



**SUBCONTRACTING STRATEGY
IN INDUSTRIAL PROJECTS**

BY
ABIDEEN ADEKUNLE GANIYU

A Thesis Presented to the
DEANSHIP OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

CONSTRUCTION ENGINEERING AND MANAGEMENT

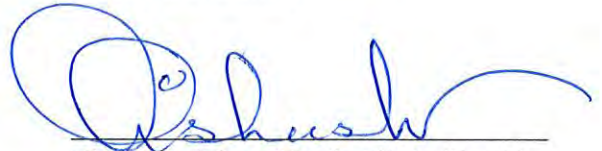
MAY 2010


**KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DHAHRAN 31261, SAUDI ARABIA**

DEANSHIP OF GRADUATE STUDIES

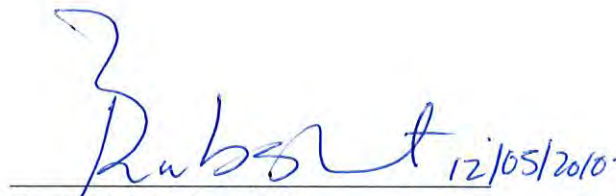
This thesis, written by **ABIDEEN ADEKUNLE GANIYU** under the direction of his Thesis Committee, and approved by all the members, has been presented to and accepted by the Dean, College of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING & MANAGEMENT**.


Thesis Committee


Thesis Advisor (Prof. Ali A. Shash)


Member (Prof. Sadi Assaf)


Member (Dr. Ashraf Elazouni)


Prof. Abdulaziz Bubshait
Department Chairman


Dr. Salam A. Zummo
Dean, College of Graduate Studies

Date: 23/5/10

DEDICATION

In the Name of Allah, the most Gracious, the most Merciful.

“... Verily, my salat (prayer), my sacrifice, my living, and my dying are for **ALLAH**, the Lord of the ‘Alamin (mankind, jinn and all that exists)” Qur’an 6: 162.

This thesis is dedicated to Almighty Allah; “who has taught (the writing) by the Pen. He has taught man that which he knew not” Qur’an 96: 4-5

ACKNOWLEDGMENT

All the praises and thanks are to Allah whose grace alone brings all good things to fruition. May the peace and blessings be upon prophet Muhammad (PBUH), his family, his companions and all that followed them in good deeds till the end of time.

Acknowledgement is due to King Fahd University of Petroleum and Minerals for the support of my masters program which culminates with this research. I wish to express my appreciation to Professor Ali A. Shash who served as my major advisor, also to other members of my thesis committee, Professor Sadi Assaf and Dr. Ashraf Elazouni for their valuable guidance and co-operation in completing this work.

I would also like to extend my gratitude to the Chairman, and all the faculties, fellow graduate students and the Secretary of the Construction Engineering and Management Department for their support throughout my program. Dr. Mohsin Siddiqui emerged as my favorite instructor and he along with Mr. Mohammed Al Jumaia aided me to administer part of the questionnaire, I express my thanks to both of you and all the people and companies who took part in the survey.

My special thanks go to the trio of Ibrahim Adeyanju, Ismail Ogunlade and Mansur Hammed for their independent efforts which aided my excellent attempt at GRE and TOEFL exams. Kudos to the duo of Moruf Yusuf and Munirudeen Oloso who catalyzed my coming to KFUPM, their guidance, encouragement and support especially during my

'early challenging days' at KFUPM were unfathomable. I enjoyed a very good brotherly care from the entire Nigerian community in and around KFUPM, How I wish we have a replica back at home! I sincerely appreciate all of you.

My late father, Mr. Ganiyu Olayiwola, labored hard to see me through my spiritual and educational life, may Allah grant him eternal rest (Aamin). My ailing mother toiled away her youthful vigor in the same vein, may Allah restore your health plus a prolonged life to enjoy the fruits of your labor with delight (Aamin). My paternal aunt, Mrs. Idiat Mojeed; brother, Mr. G.T Ganiyu; sisters- Tawakalt, Haneefah, Mujidah (late) and Asiyah are duly acknowledged as well.

The consciousness gained from the Muslim Students' Society of Nigeria (MSSN) continues to be the driving force in me; my heartfelt gratitude goes to ALL our forerunners. Engr. AbdulWasii Ajagbe has not relent in his all-round continual support, his outstanding contributions now makes him 'the most influential person in my life'. My far-sighted friends Muhydeen Oyebode and Tawfiq Olatunji are indispensable parts of my life. May Allah bless you all 'n' times as 'n' goes to infinity (Aamin)!

Finally, my sincere appreciation goes to all people (too numerous to mention by names) who contributed something in making me a little better than what my frailty would have allowed. May Allah reward you all with the best (Aamin).

Table of Contents

DEDICATION	iii
ACKNOWLEDGMENT.....	iv
LIST OF TABLES	x
LIST OF FIGURES	xi
THESIS ABSTRACT	xii
ARABIC ABSTRACT.....	xiii
CHAPTER 1: INTRODUCTION.....	1
1.0 Background.....	1
1.1 Statement of the Problem.....	1
1.2 Objectives of the Study.....	2
1.3 Significance of the Study	3
1.4 Scope and Limitation of the Study.....	4
CHAPTER 2: LITERATURE REVIEW	5
2.0 Introduction.....	5
2. 1 Subcontracting	5
2.1.1 Reasons for Subcontracting	5
2.1.2 Structure of Subcontracting System.....	7
2.1.3 Impact of Subcontracting on Construction Industry	8
2.1.4 Theoretical Foundation of Subcontracting in Economics.....	9
2.1.5 The Contract.....	10
2.1.6 Equitable Construction Contract.....	11

2.2 Subcontracting Strategy	12
2.2.1 Volume of Subcontract Work	13
2.2.2. Subcontractor Selection Process	13
2.2.3 Timing of Subcontract	16
2.2.4 Subcontractors' Bidding Strategy	17
2.3 Subcontractors' Working Relationship.....	17
2.3.1 Contractors' - Subcontractors' Relationship.....	18
2.3.2 Owner-Subcontractors' Relationship.....	20
2.3.3 Domestic versus Nominated Subcontractor.....	20
2.3.4 Equipment Intensive and Labor Intensive Subcontractor	21
2.3.5 Subcontract Provisions.....	21
2.4 Industrial Projects	22
CHAPTER 3: RESEARCH METHODOLOGY	23
3.0 Introduction.....	23
3.1 Data Required	23
3.1.1 Potential Factors Affecting Subcontracting Strategy.....	25
3.1.2 Potential Problems Affecting Subcontracting Strategy	35
3.2 Data Collection	45
3.3 Population and Sample Size.....	46
3.4 Data Analysis	46
CHAPTER FOUR: RESULTS AND DISCUSSIONS.....	49
4.0 Introduction.....	49
4.1 Characteristics of the Respondents and their Firms.....	49

4.1.1 Classification of the Companies	49
4.1.2 Position of the Respondents in the Companies.....	50
4.1.3 Working Life and Experience of the Respondents	51
4.1.4 Amount of Subcontract Work.....	53
4.1.5 Owner’s Use of Project Delivery System	54
4.1.6 Contract Type Used for Subcontracting	55
4.2 Factors Influencing Subcontracting Strategy.....	57
4.2.1 Factors Related to Scope and Number of Subcontracts.....	57
4.2.2 Factors Related to Awarding Method.....	61
4.2.3 Factors Related to Type of Subcontracts (Pricing Approaches).....	64
4.2.4 Factors Related to Timing/Schedule of Subcontracting	67
4.2.5 Respondents View on the Importance of the Factors of Subcontracting.....	68
4.3 Problems Affecting Subcontracting Strategy.....	76
4.3.1 Problems Related to Planning Issues	76
4.3.2 Problems Related to Awarding Issues	81
4.3.3 Problems Related to Contracting Issues	84
4.3.4 Respondents View on the Significance of the Problems of Subcontracting....	85
4.4 Problems and Project Performance Matrix.....	96
CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	99
5.0 Introduction.....	99
5.1 Summary of the study	99
5.2 Summary of Major Findings.....	100
5.3 Summary of Minor Findings.....	102

5.3 Recommendations.....	103
5.4 Recommendations for Further Studies.....	105
REFERENCES	106
APPENDIX 1	113
APPENDIX II.....	118
VITA.....	119

LIST OF TABLES

Table 4.1: Classification of the Companies	50
Table 4.2: Position of Respondents in the Companies	51
Table 4.3: Ratings of Potential Factors.....	70
Table 4.4: Mean, OIV and ORIW of Categories of Factors	76
Table 4.5: Ratings, Mean, IV, RIW and Ranking of Potential Problems	87
Table 4.6: Mean, OIV and ORIW of Problem Categories.....	96
Table 4.7: Potential Problems and their Project Value Drivers	96

LIST OF FIGURES

Figure 4.1: Years of Experience of Respondents in Industrial Projects	52
Figure 4.2: Years of Management Experience of Respondents in Subcontracting Practices	52
Figure 4.3: Percentage of Subcontract Works on a Typical Project.....	54
Figure 4.4: Owners Use of Project Delivery System.....	55
Figure 4.5: Contract Type Used to Sublet Work to Contractors.....	57

THESIS ABSTRACT

NAME : ABIDEEN ADEKUNLE GANIYU

TITLE : SUBCONTRACTING STRATEGY IN INDUSTRIAL PROJECTS

MAJOR : CONSTRUCTION ENGINEERING & MANAGEMENT

DATE : MAY 2010

This research utilized questionnaire survey to investigate the process of subcontracting practices in industrial projects in the Eastern Province of Saudi Arabia. It identified the factors affecting subcontracting practices in industrial projects and the level of significance of each factor. The problems encountered by contractors while making subcontracting decisions were identified and the negative impacts of each of the problem on cost, schedule and quality performance of projects ascertained. The preferred pricing approach with which the contractor used to sublet works to the subcontractor in industrial projects was ascertained to be price based while the level of involvement of subcontractors in industrial project measured relative to the total contract price was obtained to be 20%. Having addressed the issues from the contractors' point of view, the study concludes with recommendations for effective subcontracting strategy in industrial projects.

