontractor Management to the Ghanaian building industry?

Highly unbeneficial ( )

Unbeneficial ( )

Moderately beneficial ( )

Beneficial ( )

Highly beneficial ( )

Section Three: CHALLENGES IN SUBCONTRACTOR MANAGEMENT

12 Below are a number of potential challenges inherent in the management of Subcontracts. From your experience, please tick the appropriate cell by indicating how significant each challenge is.

Ranking	Interpretation
1	Strongly Not Significant
2	Not Significant important
3	Average
4	Significant
5	Very Significant

No.	Potential challenges in the management	Ranking				
		1	2	3	4	5
a.	Legal disputes					
b.	Shortage of construction materials					
c.	Delay in shop drawings and sample material approval					
d.	Amendments					
e.	Incomplete work-drawings or specifications					
f.	Lack of Safety					
g.	Site coordination challenges					
h.	Lack of proper communication					
i.	Non-adherence to the construction schedule					
j.	Contractor's financial challenges					

Section four: FACTORS AFFECTING COST AND TIME PERFORMANCE OF SUBCONTRACTORS

13 The following are some of the factors affecting the cost and time performance of subcontractors as identified from literature. Using the scale below, what is the relative importance of each of the factors.

Ranking	Interpretation
1	Strongly not significant
2	Not significant
3	Average
4	Significant
5	Very significant

No.	Factors affecting the cost and time performance of subcontractors	Ranking				
		1	2	3	4	5
1.	Project related factors					
a.	The presence of the project in a densely populated place					
b.	Large/complex project					
c.	Increase the additional work for the project from the limit set in the contract					
d.	Remote location (difficult accessibility to the site)					
e.	There is no contingency budget to proceed works					
f.	Increasing the fundamental changes in the nature of works					
g.	Many execution obstacles					
h.	Government policy, market condition & political situation					
2.	Contract documents & management related factors					
a.	Implementing the lowest bid price system					
b.	Selection of subcontractors through competitive strategy & taking the lowest price as the only criteria for selection					
c.	Assisting the main contractors in pricing the tender by the subcontractors					
d.	The subcontractors id preferred to be company registered in contractors union					
e.	Clear understanding of the contract conditions and requirements, project objectives and implementation					

	methods by the contractors and subcontractors					
f.	The clarity of the contract between contractors and subcontractors					
g.	Delays in the adoption of change orders					
h.	Compliance with regulations by the contractors & subcontractors					
i.	Adherence to subcontract requirements					
j.	Quality and clarity of design drawing and shop drawings					
k.	Payment method to the main contractor by the client					
l.	Insurance terms, interest rate and bond/loan terms					
3.	Factors pertaining to project staff in general					
a.	The lack of the efficiency, qualification and skills of the project team					
b.	Morally support the project staff					
c.	Conduct of training courses to qualify the project staff to work on-site					
d.	Number of craftsmen and labourers in the project					
e.	Qualified supervisory staff					
4.	Factors pertaining to project manager					
a.	Manager personality & his experience					
b.	Salary of the managers					
c.	Management level leadership					
d.	Regular and effective communication & coordination of main contractor and subcontractors by the project manager					
e.	Managers' recognition of the other construction activities related to subcontractors tasks to ensure the continuity of the work of subcontractors					
5.	Factors related to main contractors					
a	Previous experience, history and reputation of the main contractors					
b	Practical and technical ability of the main contractors					
c	Contractors performance of relevant previous projects					
d	Financial ability & strength of the main contractors					
e	Ability in dealing with uncertainty in the construction projects					
g	Controlling and follow up of subcontractors activities by main contractor's engineers					
h	Financial facilitation to subcontractors to be able to purchase the materials and equipment					