ARABIC ABSTRACT

لاسم: عابدين اديكونل غانو

عنوان الرسالة: استراتيجية المقاولات من الباطن للمشاريع الصناعية

التخصص: ادارة هندسة المشاريع

تاريخ التخرج: مايو 2010

يقوم هذا البحث باستقصاء ميداني للاساليب المتبعة في المنطقة الشرقية من المملكة العربية السعودية في تعميم المشاريع لمقاولي الباطن وذلك عن طريق تحديد ودراسة العوامل المؤثرة على استراتيجيات تعميم مقاولات الباطن في المشاريع الصناعية ومدى تأثير كل منها . لقد تمت دراسة المشكلات التي يواجهها المقاولون لاتخاذ القرار المناسب وتحديد السلبيات المترافقة مع كل مشكلة ومدى تأثيرها على الكلفة والجدول الزمني ونوعية العمل . تبين الدراسة أن الطريقة المثلى لتعميد أعمال الباطن في المقاولات الصناعية تكون عادة مبنية على السعر بينما تبين أن نسبة مقاولات الباطن في العقود الصناعية تصل الى 20%. تم أختتام البحث بتقديم نصائح لمقاولي الأعمال الصناعية للمساعدة في اختيار الاستراتيجية المناسبة لتعميد الأعمال لمقاولي الباطن.

CHAPTER 1: INTRODUCTION

1.0 Background

The contractor by virtue of his contract with owner undertakes responsibility for the performance of construction work. However, in most cases he executes only a portion of the contract with his workforce while engaging subcontractors to carry out the rest. In such conditions, the outsourcing strategy employed by the contractor is a function of numerous factors many of which are implicit in the project and the firm's resources. "Buying out" of subcontracts and supplies require the contractor to ascertain the exact scope of work for each of the work item designated for self-perform and those to be sublet in order to ensure complete coverage of and avoid overlapping of all work items.

Industrial projects include some of the largest project ever built, they require a high technical approach, and are frequently built by large, specialized contracting firms (Clough et al, 2005). To ensure an efficient and economic use of a subcontractor on any work item(s) in such projects, a thorough analysis and evaluation of available options vis-à-vis the associated factors is required to guarantee an informed decision. This is necessary to avoid many of the pitfalls of construction process such as cost overruns, delays, litigation etc.

1.1 Statement of the Problem

One of the decisive factors in a successful construction project is the right choice of an appropriate subcontracting strategy which assembles a perfect team for the construction work with an expedient allocation of work items, schedule and resources. However, this

may be a herculean task for the contractor's project management team whose decisions are mainly based on intuition and subjective judgment. Despite this, it is disquieting to mention that sparse research exists on the subject matter and in particular none specifically addresses it from the contractors' point of view. Hence, it is relevant to ask the following questions which make up the basic research questions that this study attempts to provide answers to:

1. What are the factors influencing the subcontracting strategy of contractors in industrial projects?
2. What are the problems encountered by contractors in assigning subcontracts/supplies to subcontractors /suppliers?
3. Which of the project's value drivers (cost, time and quality) is affected by each of the identified problem?
4. To what extent does each of the identified factors or problems affects the subcontracting decision of contractors?
5. How can the present process of subcontracting contract be improved?

1.2 Objectives of the Study

The principal objectives of this study are to:

1. Investigate the process of subcontracting practices in industrial projects with a prospect of identifying the factors affecting subcontracting practices and the level of significance of such factors.

2. Determine the problems encountered by contractors, their effects on project value drivers (cost, quality and time) and the magnitude of each of the identified problem on project performance.

1.3 Significance of the Study

The selection and designation of work item to subcontractors is very crucial to the successful execution of an industrial project. The fact that the underlying factors vary with the contractor's organization and are often project specific usually complicates the problems. However, in practice, there is no definite approach to demystify the procedure. The study of the contractors subcontracting strategy on industrial projects will be helpful in the following ways:

1. Establish the scope and methodology of subcontracting practices of contractors on industrial projects in the Eastern Province of Saudi Arabia for the benefit of the entire construction industry including prospective clients.
2. Improve the practices of contractors by providing a comprehensive knowledge of the factors affecting subcontracting decisions on industrial projects.
3. Enhance the performance of contractors on industrial projects in terms of job coordination and cost optimization while avoiding substandard works, claims and delays.
4. Provide recommendations for contractors on strategy of subcontracting work items to subcontractors on industrial projects.

1.4 Scope and Limitation of the Study

The scope of this study is to determine the factors affecting contractor's subcontracting strategy in industrial projects. It will also address the problems being faced by contractors and determine their effects on project performance. The study is limited to industrial construction contractors practicing in the Eastern Province of Saudi Arabia. These contractors undertake the construction of a wide range of industrial facilities within the Kingdom of Saudi Arabia and beyond. The Eastern province is chosen because it is the largest industrial and commercial area in Saudi Arabia with 86% (Asharqia Chamber, 2008) of the Saudi basic industries and also because of its proximity and the constraints of time and finance available for this study.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter reviews existing literatures related to the subject matter. The discussions are partitioned into four parts. The first part discusses the basics of subcontracting; the second part discusses subcontracting strategy and the bidding strategy of subcontractors. The third part discusses subcontractor working relationship and last part briefly discusses industrial projects.

2.1 Subcontracting

Subcontracting refers to an arrangement whereby a contractor authorizes another firm (a subcontractor) to undertake part of work he has secured with the owner (Lehtinen, 2001). According to Kimura (2001), the relationship is often between an upstream larger firm and a downstream smaller firm and it is not exclusive as the subcontractor may have many customers among the contractors.

2.1.1 Reasons for Subcontracting

Subcontract arrangements are widely used in construction because of the structure of the industry, the industry's workload is highly diversified by type, size, function, form and method of production, and materials used. The execution of the works demand the services of many different trade specialists, hence the industry is dominated by a large number of small companies which provide subcontract services to their larger counterparts (Edum-Fotwe et al, 1999).

Everyday economic facts justify the use of subcontracting because it utilizes the resources efficiently and economically. Generally, the activities of contractors are not extensive enough to sustain full-time employment of skilled workers in all the available trade classifications necessary in the construction field. Also it is impracticable for these companies to possess, operate and maintain specialized equipment that may have little use during a project (Arditi and Chotibhongs, 2005).

Subcontracting is widely considered as an avenue to optimize costs, redistribute the contractor's workload and rationalize their in-house manpower (Kumaraswamy and Mathews, 2000). Subcontracting helps to utilize already available resources in the market, diversify against risk, lower operation costs, obtain competitive advantage and inquire for the most satisfactory profit base (Tseng and Lin, 2002).

Subcontract works often entail the use of special method, delivery of proprietary products, or works that can only be executed by registered or licensed companies which may also involve a certain amount of design input (Yik and Lai, 2007). Construction sites are often geographically dispersed and itinerant workforce is uncommon, making it imperative to contractors to sublet works to local subcontractors who have resident workforce (Murdoch and Hughes, 2008).

Non-performance of any subcontracting firm can be a chief cause of project failure since a significant proportion of construction work is done by subcontractors (Arditi and Chotibhongs, 2005). Gonzalez-Diaz et al (2000) examined factors explaining subcontracting decisions in the construction industry using evidence from panel data on

construction firms. The result revealed that firm subcontract more when engage in heterogeneous work which required diverse expert knowledge and equipments and subcontract less as specificity grows.

2.1.2 Structure of Subcontracting System

Two basic structures of subcontracting were identified by Lehtinen (2001), the star-shaped and the tiered or clustered structure. In star-shaped structure, the subcontractors have direct contact with the contractor who plays a central role in the flow of information. In tiered structure, few subcontractors who have direct contact with the contractor later sublet the contract down the chain.

Yik and Lai (2008) studied how multilayer subcontracting systems works in the Hong Kong building construction industry. The study revealed that the system is highly effective in mobilizing workers to cope with fluctuating labor demand and ensuring workers effective performance but plagued by non-payments for lower tier subcontractors and workers which often lead to project delays and substandard quality performance.

Tam et al (2010) investigated the effects of the multilayer subcontracting system on project performance and established inverse correlation between the numbers of layers in the chain and project performance. He recommended a restrain in the number of subcontracting layers as a remedy to the associated poor quality, schedule and cost performance on projects utilizing such system. The poor communication, lack of coordination, poor supervision of bottom layer subcontractors, diffusion of accountability for work within the hierarchy of subcontractors were some of the reasons identified as the

causes of poor performance inherent on projects utilizing multi-layer subcontracting system.

2.1.3 Impact of Subcontracting on Construction Industry

Subcontractors' provide specialist construction services thereby absorbing the fluctuating workloads of contractors (Hinze, 2001). In recent years, most engineering functions and values of a project are executed by specialized engineering firms or subcontractors who de facto employ the actual builders and direct labor to carry out the work while the contractor functions as the project coordinator or manager (Tserng and Lin, 2002).

Boundless subcontracting can upset the overall scheduling of job operations, precipitate grave segmentation of project authority, fragmentize responsibility, make the coordination of construction activities herculean, cripple communication between management and site, encourage disputes, and be generally detrimental to job efficiency (Clough et al, 2005).

Chiang (2009) reviewed the consequence of high and increasing growing rate of subcontracting in building industry in Hong Kong. The negative impacts such as weak bargaining power of subcontractors, vulnerability to bankruptcies, and non-payment to workers, labor intensity, lackluster quality performance and negligent safety practices were mentioned while the specialized services as well as organizational and managerial flexibility provided by the subcontractors were acknowledged.

2.1.4 Theoretical Foundation of Subcontracting in Economics

Kimura (2001) used the transaction cost, game theory, economics of information and network approaches to summarize the theoretical foundation of subcontracting. The concept of bounded rationality (which is based on the fact that thinking capacity of individuals is limited by the information they have, the subconscious limitations of their minds, and the limited amount of time they have to make decisions) featured in business environment through uncertainties, repeated transactions and relation-specific assets, a firm decides to execute a transaction in-house or not. The game theory reiterates a long-term relationship between upstream and downstream firm found on recurrent game, reputation and coordination. The contract theory approach describes how economic actors construct contractual arrangements in the presence of asymmetric information. The network approach theory advocates interfirm relationship with an efficient synergy of competition and coordination constructed on the coexistence of market and organizational principles.

The theoretical predictions of characteristics of subcontracting can be adapted from the theories, transaction cost and network approaches postulates that subcontracting is chosen when upstream production requires functional technology. The game approach elaborates the steadiness and hierarchical nature of subcontracting while the information approach exemplify the rational of saving monitoring costs which prompts for subcontracting instead of purchasing in the spot market (Kimura, 2001).

2.1.5 The Contract

A contract is a prominent tool used in the construction industry; this manifest in the name given to the constructors – main contractor, subcontractor, it is a management mechanism which stipulates the organization within which jobs are consummated and the dispensation of risk and reward for engaging in the project (Puddicombe, 2009). According to Cheung et al (2006) the construction industry depends on contracts to delineate and administer the rights and obligations of the contracting parties.

A contract is an agreement between two or more people stating what each will do. A subcontract is a contract between the contractor and the subcontractor. A (sub)contract may or may not be in writing. However for a subcontract to be valid there has to be an offer to execute the work from the subcontractor and an acceptance by the contractor for valid consideration (fees), both of them must be acceptable in law as having the capacity to contract and genuinely accept the terms of the contract with an intention to establish the legality of the contract and the contract must be achievable and legal (Harris and McCaffer, 2001).

Contract documents refers to all records in connection with the work at any specific time, before bidding the project documents would include drawings, the specifications, and the proposal form. As the construction nears completion, the contract documents would consists of the drawings(including shop drawings), the specifications, all addenda, the proposal form (duly completed and signed), the signed contract, all bulletins, replies to bulletins, change orders, field orders and all field work orders (Ayers, 1984).

The contents of contract documents should include the work to be performed, the quality of work required, the contractual conditions, and the cost of the finished work and the schedule of the construction program as minimum information (Ashworth, 2001)

2.1.6 Equitable Construction Contract

A report of the United Kingdom Construction Sponsorship Directorate (1995) encapsulates the basic guidelines of a fair construction contract to include:

- Considerate dealing of all parties under an atmosphere of reciprocal alliance
- Dedicated teamwork with mutual financial impetus to pursue stated objectives
- A complementary set of documents which clearly depicts functions and responsibilities
- Expedient risk allocation to parties capable to handle them
- Upholding the pre-tender information as much as possible
- Determination of interim payments based on project schedules
- Clearly stating the actual payments period and specifying the penalties for late payments
- Arrangement for speedy dispute resolution
- Inclusion of incentives for outstanding performance
- Arrangement for advance payment of fees to parties involved in prefabricated off-site materials and components.

2.2 Subcontracting Strategy

Subcontracting strategy is based on the business strategy of the contractor, and the management level to be display in a particular project, it determine the subcontractor evaluation and management system employed in a project (Eom et al, 2008). The nature of the project, options available, the perceptions on the various options, attitude toward risk retention, previous experience and the knowledge of all the options have a bearing on the contractor's decision (Cheung et al, 2000).

Rowlinson & McDermott (1999) identified the following as variables that must be considered in order to clearly depict a contract strategy

- Organizational form: the roles of each of the disciplines (decision making, Advise etc) at what stage and to what extent in the project life-cycle
- Payment method: Cost based or price-based, payment method in addition with the organizational form is an indication of the risk involved by each party
- Overlap of project phases: the extent of the use of fast tracking, crashing etc
- Selection process: competition or negotiation
- Source of project finance: Client, Contractor or third party financed
- Contract document: New Engineering Contract (NEC), Joint Contract Tribunal (JCT), American Institute of Architects (AIA), Construction Management Association of America (CMAA), Associated General Contractors of America (AGC) etc or a client's customized contract document.

2.2.1 Volume of Subcontract Work

To what extent a contractor sublet part of his work is a function of the type of construction involved and the nature of his business organization (Clough et al, 2005). Contractors generally sublet portions of the project for which no in-house capability exists, however other reasons for which a subcontract may be awarded includes avoidance of overextended workload and transfer of risks. Sometimes, contract terms require the contractor to sublet certain percentage of work to minority-owned and/or women-owned businesses (Hinze, 2001).

Elazouni and Metwally (2000), presented a decision support system that assist contractors with regard to subletting construction works to subcontractors, the system calculates and plots the overdraft profile based on the financial terms of the contract and the project schedule with a view to making work assignments to subcontractors under constraints economical and predict the expected profit at the end of the project.

2.2.2. Subcontractor Selection Process

A reasonable amount of competition on time, price and quality is desirable for subcontractor selection; the contractor is likely to strike a better deal in the presence of competition among the subcontractors. However, negotiated approach has proof more valuable in situations such as; early start on site, continuation contract, business relationship, contractor specialization, financial arrangements, geographical situation etc. Each project being specifically examined based on its features and the prevailing conditions (Ashworth, 2001).

On public works, the names of contractors who obtained bid documents are usually made known to public, hence contractors do receive price quotations from some unfamiliar subcontractors. If the lowest price is from an unfamiliar firm, the contractor may decide to use a price submitted by a familiar firm as the objective is to submit a reliable and reasonable bid at which profit can be made (Hinze, 2001).

Many contractors have a tendency to award a majority of their subcontracts to prefer subcontractors but this do discourage competing subcontractors. However it is advantageous to contractors to have a cordial relationship with several subcontractors associated with each work specialty (Clough et al, 2005). Selecting subcontractor on a basis of lowest price often results in claims for extension of time, claims for additional fees, less trust between the parties, less investment in training and development, higher capital cost of construction and operation, and a reduced quality in workmanship (Lavelle, et al, 2007).

Prequalification is the process of screening (sub)contractors to verify their competence to execute the project within the specified objective of time, budget and quality standard, it is also used to identify (sub)contractor groupings based on factors including size, resource capacity and suitability for particular project types. The groups are assigned to standing lists which are used to segregate the qualified (sub)contractor's bid for further financial scrutiny. This facilitates the identification of injudicious (sub)contractor at an early stage (Elazouni, 2006).

The most widely used (sub)contractor's pre-qualification criteria are financial stability, technical and management ability, experience, performance, resources, quality management, and health and safety concerns (El-Sawalhi, 2007). Ng (2003) also compiled 26 commonly used criteria for scrutinizing subcontractors structured under the above mentioned 8 aspects/issues.

According to Arslan et al (2008), the need to evaluate subcontractors during the selection process becomes more salient as the project becomes more complicated as this plays an important role in the success of the project. He further developed a web-based subcontractor evaluation system which can be used by contractors to evaluate subcontractors based on certain combined criterion similar to some of the above mentioned.

Numerous research models exists for subcontractor/ suppliers selection, others researches listed the criteria and some went further by assigning weights to them. Lavelle et al (2007) is a rich source of previous works, he went ahead to test the theory that subcontractors are chosen mainly on the basis of price and the significance put on the selection criteria varies with project scenarios using five project scenarios of "in general, specialist packages, non-specialist packages, packages low in value and packages high in value" by using fourteen earlier used criteria in previous studies. He concluded that health and safety, past performance and insurance cover were considered equally important as price and in some scenarios more important than price.

Hartmann et al (2009) using a choice-based conjoint experiment observed that the Singaporean contractors utilizes an unbalanced multicriteria selection which gives preference to price ahead of quality, cooperation and technical know-how of a known subcontractor although they perceive all the four criteria to be important.

Recent researches in construction project management like the work of Kumaraswamy and Matthews (2000), Mautarana et al (2007), Eom et al (2008) etc. advocates partnering between contractors and subcontractors as an effective method for subcontractor selection.

2.2.3 Timing of Subcontract

Buyout period is the time between the contract award to the contractor and the subcontracts being awarded, it is a transitional time between the preconstruction and the construction phases of a project during which subcontracts and purchase orders are issued (Zwick and Miller, 2004). Most subcontractors are selected close to the time they are to start their own portion of the work, in essence the time for issuing the subcontract is very short, this often leads to poor communication between the parties, impetuosity and complications in making the optimum choice of subcontractor which breeds hostility later on the project (Tserng and Lin, 2002).