i	Main contractor should give a subcontractors management work plan before start the work					
j	Providing subcontractors location services and work requirements					
k	Make sure that the subcontractors' price fit to quality and specifications					
l	Commitment of the main contractors with project schedule					
m	Ability in bearing the risk in case payment delay from the client					
n	Bearing responsibility in case of accidents					
p	Relationship with subcontractor/client/consultant					
q	Lack of trust between main contractors and subcontractors					
6.	Factors related to subcontractors					
a.	Size of subcontractors' staff					
b.	Previous experience, history and reputation of the subcontractors					
c.	Practical and technical ability of the subcontractors					
d.	Financial ability & strength of the subcontractors					
e.	Performance of relevant previous projects					
f.	Subcontractor familiarity with the nature of the required tests for its own work and materials supplied by him.					
g.	The extent of the subcontractor's commitment to the specifications and quality of the project					
h.	The extent of the subcontractor's commitment to the project's schedule					
i.	Close control over the cost by the subcontractors					
j.	Prompt payment to labourers					
k.	Providing adequate information/conditions to main contractor					

Section Five: COST AND TIME RELATED FACTORS MOST AFFECTED BY SUBCONTRACTOR MANAGEMENT.

14 In your opinion, what is the most affected cost and time related factors by subcontractor management?

Ranking	Interpretation
1	Strongly not significant
2	Not significant
3	Average
4	Significant
5	Very significant

No.	Effects of subcontract management in saving project cost and time	Ranking				
		1	2	3	4	5
a.	Profit rate of project					
b.	Material and equipment cost					
c.	Project labour cost					
d.	Waste rate of materials					
e.	Cost of variation orders					
f.	Planned time for project construction					
g.	Time needed to implement variation orders					
h.	Time needed to rectify defects					
i.	Overhead percentage of project					

15. What recommendation(s) would you propose in the subcontractor management process to improve the performance of subcontractors within the cost and time constraints?

……

……

……

Thank you for your input

Researcher: Richard Kadan, *Mobile No.: 0244101788, Email: richardiho@yahoo.com*

Appendix B

VALIDITY AND RELIABILITY TEST

FACTORS		TOTAL
Legal Disputes	Pearson Correlation	.143
	Sig. (2-tailed)	.185
	N	88
Shortage of Construction Material	Pearson Correlation	.367**
	Sig. (2-tailed)	.000
	N	88
Delay in Shop Drawings	Pearson Correlation	.204
	Sig. (2-tailed)	.057
	N	88
Amendments	Pearson Correlation	.042
	Sig. (2-tailed)	.705
	N	85
Incomplete Work-drawings or Specifications	Pearson Correlation	.143
	Sig. (2-tailed)	.183
	N	88
Lack of Safety	Pearson Correlation	-.012
	Sig. (2-tailed)	.915
	N	88
Site Coordination Challenges	Pearson Correlation	.055
	Sig. (2-tailed)	.611
	N	88
Lack of Proper Communication	Pearson Correlation	.158
	Sig. (2-tailed)	.148
	N	85
Non-Adherence to Schedule	Pearson Correlation	.005
	Sig. (2-tailed)	.965
	N	88
Contractor's Financial Challenges	Pearson Correlation	.293**
	Sig. (2-tailed)	.006
	N	87
Densely Populated Place	Pearson Correlation	.028
	Sig. (2-tailed)	.794
	N	88
Large Project	Pearson Correlation	.047
	Sig. (2-tailed)	.664
	N	88
Additional Work Increase	Pearson Correlation	.255*
	Sig. (2-tailed)	.017
	N	88
Remote Location	Pearson Correlation	.183
	Sig. (2-tailed)	.104
	N	80