It is require of subcontractors to execute their work in line with the schedule of the contractor. They should have a copy of the project schedule indicating the exact dates their work is scheduled and the time allocated for the execution. Contractors often inform each of their subcontractors by letter two weeks or more ahead of the date of

commencement of their operations. Subcontractors should not be schedule to be on site until the job is ready and the subcontract work can proceed uninterrupted. Progress of work of the subcontractors should be monitored and ensured it is in pace with the project schedule (Clough et al, 2005).

2.2.4 Subcontractors' Bidding Strategy

Subcontractors play a significant role in the bidding process as the contractors depend substantially on their submitted bid prices to estimate the final bid of the project. It is highly important that the most appropriate subcontractors are chosen for each of the subcontracts. Contractors must be unbiased, just and be fastidious in their choice of subcontractor as any lapse could result in poor quality work and wastage of time and money (Arslan et al, 2008).

Shash (1998a) in his study on subcontractors bidding decisions identified top factors that affects bid/ no-bid decisions of subcontractors to include contractor's credit history, habit in issuance of periodical payments, leadership and capability in planning and managing the project. The top factors affecting subcontractor's mark up size for pricing a job as identified in the same study included; the subcontractor's previous relationship with the contractor, the contractor's capabilities, financial capacity, current work load, and specialty and the prospect for future business relationship.

2.3 Subcontractors' Working Relationship

The dynamic quality of construction mandates provisional relationship of a group, comprising the contractor, subcontractors and owners. The relationship terminates with

the completion and acceptance of the works and the consequent payments of fees (Shash, 1998a). According to Love (1997), every company involved in a project has expectations regarding the other companies, and unfulfilled expectations are responsible for most conflict that arises on a project.

2.3.1 Contractors'- Subcontractors' Relationship

The practice in subcontracting for a designated subcontract work is that the contractor invite subcontractors to submit price quotations, he then evaluates the submitted quotations and select one to be used for bidding. After the award of the contract, he then awards the sublet work to either the subcontractor whose quotation was used in the bid or to a different subcontractor (Shash, 1998b).

Hinze and Tracey (1994) conducted an exploratory study on contractor-subcontractor relationship, the result revealed a more adversarial situation with a large amount of mistrust and insufficient communication. Relationship between subcontractors and the contractor are often strained and liable to cause conflicts due to poor sense of fairness and misunderstanding of each others. In order to coordinate the subcontractor's work with that of other subcontractors, the contractor must know each subcontractor's work in detail (Olsson, 1998).

Hsieh (1998) established that the gap between contractors and subcontractors has a negative impact on site productivity. Proctor (1996) emphasized the importance of the four C's; Consideration, Communication, Cooperation and Compensation during contract negotiation and execution as the golden rule of contractor-subcontractor relation. He

emphasized the need for the subcontractor to understand the complete scope of work of the general contractor as well as the methods and schedule by which the general contractor plans to execute the project ahead of submission of proposal.

According to Love (1997), the ideal subcontractor (as viewed by the contractors): is honest about mistakes, innovative and creative, adheres to schedules, fairly resolves impacts and change orders, produces work of high quality, has fully supported invoices, works in the best interest of the project, flexible to reasonable changes, helps the project beyond his own scope of work, comes in under budget, has a well trained workforce, is thoroughly familiar with the terms and conditions of the contract, identifies needs in timely fashion and has a perfect safety program.

Similarly, an ideal contractor (as viewed by subcontractors): accepts responsibility, is flexible and open to suggestions, gives accurate information for scheduling and coordinating, is fair and honest with compensation for changes, demands quality, pays promptly, has no hidden agendas, treat subcontractors equally, presents a reasonable and logical schedule, makes decisions and resolves conflicts in timely fashion, has a defined chain of command and shows faith and trust in subcontractor's experience (Love, 1997).

In a study, Lee et al (2008) identified three relationship types between the contractor and the subcontractor namely: competitive relationship – also referred to as distributive, win – lose, or adversarial relationships, its' used to transfer the associated risks to other project participants, it diminishes subcontractors' bargaining power with the contractor and often results in unfair contractual condition and onerous practices. The other two are

strategic partnering and strategic partnership, both approaches highlight the need for close and long term relationship between contractors and subcontractors, the knowledge and experience gained through a sustained relationship can enhance cooperation and future collaboration which is built on trust, which results in a productive, win-win relationship.

However, the more the contractor relies on the technical skills of a specific subcontractor, the more cumbersome it becomes to control costs, the more mandatory it becomes to rely on specific producers; all these make it less likely that new technological skills or ideas will be accepted (Tserng and Lin, 2002).

2.3.2 Owner-Subcontractors' Relationship

Subcontractors are contractually bound to answer to the contractor but at the same time must perform their work to the satisfaction of the owner with whom they have no direct contractual relationship (Hinze, 2001). Also the subcontractor is not liable to the owner for a breach of the main contract and the owner who is not a party to the subcontract cannot claim damages for a breach of the subcontract (Murdoch and Hughes, 2008).

2.3.3 Domestic versus Nominated Subcontractor

A 'domestic' subcontractor is the one in which the owner is not involved in its selection and appointment except by giving his approval where this is specified in the terms of main contract while a 'nominated' subcontractor is the one selected by the owner to enter into subcontract with the contractor. (Murdoch and Hughes, 2008)

2.3.4 Equipment Intensive and Labor Intensive Subcontractor

Ng et al (2009) broadly classified subcontractors into two types namely equipment-intensive and labor-intensive subcontractors, the former are those who are mainly hired as a result of their specialized plants and equipments while the later are chiefly hired on the basis of their specialized labor resources. They have a significant proportion of their expenditure dedicated to employing skilled manual labors to execute a trade specific construction operation, many contractors would subcontract work to those specialist traders who possess the required manpower and expertise to accomplish the task in order to reduce the risk of hiring direct labors (Ng and Tang, 2009).

2.3.5 Subcontract Provisions

Subcontracts are similar in form and content to main contract. In most cases, the provisions of general contract such as changes, changed conditions, warranty period, compliance with applicable law, approval of shop drawings and responsibility for safety extend to the subcontractors. Clauses relevant to temporary site facilities to be furnished, insurance and surety bonds to be provided by subcontractors, arbitration of disputes, and extension of time and indemnification of main contractor by subcontractor are always provided as general conditions to the subcontract. Terms of payment and retainage, job site storage, security clearance for workers, works to be completed after hours and other peculiar requirements of a particular project will be in the special condition of subcontract (Clough et al, 2005).

According to Hinze and Tracey (1994), Subcontractors are often required to assume all the obligations contained in the contract between the owner and the contractor without being allowed to scrutinize it. Most of the subcontractor's payment are made late because of "pay-when-paid" and "pay-if-paid" clauses often incorporated in most subcontract agreements (Clough et al, 2005).

2.4 Industrial Projects

According to Clough et al, (2005), industrial construction includes the erection of projects associated with the manufacture and production of commercial products or services. They include some of the largest project built and require a high technical approach. They are mostly built by large, specialized contracting firms that do both design and field construction. They are designed by engineers; examples include petroleum refineries, steel mills, paper mills, chemical plants, electric power-generating stations etc.

Ochieng and Price (2006) stated that industrial projects are of critical importance to the organizations that build and finance them, on successful completion they are of great benefit to the society and generate substantial revenues to the owner, conversely the society suffers if they go wrong and the organizations associated with them experience severe financial difficulties and considerable damage to their reputations.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

This section presents all the steps that were performed to achieve the objectives of this study. It includes all information relevant to the collection of the required data, where and how the data was obtained, and the method used for the analysis of the responses.

3.1 Data Required

The study objectives make it imperative to obtain some data of subcontracting practices on industrial projects. The following terms are being defined to provide a common understanding of their usage for the purpose of this study.

1. Owner: The instigating party for whose purposes the construction project is designed and built.
2. Contractor: The business firm that is in contract with the owner for the construction of the project.
3. Subcontractor: A firm that contracts with a contractor to perform some aspects of the contractor's work.
4. Subcontract: An agreement between a contractor and a subcontractor for the execution of a portion of the contractual obligation of the contractor to the owner.
5. Subcontracting Strategy: A series of decisions that a contractor makes regarding designating work items to be subcontracted, choosing an adequate contract type,

assigning subcontract to suitable subcontractors and scheduling subcontract works to an appropriate time in the project schedule.

6. Industrial Projects: Constructions of projects associated with the manufacture of commercial products or services. Petroleum refineries, steel mills, chemical plants, electric power-generating stations are examples of industrial projects.
7. Project Delivery System: The basis of the project's contractual relationships, it dictates the nature, extent, responsibilities and duration of each party to a contract.
8. Contract Type: The basis for the terms of payments for the contract i.e. lump sum, unit price and cost-plus contracts.
9. Project Value Drivers: Strategic factors that significantly add or enhance the performance or values of a construction project. These factors are restricted to quality, cost and time for the purpose of this study.
10. Quality: The ability of the contractor to deliver a completed project that meets or exceeds the owner's requirement as specified in the contract documents
11. Cost: The cost of construction i.e. the total of all direct and indirect costs of construction.
12. Time: The ability of the project to proceed efficiently as scheduled and be completed within the stipulated contract duration.

13. Project Performance: It refers to what the contractor is able to achieve in terms of control over cost, schedule and quality measured relative to their baselines.

3.1.1 Potential Factors Affecting Subcontracting Strategy

The following is a list of thirty-six (36) potential factors affecting subcontracting strategy of contractors in industrial projects collated from an extensive review of literatures on the topic with particular reference to the work of Zadeh et al (2010) listed under the four categories; Scope and number of Subcontracts, Awarding Method, Type of Subcontracts, and Timing/Schedule of Subcontracting in the questionnaire with some brief explanations:

(a) Factors related to scope and number of subcontract:

- (i) *Capabilities and workload of subcontractor*: A high percentage of work can be sublet to a subcontractor only if the subcontractor has the capability i.e. required workforce, equipment, technology, financial support etc. to execute such magnitude of work. If a qualified choice subcontractor did not have the capability, the work should be divided into two or more parts and sublet to other willing subcontractors. Also if a choice subcontracting firm has the capability to execute such magnitude of work but is currently outstretch by numerous outstanding workloads, the firm should be considered temporary incapable and the amount allocated for the firm should be reduced by separating it into two or more portions and sublet the remaining to other less busy firms.

- (ii) *Capabilities and workload of supplier:* Similar rules like those in (i) should be applied to suppliers as well, this is because when either the subcontractor or supplier is allotted more work than his capabilities and/or workload, their expected performance is questionable and the contractor might be guilty of deliberately paving way for the failure of the project.
- (iii) *Financing requirement:* The financial institution who loan out money to the contractor for the project execution always stipulates that the contractor carry out a significant percentage of the work in-house with their own workforce, If this requirement exist on a project the scope of work remaining to be sublet will reduce and consequently the number of subcontract available will be minimal.
- (iv) *Economies of scale:* Economies of scale refers to the reductions in unit cost as the scale increases. Applies to subcontracting, it means the contractor is likely to get a reduction in price if he sublet to fewer contractors' than if he sublet to a higher number of subcontractor.
- (v) *Associated risks and liability exposure:* One main reason of subcontracting is to transfer or share the risk associated with the job. If a contractor is 'risk-aversing' he may want to subcontract a significant scope of the project. However if he is a 'risk-taker' he will like to take the risk to do most of the job with his in-house workforce.

- (vi) *Contractor's current capability*: There is a higher tendency for the contractor to sublet some part of the job he would have otherwise done in-house with his workforce to subcontractors if he currently engages his staff with some other work and time is not to his advantage. Conversely, a contractor might venture into executing specialized work he normally sublet to subcontractors with his own workforce if he is not presently engage in any other work because he doesn't want to keep an idle workforce. Generally, contractor sublet more when their current workforce is more engaged and less when their staff is less engaged.
- (vii) *Timing issues (project schedule)*: Each project has a budgeted schedule of time with which some deliverables must be met (milestones) or the entire project must be completed. In fact liquidated damage clause is always there to penalize the contractor for any unnecessary delay on projects completion. However, in cases when there is plenty of time for a project, the contractor will allocate the project into few subcontracts and the subcontractors work steadily on the project. In contrast when 'time is of essence' on a project, the contractor break down the project into many subcontracts so that each subcontractor has a small scope of work and each can expedite actions on their work in order to meet up with the limited time schedule.
- (viii) *Technological requirements/work sophistication*: For works which requires major technology or sophisticated machineries/equipments to accomplish, the economies of scale also comes in. It is better not to fragmentize such jobs into

numerous subcontracts but to have them done by a single subcontractor who mobilize such technology/ machinery/ equipment only once to the project site. This could mean a significant proportion of the project scope is being handled by a single firm.

(ix) *Work interface requirements:* When too many subcontractors are working on a project site concurrently, interface problem is bound to occur. Interface problem could be managed if location based scheduling is judiciously utilized in the scheduling of the project. However, the contractor can prevent most interface problem by restricting the number of subcontract in a single project by making sure each subcontract constitutes a significant portion of the scope of the entire project.

(x) *Contractor tendency to involve in the works:* If the contractor has a high tendency to be involve in the works, the available scope of work left to be sublet will reduce and subsequently the number of subcontract available.

(b) Factors related to awarding method:

(i) *Main contract requirement:* In some cases, the main contract does specify the subcontract awarding method allowed. It could be the same as the awarding method used for the main contract or a different one. When this is the case the contractor is under contractual obligation to utilize the specified method irrespective of his own preference.

- (ii) *Availability of appropriate subcontractor:* If appropriate subcontractors are available the contractor will use the desired awarding method. However when the subcontractors are not available, the available contractor may have a preferred method of award which the contractor may be tempted to use.
- (iii) *Availability of appropriate suppliers:* When the suppliers who have worked with a particular contractor before and have the experience in a specific method of award preferred by the contractor are not available, the contractor might be skeptical on the suitability or acceptability of the same method with the available suppliers, he may want to use the awarding method they are favorable disposed to.
- (iv) *External issues (government regulations etc):* In some cases regulations either banned the use of a certain award method or stipulate a specific method of award to be used which the contractor must strictly abide by it.
- (v) *Project schedule requirements (available time):* In many cases the contractor has a few period of time between the signing of the contract and the commencement of work on site. Yet, he has to ensure the subcontractor is mobilized to work on time. Some awarding method requires a significant period of time before the subcontract arrangements will be finalized. In many of such cases, the contractor has to use a delivery method that will take lesser time, finalized the subcontract in time and ensures works commenced on site as scheduled.

- (vi) *The degree of significance of the price:* The contractor becomes more conscious and cautious of the method of award he chooses and other actions on a typical subcontract as the significant of the price relative to the contract price increases. When the price is significantly high, the contractor will likely employ a method of award that will save more cost than when otherwise.
- (vii) *Current state of the market:* During the period of construction boom, many subcontractors are always engage with one job or the other. For a contractor to get the best of subcontractors to work with during such periods, he has to use a method of award that provides the most incentive to the subcontractor.
- (viii) *Scope of subcontract (equipment, supply or service):* The nature of subcontract differs with either each it is equipment or material supply, services etc. Each kind has a more suitable method of award. Equipment or material suppliers have different preferred method of award which the contractor will follow. Similarly, service providers' e.g. labor-intensive subcontractor has another appropriate method for the award in use for the subcontract.

(c) Factors related to types of subcontract (pricing approaches):

- (i) *Accuracy of the estimated cost:* The accuracy of the estimated cost can have a profound effect on the contractor's choice of a pricing policy. If the contractor is confidently sure of the estimated cost, he is more likely to favor lump sum pricing approach (other conditions being constant) to a unit price approach.

- (ii) *Accuracy of the estimated time:* Also is the accuracy of the estimated time, If a contractor believes the duration earmarked for a specific work is too much compared to the probable actual duration required, the contractor may likely favor time and material (labor-hour/man-hour) contracts with the hope of gaining the advantage of the cost of any unspent hours.
- (iii) *Extent of potential changes:* When the potential change in a project is very high, the contractor may likely favor unit price or reimbursable contracts to lump sum contract (other conditions being constant). This is because it will be easier for changes to be incorporated into such contract quickly and more conveniently than a lump sum contract.
- (iv) *Comprehensiveness of the scope definition:* Scope definition plays an important role in the choice of pricing approach use on a project. When the scope is vague or not yet clearly determined, the contractor will likely prefer the unit price to lump sum approach (other conditions being constant).
- (v) *Risk allocation:* Each of the pricing approach allots risk differently to the parties involved. In a situation where the contractor is 'risk-averse' he will prefer to use lump sum contract which transfers the risk to the subcontractor.
- (vi) *Ability to control cost:* When there is a high tendency for the contractor to control the cost, he will preferably use reimbursable contract in preference to other contract approaches.

- (vii) *Contract award method (competitive bidding or negotiation):* Although not a rule, each pricing approach is commonly associated with the different award method. The contractor may find it convenient using a pricing approach simply because of the contract award method used.
- (viii) *Importance of the schedule performance:* Some pricing approach requires the subcontractor to meet certain milestone on project execution before his periodic payments are released while others are not specific about this. If the schedule performance is important, the contractor could use such approach to ensure meeting up with the deadlines.
- (ix) *Importance of quality performance:* Reimbursable pricing approach motivates the subcontractor to ensure quality performance more than lump sum contract. Hence if quality performance is highly important on a project, the contractor could give preference to such an approach.
- (x) *General contractor involvement requirement:* The level of involvement of contractor required on cross-checking and measuring the actual work done on site, number and hour of work of subcontractor's staff spent on site etc. is far less or probably not essential on a lump sum contract than other forms of contract. Hence, the contractor will prefer to use lump sum if he does not want to be involved in such unnecessary details of how the subcontractor executes his job.

(xi) *Available time to prepare the contractual documents:* The time requires preparing the contract documents varies with each pricing approach because of difference in level of details required for each. For example, a more extensive detail of the work is required for a lump sum as compared to unit price contract approach.

(d) Factors related to timing /schedule of subcontracting:

(i) *Project time schedule:* All subcontracts in a typical project are not always awarded at the beginning of the project. For example, in a project schedule to span thirty months, if a contractor plans to sublet excavation, roofing and landscaping/external works, it is more imperative for him to award excavation earlier than roofing and roofing earlier than external works/landscaping. This is because it is logical that the project is schedule that excavation comes before roofing, and roofing before external works/landscape with a reasonable amount of time in between each pair.