No Contingency Budget	Pearson Correlation	.335**
	Sig. (2-tailed)	.002
	N	86
Fundamental Changes Increase	Pearson Correlation	.053
	Sig. (2-tailed)	.622
	N	88
Many Execution Obstacles	Pearson Correlation	.102
	Sig. (2-tailed)	.351
	N	85
Government Policy	Pearson Correlation	.164
	Sig. (2-tailed)	.132
	N	86
Lowest Bid Price Implement	Pearson Correlation	-.005
	Sig. (2-tailed)	.965
	N	86
Competitive Strategy Selection of Subcontractors	Pearson Correlation	-.145
	Sig. (2-tailed)	.182
	N	86
Assist Main Contractors in Pricing	Pearson Correlation	.020
	Sig. (2-tailed)	.856
	N	88
Subcontractors ID Preferred	Pearson Correlation	.244*
	Sig. (2-tailed)	.023
	N	87
Clear Understanding	Pearson Correlation	.099
	Sig. (2-tailed)	.357
	N	88
Clarity of Contract	Pearson Correlation	.307**
	Sig. (2-tailed)	.004
	N	88
Delays in Adoption of change	Pearson Correlation	-.037
	Sig. (2-tailed)	.742
	N	82
Compliance with Regulations	Pearson Correlation	.203
	Sig. (2-tailed)	.057
	N	88
Adherence to Subcontract	Pearson Correlation	.523**
	Sig. (2-tailed)	.000
	N	86
Quality and Clarity of Design Drawing	Pearson Correlation	.284**
	Sig. (2-tailed)	.009
	N	83
Payment Method	Pearson Correlation	-.039
	Sig. (2-tailed)	.719
	N	88
Insurance Terms	Pearson Correlation	-.195
	Sig. (2-tailed)	.072
	N	86

Lack of Efficiency	Pearson Correlation	-.004
	Sig. (2-tailed)	.970
	N	86
Morally Support	Pearson Correlation	-.117
	Sig. (2-tailed)	.282
	N	86
Preparation of Training Courses	Pearson Correlation	.086
	Sig. (2-tailed)	.450
	N	79
Work On-site	Pearson Correlation	.521*
	Sig. (2-tailed)	.011
	N	23
Number of Craftsmen and Labourers	Pearson Correlation	.328**
	Sig. (2-tailed)	.002
	N	86
Qualified Supervisory Staff	Pearson Correlation	-.097
	Sig. (2-tailed)	.378
	N	84
Manager Personality	Pearson Correlation	-.048
	Sig. (2-tailed)	.662
	N	85
Salary of Managers	Pearson Correlation	.141
	Sig. (2-tailed)	.200
	N	84
Management Level Leadership	Pearson Correlation	.022
	Sig. (2-tailed)	.849
	N	80
Regular and Effective Communication	Pearson Correlation	.007
	Sig. (2-tailed)	.948
	N	85
Managers Recognition of Construction	Pearson Correlation	.044
	Sig. (2-tailed)	.687
	N	85
Previous Experience	Pearson Correlation	.049
	Sig. (2-tailed)	.652
	N	87
Contractors Performance	Pearson Correlation	.112
	Sig. (2-tailed)	.305
	N	86
Financial Ability & Strength	Pearson Correlation	.153
	Sig. (2-tailed)	.162
	N	85
Ability in Dealing with Uncertainty	Pearson Correlation	.457**
	Sig. (2-tailed)	.000
	N	86
Controlling & Follow up of Subcontractors	Pearson Correlation	-.010
	Sig. (2-tailed)	.928
	N	86