(ii) *The origin of subcontractor/suppliers (local or foreign):* It is more advisable to sublet contract work of foreign subcontractors earlier as they will require time to process visa for their personnel, commute them into the Kingdom, secure accommodation, settle them down and more importantly to get 'Iqamah' for them. Even for supplies, it will take time for the shipping, processing of documents with immigration officials, clearing of the supplies at the port and transporting it from the port to the project site.

- (iii) *Contract award method (competitive bidding or negotiation):* In practice, on average it takes a longer time to award competitive bidding as compared to negotiation because it involves more processes. Hence, a contractor who plans to sublet a subcontract through competitive bidding should initiate the process earlier than it would be if he plans to use negotiation.
- (iv) *Associated risks:* Contractors often sublet work in order to transfer or share the risks involved in the project. When associated risk is high, there is a tendency for the contractor to sublet the work as early as possible.
- (v) *Availability of required resources to prepare RFP's and to evaluate the proposals:* When a contractor has a capable and standby in-house resources to prepare RFP's and to evaluate the proposals he might be relaxed with the way he handles these things than if otherwise.
- (vi) *Work interface requirements:* When the same task is divided into two subcontracts and sublet to different subcontractors, the contractor may put an interval of time between the times of award so that both of them are not competing for space on site causing interface problem.
- (vii) *Difficulty of RFP's preparation process:* When the process of preparation of RFP's is simple and straightforward, the contractor may delay the timing and carry out other pressing tasks first.

3.1.2 Potential Problems Affecting Subcontracting Strategy

The following is a list of thirty-three (33) potential problems affecting subcontracting strategy of contractors in industrial projects as listed under the three categories of planning, awarding and contracting issues in the questionnaire with some brief explanations.

a) Problems related to planning issues

- (i) *Inadequate planning of subcontracting practices*: The contractor should have a detail plan of how he is going to administer all activities relating to subcontracting prior to the commencement of the project. This will serve as a guide and a benchmark during the actual execution of the activities.
- (ii) *Incompatibility of the subcontractor/supplier's time schedule with the project's time schedule*: Subcontractor/suppliers often work on more than one project concurrently and they have limited number of workforce on their payroll, it does happen that the same resources needed to execute a project is currently engaged on a different project at the same time, the resources could be manpower or machineries/equipments.
- (iii) *Lack of information/imprecise data from previous practices*: To make an effective plan, subcontractors need accurate information from previous similar projects. Many times, the contractor is working on a new form of project for the first time or the data from previous projects were not kept or the data have not been processed. The contractor has to rely on subjective intuition or he

follows data from internationally published sources (e.g. RS Means) which cannot be accurately relied upon because of the difference in environmental conditions, business culture, government policies etc. between Saudi Arabia and the source country (e.g. United States). A good management information system where contractor should store and organize all previous experience, lessons learned, achievements and mistakes is a recommended practice for contractor's success. He shall be utilizing his database to analyze new projects and rely on his record for successful performance on new projects.

- (iv) *Too much interfaces between subcontractors/suppliers works:* Contractor has to coordinate the activities of different subcontractors on job site. This is easier if there are few contractors on a site at a given time, when many contractors are on site at the same time and working on the same or adjacent locations on site, the interface problem becomes manifest.
- (v) *Insufficient period/squeezed schedule for subcontract's arrangement activities:* Enough period of time must be allowed between the approval of the contractor and the commencement of work at site, this will allow the contractor to have ample time to arrange subcontract activities.
- (vi) *Inaccurate cost estimates of subcontracted packages:* Subcontractors makes estimates of works and submit quotations of it to the contractor, it is the same estimate the contractor uses in the preparation of his bid and subsequent subcontract agreement. In case of detection of errors and inaccuracy in the

estimates, it will pose a problem for the contractor who will have to arrange for extra efforts to correct and ensure the accuracy of the estimate

- (vii) *Inconsistency in subcontractor/suppliers schedules:* When subcontractors or suppliers keeps changing their schedules, it leads to confusion for the contractor as the changes might not align with the overall project schedule since contractors is obliged to coordinate the schedules of all subcontractors together with the required work sequence at site to produce the overall project schedule

- (viii) *Gap or double coverage in the scope of work of subcontractor/suppliers compared to the project scope of work:* It is advisable to mobilize and demobilize a crew once on a project, this enhances their productivity and ultimately conserves the resources, however the nature of some work activities doesn't permit this, contractor should try to avoid gap or double coverage in the scope of work for subcontractors/suppliers except when this is not practically feasible.

- (ix) *Financing and other regulatory constraints:* Contractors often need loans from banks and other financial institutions to execute the project. Some of the loans might come with some conditions which restrict the contractor's decision on subcontracting, for example the bank might stipulate that the contractor must execute a certain percentage of the work directly with his own workforce as a condition for the loan.

(x) *Requiring too much management and coordination effort:* Most contractors sublets substantial part of the project to subcontractors and only execute a small portion of the work with their own workforce, to manage the subcontractors might become an herculean tasks if the project is too much fragmentize among numerous subcontractors.

(b) Problems related to awarding issues

(i) *Incomplete request for proposal:* Clients/consultants often send incomplete request for proposal to the contractor by mistake or because the design is not yet complete. It is this same document the contractor will depend upon for their estimates and bids, after the award of the contract, the contractor will face serious problems after detecting a very important component of the project is missing, although the contractor might succeed in adding the component through a change order but this might have cause a big headache for him during the award of the subcontract.

(ii) *Inappropriate request for proposal:* If an inappropriate request for proposal was initially issued, this will cause every other steps took by the contractor from estimating, bidding and now the award of subcontract to be inappropriate.

(iii) *Lack of appropriate vendor list:* When a contractor has an appropriate vendor list, it will be easy for him to quickly contact appropriate subcontractor to submit bid for any new project.

- (iv) *Lack of an updated vendor list:* Vendor list like any other real time database must be updated frequently. When a contractor fails to update his vendor lists, he might be missing bids from new emerging competitive subcontractors, this may make him to miss lowest prices and he might lose bids based on higher prices he got from few known subcontractors.
- (v) *External issues/ regulatory restrictions:* Some issues worthy consideration are external to the project e.g. governmental regulations concerning health and safety on site.
- (vi) *Imposed vendor list by the client:* Corporate organizations like SAUDI ARAMCO, SABIC etc. have lists of pre-qualified subcontractors of different grades or cadres. Whenever a contractor is working with such clients, he is under obligation to choose his subcontractors from their approved list.
- (vii) *Inappropriate subcontractors' evaluation criteria:* Price remains the core criteria used to evaluate subcontractors. However, quality, work experience, adequacy of personnel and a host of other factors are usually combined together in various combinations to evaluate subcontractors. The choice of a combination also depends on another set of factors like the type, nature, size of contract etc. A wrong choice of an evaluation criteria will ultimately leads to the selection of a wrong subcontractor.
- (viii) *Inadequate suppliers' evaluation criteria:* Just like for the subcontractors mentioned above, Price and other factors are considered depending on the

type, nature, size etc. of the project. Contractor has to utilize correct evaluation criteria in order to select appropriate supplier.

- (ix) *Insufficient number of contractors to allow for competitive bidding:* When a contractor receives bids from many different and diverse subcontractors, there is a high possibility he gets many low bids from which to make a choice. But if the number of subcontractors available to bid for a project is small, A subcontractor has a higher chance of winning the bid hence he is not encourage to reduce his fees and the contractor might end up not getting the lowest possible fees.
- (x) *Insufficient number of suppliers to allow for competitive bidding:* A reasonable number of suppliers are necessary for favorable competitive bidding, when there is insufficient number of suppliers, monopoly or oligopoly will arise, and this may prevent the contractor to receive the minimum possible fee for the bid as the few available suppliers tend to raise their fees.
- (xi) *Lack of subcontractor performance history:* Performance history is a major criteria used for subcontractor evaluation. If the subcontractor has done jobs of similar capacity, this may stand as a proof of his suitability for the present work. Contractors always hesitate to award jobs to an unknown contractor (past history not available) even if he happens to be the lowest bidder because the contractor is not sure of the reliability of his bid.

- (xii) *Lack of suppliers' performance history*: A supplier with a very good performance history will have a strong reputation with the contractor and this is an added advantage for his evaluation. Whenever the contractor did not have the performance history of suppliers it became difficult for him to rely completely on their figures for their bids and they stood disadvantaged in being considered for the contract.
- (xiii) *Inappropriate company procedures*: Each subcontractors company has procedure in use with their prospective customers (i.e. contractors). When such procedures are not aligning with the contractors' processes it creates problems for the contractor in awarding subcontract to such companies.
- (xiv) *Communication problems*: Effective communication must be ensured between the contractor and the subcontractor at all stages of the project. At the awarding stage, the contractor will like to clarify ambiguities in subcontractor's bid, verify some information supplied and ensures the subcontractor incorporates every aspects of the job to be done in his bid. He may also want to confirm that the subcontractor understood the construction method as specified in the main contract. All this requires an efficient exchange of information through an appropriate medium with a prompt feedback. If any of this is defective, communication problem ensues.

(xv) *Unethical practices*: Bid peddling, bid shopping etc. do occur during the buyout phase of project. Although not illegal, these practices are considered unethical. It is important that the contractor be wary of them.

(c) Problems related to contracting issues

- (i) *Inappropriate contract pricing (lump sum, unit price, cost-plus, etc.)*: Different contract pricing methods are in use in construction. Each with its' own pros and cons. The contractor choice of an appropriate contract pricing method often leads to reduction in cost. Also, each pricing method apportions risks differently to parties involved. However, contractor must ensure he choose the appropriate contract pricing method that met the project requirements and objectives.
- (ii) *Time consuming contract negotiations*: The terms and conditions of the contract must be properly negotiated, intricately understood and agreed upon by all the parties to it. However, this must be done expediently to avoid time-consuming negotiations which may hamper the commencement of work and hence cause delay of the project.
- (iii) *Incompatibility of subcontracts terms and conditions with the main contract's terms and conditions*: Two different contracts exist between the owner and contractor and between contractor and subcontractor. However, the subcontract is a subset of the main contract. Hence, the subcontract terms and

conditions must align with the main contract's terms and condition otherwise dispute is bound to occur later during the execution of the project.

- (iv) *Reneged of subcontractors on the previous agreements during contract negotiation:* Contract documents are a legal tender which once agreed upon is binding on all the parties, hence the importance of understanding all the details before signing it. In practice however, subcontractors often enter into agreements with contractor in haste and out of passion to desperately get the job, this often leads them to undervalue some contract condition and then into unfavorable situations in which they have to renege on previous contract negotiations.

- (v) *Reneged of suppliers on the previous agreements during contract negotiation:* The suppliers also do find themselves in such a difficult and messy situation mentioned above in which they renege on previous agreements due to their initial unguided zeal, lackadaisical attitude or in some cases unforeseen circumstances beyond their control.

- (vi) *Improper contractual terms and conditions (terms of payment, liquidated damages etc.):* Different terms and conditions apply to a contract, the effect of all must be carefully considered while issuing subcontract. When 'time is of essence', liquidated damages clause are used by the owner to mitigate the effect of their anticipated loss due to delay in project completion. In such cases, the contractor has to bear the cost if the delay in completion is actually

caused by a subcontractor who does not complete the subcontracted work on schedule. Hence the contractor must consider this while issuing subcontract. The same thing applies to other conditions like retainage etc. However some of the terms may not be proper when applied to subcontracted works due to the small size of the subcontract and the low financial strength of the subcontractor.

- (vii) *Inconsistency in the different parts of subcontract's documents:* Subcontract documents are many, each one complements the other. However, all combines to form a single contract. Hence, all efforts must be made to ensure the contents of the various documents did not contradict one another in any way. Every inconsistency must be resolved and all ambiguity clarified. If this is not resolved earlier in the project, it could be a possible cause of dispute during the execution of the project.
- (viii) *Management and coordination problems:* with an increasing use of subcontracting in construction, the managerial and coordination roles expected of contractors keeps increasing. However, many contractors are plagued with management and coordination problem due to lack of project management competence of their staff. To keep abreast of the current trend of things, it is a challenge for contractors to update the knowledge and skills of their staff. One temporary hideout is to reduce the number of subcontracts which implies less management and coordination problems.

3.2 Data Collection

This section of the study investigated the subcontracting practices of industrial project. The principal research tool was the questionnaire which was administered to industrial construction contractors practicing in the Eastern Province of Saudi Arabia. The key informants of the contractor's staff were the Construction Management Personnel (i.e. Construction/Project Managers, Estimation Engineers, and Project Engineers etc.) who have hands-on experience in subcontracting practices.

The questionnaire (see Appendix 1) was in four parts:

- (i) Part 1 contained questions on general information of the respondent and its organization.
- (ii) Part II contained the potential problems in the buyout phase of projects as identified in the literature review listed and previous studies under the three categories; planning issues, awarding issues, and contracting issues. The respondents were required to relate the potential problems by matrix with the project's value drivers (cost, time and quality) with which they may have negative impacts.
- (iii) Part III contained the same potential problems listed under the same categories as part II, but the respondents were required to rate each of the problems on a Likert scale of 1 to 5, the magnitude of the problem on project performance. The corresponding scale were 1= no impact; 2= low impact; 3= moderate impact; 4= high impact and 5= extremely high impact.

- (iv) Part IV contained potential factors affecting subcontracting strategy as identified in the literature review and previous studies listed under the four categories; scope and number of subcontracts, awarding method, type of subcontract (pricing approaches), and timing/schedule of subcontracting. The respondents were required to rate the importance of the factors on project performance on a Likert scale of 1 to 5, The corresponding scale were 1= not important; 2= slightly important; 3= moderately important; 4= highly important and 5= extremely important.

3.3 Population and Sample Size

A list of contractors working on industrial project in the Eastern Province of Saudi Arabia was obtained from previous studies like Bu-Khamsin (1999), a construction database (www.constructionweekonline.com) and Eastern Province Chamber of Commerce & Industry. A valid list of 40 industrial contractors was obtained from all the sources. The questionnaires sent to all of them and only 15 questionnaires were returned. Although the figure appears low, the number represents 37.5% of the population frame. This response rate is adequate and the results should be read accordingly and their unrestricted generalization beyond the context of the scope and study area should be avoided.

3.4 Data Analysis

The responses were analyzed using basic statistical methods, the average or the mean score was calculated when required, the importance value (*IV*) and the relative importance weight (*RIW*) were also calculated for the potential problems and factors. The

importance value, corresponding to a scale of 0-100 of each problem in each category was calculated using the interpolation concept by applying equation 1.

$$IV_i = (100 * M_i - 100) / (5 - 1) * 100 \dots \dots \dots (1)$$

Where i = the respective problem/factor in each category, IV_i = the importance value for problem/factor i and M_i = the mean score for problem /factor i .

The relative importance weight factor for each problem/factor in each category was obtained by applying equation 2.

$$RIW_i = IV_i / \sum IV_i \dots \dots \dots (2)$$

Where RIW_i = the relative importance weight of problem / factor i .

The overall mean score, overall importance value and the overall relative importance weight of each category of problems/ factors was also calculated using the following equations.

$$OM_j = \sum M_i / Z_j \dots \dots \dots (3)$$

$$OIV_j = (100 * OM_j - 100) / (5 - 1) * 100 \dots \dots \dots (4)$$

$$ORIW_j = OIV_j / \sum OIV_j \dots \dots \dots (5)$$

Where OM_j = the overall mean score for the j category of problems/factors; M_i = the mean score for the problem/factor I in each category, Z_j = the number of problems/factors

in category j , OIV_j = the overall importance value of category j , and $ORIW_j$ = the overall relative importance weight for category j .

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter presents the findings and analyses of data obtained from survey of contractors on their subcontracting strategy in industrial projects. The first section discusses the results on general information about the respondents and their firms. The second section addresses the results of the importance of the factors influencing subcontracting strategy as rated by the respondents. The third section presents the magnitude of the impact of the problems affecting subcontracting on project performance as rated by the respondents while the last section considers the relationship between the potential problems affecting subcontracting strategy and the project's value drivers (cost, time and quality) with which have negative impacts as identified by the respondents. The data used for the analyses were the responses obtained from fifteen (15) industrial contractors (see appendix II) who participated in the survey.

4.1 Characteristics of the Respondents and their Firms

This section contains information on the status and working life of the respondent in the firm, the classification of the company, experience (both in industrial projects and management of subcontracting practices), the pricing method and the percentage of work usually sublet by contractor and the project delivery method being used by the owner.

4.1.1 Classification of the Companies

The Ministry of Municipal and Rural Affairs (MOMRA) classifies qualified and registered contractors as a requirement for participation in government projects. Table 1 shows the distribution of the categories of the firms in this survey. The companies cut

across all the different categories while about a third of them were not classified, this demonstrates the variations in size, organization and nature of work specialty among the respondents which eventually corroborate diversity in the sample population as another evidence which strengthen the survey.

Table 4.1: Classification of the Companies

Position	Frequency	Percent	Cumulative frequency	Cumulative percent
Grade 1	3	20.0	3	20.0
Grade 2	5	33.3	8	53.3
Grade 3 and Below	2	13.3	10	66.6
Not classified	5	33.3	15	100

4.1.2 Position of the Respondents in the Companies

The distribution of the position of the respondents in the various participating companies is shown in Table 4.2. They are top management officials in their respective companies and are directly involved in subcontract decisions in numerous projects. Interestingly about 20% of the respondents specified others and all of them wrote ‘estimation manager’ as their position, this reiterates the importance of accurate estimate to successful bidding which is a key to successful construction of project, in addition the Saudi construction industry recognizes the importance of estimation experts and they accord them esteem positions.

Table 4.2: Position of Respondents in the Companies

Position	Frequency	Percent	Cumulative frequency	Cumulative percent
Owner/General Manager	3	20.0	3	20.0
Project Manager	6	40.0	9	60.0
Project Engineer	3	20.0	12	80.0
Estimation Manager	3	20.0	15	100

4.1.3 Working Life and Experience of the Respondents

Figures 4.1 and 4.2 respectively show the distribution of experience in industrial projects and management experience in subcontracting practices of the respondents. It can be seen that 87% of the respondents are having more than 10 years of experience and 73% of the respondents have over 10 years of management experience in subcontracting practices. The average years of experience of the respondents is 20 years with an average of 13 years hands-on experience in management of subcontracting practices. These shows that the respondents are very experienced, this reflected in the level of completeness, consistency and precision of the information provided, which provides further validity for the survey results.