Financial Facilitation to Subcontractors	Pearson Correlation	.255*
	Sig. (2-tailed)	.018
	N	86
Main Contractor give Subcontractors Work Plan	Pearson Correlation	-.029
	Sig. (2-tailed)	.788
	N	87
Provide Subcontractors Location Services	Pearson Correlation	.045
	Sig. (2-tailed)	.687
	N	84
Make Sure Subcontractors Price Fit to Quality	Pearson Correlation	.010
	Sig. (2-tailed)	.931
	N	85
Commitment of Main Contractors with Project Schedule	Pearson Correlation	.264*
	Sig. (2-tailed)	.015
	N	85
Ability in Bearing risk	Pearson Correlation	.278*
	Sig. (2-tailed)	.010
	N	84
Bearing Responsibility in Case of Accidents	Pearson Correlation	.452**
	Sig. (2-tailed)	.000
	N	83
Relationship With Subcontractor	Pearson Correlation	-.034
	Sig. (2-tailed)	.758
	N	84
Lack Of Trust	Pearson Correlation	-.109
	Sig. (2-tailed)	.336
	N	80
Size of Subcontractors Staff	Pearson Correlation	.023
	Sig. (2-tailed)	.839
	N	82
Previous Experience	Pearson Correlation	.135
	Sig. (2-tailed)	.216
	N	86
Practical & Technical Ability	Pearson Correlation	.196
	Sig. (2-tailed)	.070
	N	86
Financial Ability & Strength	Pearson Correlation	.514**
	Sig. (2-tailed)	.000
	N	86
Performance of Relevant Previous Projects	Pearson Correlation	.158
	Sig. (2-tailed)	.149
	N	85
Subcontractor Familiarity with Work	Pearson Correlation	.536**
	Sig. (2-tailed)	.000
	N	83
Extent of Subcontractors Commitment to Specifications	Pearson Correlation	.181
	Sig. (2-tailed)	.096
	N	86

Close Control Over the Cost by Subcontractors	Pearson Correlation	-.467**
	Sig. (2-tailed)	.000
	N	86
Prompt Payment to Labourers	Pearson Correlation	-.076
	Sig. (2-tailed)	.485
	N	86
Provide Adequate Information	Pearson Correlation	.142
	Sig. (2-tailed)	.193
	N	86
Profit Rate of Project	Pearson Correlation	.303**
	Sig. (2-tailed)	.004
	N	87
Material & Equipment Cost	Pearson Correlation	-.115
	Sig. (2-tailed)	.288
	N	87
Project Labour Cost	Pearson Correlation	-.036
	Sig. (2-tailed)	.741
	N	87
Waste Rate of Materials	Pearson Correlation	.196
	Sig. (2-tailed)	.068
	N	87
Cost of Variation Orders	Pearson Correlation	.288**
	Sig. (2-tailed)	.007
	N	87
Planned Time for Project Construction	Pearson Correlation	.080
	Sig. (2-tailed)	.462
	N	87
Tune Needed to Implement Variation Orders	Pearson Correlation	.017
	Sig. (2-tailed)	.878
	N	87
Time Needed to Rectify Defects	Pearson Correlation	.108
	Sig. (2-tailed)	.320
	N	87
Overhead Percentage of Project	Pearson Correlation	.358**
	Sig. (2-tailed)	.001
	N	86

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Basic Making Decision in Validity Test

Seeing the Value of Significance

1. If the significance value < 0.05, then the instrument is declared valid
2. If the significance value > 0.05, then the instrument is declared invalid

2. RELIABILITY TEST

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.711	.694	76

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Legal Disputes	39.41	7.194	.277	.703
Shortage of Construction Material	39.15	6.053	.650	.643
Delay in Shop Drawings	39.57	7.048	.224	.712
Amendments	39.73	6.125	.429	.679
Incomplete Work-drawings or Specifications	39.09	5.580	.653	.631
Lack of Safety	38.94	7.334	.117	.727
Site Coordination Challenges	38.86	6.544	.416	.682
Lack of Proper Communication	39.09	6.105	.413	.683
Non-Adherence to Schedule	38.57	7.598	.069	.727
Contractor's Financial Challenges	38.94	6.484	.427	.680
Densely Populated Place	28.53	2.586	.220	.475
Large Project	28.12	2.915	-.024	.572
Additional Work Increase	27.73	2.285	.525	.363
Remote Location	27.95	2.053	.538	.327
No Contingency Budget	27.23	2.292	.353	.417
Fundamental Changes Increase	27.77	2.570	.431	.421
Many Execution Obstacles	26.92	2.799	.149	.497
Government Policy	27.93	3.092	-.121	.606
Lowest Bid Price Implement	44.34	6.198	.369	.440
Competitive Strategy Selection of Subcontractors	44.35	6.603	.350	.455
Assist Main Contractors in Pricing	43.61	6.757	.283	.472
Subcontractors ID Preferred	43.89	5.930	.295	.464
Clear Understanding	42.66	7.513	.043	.531
Clarity of Contract	43.48	7.053	.153	.506
Delays in Adoption of change	43.59	6.645	.307	.465
Compliance with Regulations	43.62	6.725	.336	.461
Adherence to Subcontract	42.62	6.896	.359	.463
Quality and Clarity of Design Drawing	42.77	7.777	-.031	.544
Payment Method	43.15	8.247	-.188	.576
Insurance Terms	43.25	7.421	.154	.504

Lack of Efficiency	8.65	.243	.185	-1.576[a]
Morally Support	8.88	.110	-.126	-1.867[a]
Preparation of Training Courses	7.88	.485	-.537	.606
Work On-site	18.76	.413	-.232	-.204[a]
Number of Craftsmen and Laborers	19.89	.130	-.209	-.095[a]
Qualified Supervisory Staff	18.77	.434	-.319	-.088[a]
Manager Personality	18.79	.340	-.059	-.315[a]
Salary of Managers	18.77	.348	.080	-.437[a]
Management Level Leadership	52.39	5.069	.330	.481
Regular and Effective Communication	52.89	4.869	.139	.525
Managers Recognition of Construction	53.21	5.475	.015	.540
Previous Experience	52.75	4.830	.274	.482
Practical & Technical Ability of Main Contractors	52.33	5.717	-.075	.540
Contractors Performance	52.79	4.942	.222	.496
Financial Ability & Strength	52.34	5.508	.085	.521
Ability in Dealing with Uncertainty	53.00	4.187	.442	.422
Controlling & Follow up of Subcontractors	52.93	5.502	-.016	.550
Financial Facilitation to Subcontractors	53.20	4.507	.480	.431
Main Contractor give Subcontractors Work Plan	53.39	4.375	.411	.438
Provide Subcontractors Location Services	52.95	5.251	.103	.524
Make Sure Subcontractors Price Fit to Quality	52.97	5.306	.083	.527
Commitment of Main Contractors with Project Schedule	40.85	2.951	.151	.277
Ability in Bearing risk	40.09	2.492	.408	.144
Bearing Responsibility in Case of Accidents	40.05	2.767	.314	.212
Relationship With Subcontractor	40.53	2.688	.246	.225
Lack Of Trust	40.33	2.147	.465	.059
Size of Subcontractors Staff	40.46	2.661	.107	.302
Previous Experience	39.86	3.301	.077	.310
Practical & Technical Ability	40.06	3.701	-.314	.445
Financial Ability & Strength	40.66	3.587	-.246	.438
Performance of Relevant Previous Projects	40.63	3.081	.012	.340
Subcontractor Familiarity with Work	37.42	2.364	.424	.354
Extent of Subcontractors Commitment to Specifications	37.88	2.127	.289	.375
Extent of Subcontractors	37.76	2.775	-.067	.528

Commitment to Schedule				
Close Control Over the Cost by Subcontractors	37.42	2.340	.449	.346
Prompt Payment to Laborers	37.84	2.208	.152	.455
Provide Adequate Information	37.34	2.673	.202	.426
Profit Rate of Project	37.37	2.707	.105	.448
Material & Equipment Cost	37.33	2.622	.302	.407
Project Labor Cost	37.98	2.329	.160	.440
Waste Rate of Materials	37.76	2.775	-.067	.528
Cost of Variation Orders	37.42	2.340	.449	.346
Planned Time for Project Construction	37.84	2.208	.152	.455
Tune Needed to Implement Variation Orders	37.34	2.673	.202	.426
Time Needed to Rectify Defects	37.37	2.707	.105	.448
Overhead Percentage of Project	37.33	2.622	.302	.407