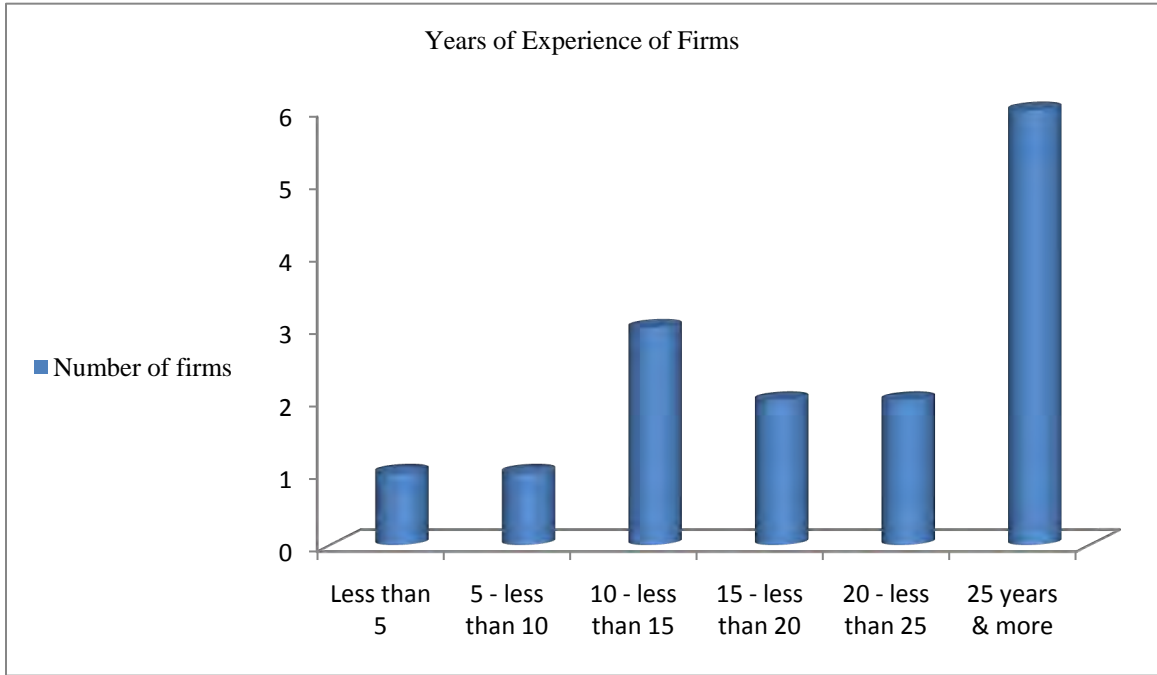


Figure 4.1: Years of Experience of Respondents in Industrial Projects

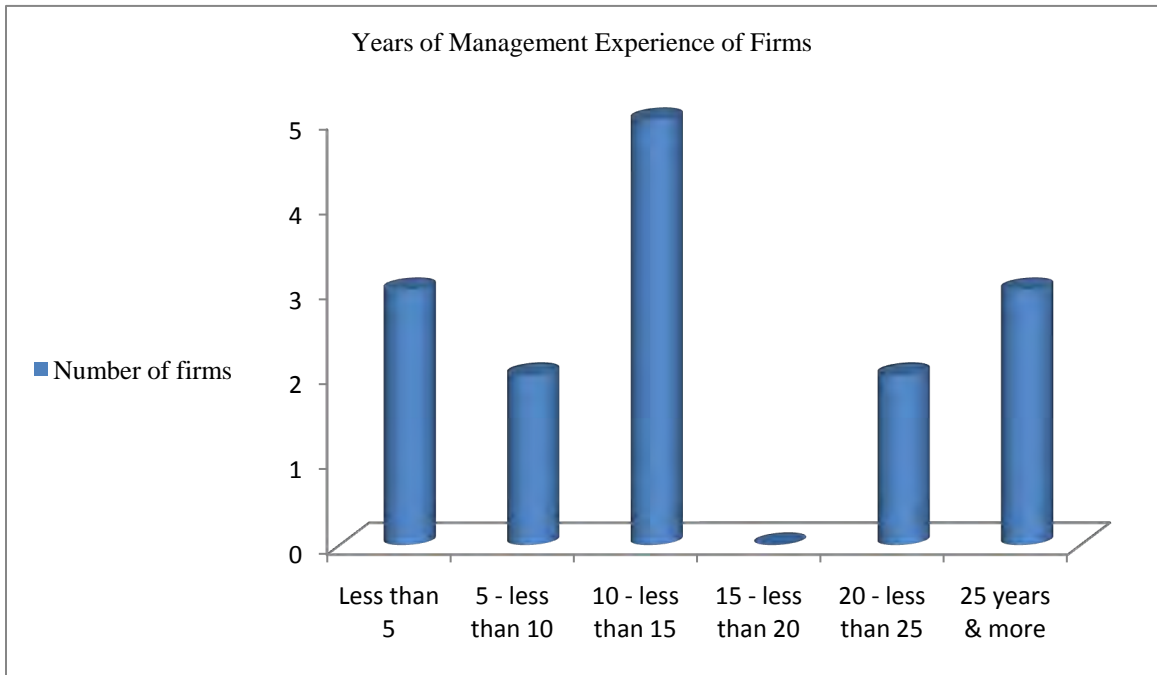


Figure 4.2: Years of Management Experience of Respondents in Subcontracting Practices

4.1.4 Amount of Subcontract Work

The distribution of the percentage of work sublet on a typical project (measured relative to the total contract price) is shown in Figure 4.3. The results indicated that a small minority (27%) of the contractor sublet 30%-40% or more of the work to subcontractors on a typical industrial project or precisely only 20% of work (measured relative to the total contract price) is sublet to subcontractors on a typical industrial project in Saudi Arabia, this is far less than what is obtained in the work of Chiang (2008) which reported 80% of the value of building works being undertaken by subcontractors in Hong Kong. This is largely due to the difference in the nature of the work between building and industrial constructions. Building works are predominantly labor-intensive projects whereas industrial constructions are mainly equipment-intensive. Also, the works of many distinct specialty trades that are traditionally involved in the construction of a building- Mason, Carpentry, Plumbing, Painting etc. constitutes a significant proportion of the total work and hence will represent a large chunk of the work if they were issued as separate subcontracts. Although, many if not all of these trades will equally be engaged on an industrial project, however, the volume of their involvement compared to the overall size of the project is lower due to comparatively large size of industrial projects. In addition, the difference in business culture of Hong Kong and Saudi Arabia could equally contribute to the difference.

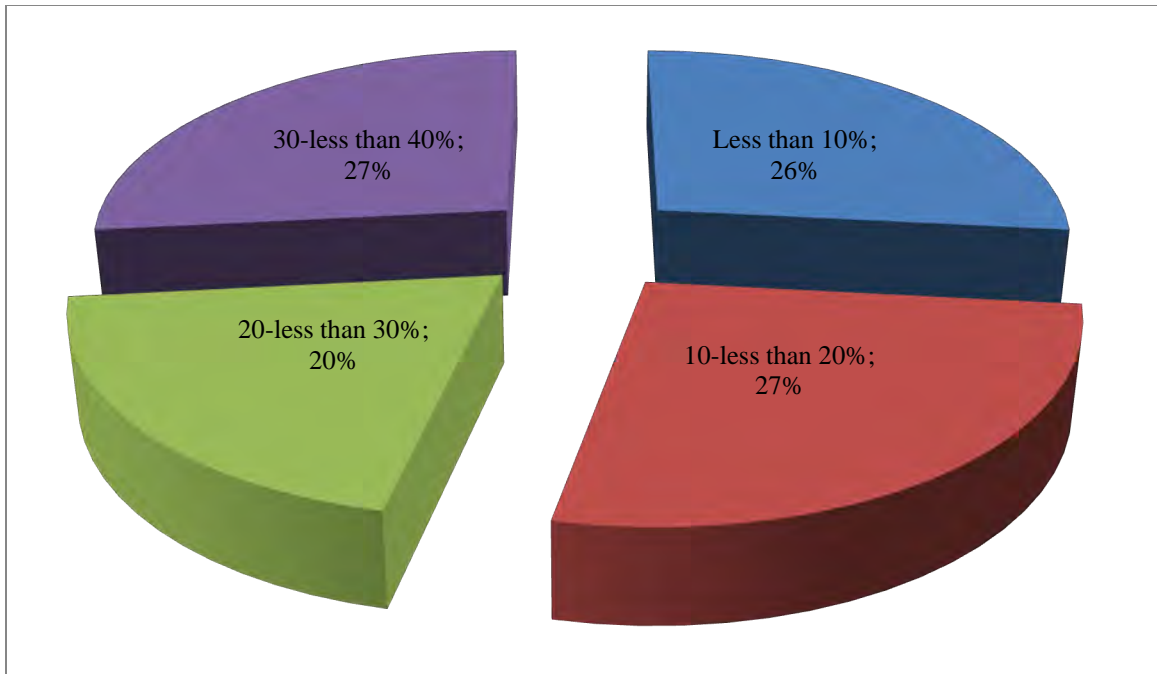


Figure 4.3: Percentage of Subcontract Works on a Typical Project

4.1.5 Owner's Use of Project Delivery System

Figure 4.4 shows a summary of the analysis of the responses on project delivery method in use to award industrial projects to contractors. The dominant project delivery system in use is the Turnkey or Engineer Procure and Construct (EPC) which accounts for 38.7% while Design-Build accounts for 14.7%. Industrial projects require a highly technical approach, this justifies that the same firm undertakes both the design and the construction which is typical with both delivery methods. It also implies that the construction contractors are involved in the design phase of the project which will enable them to have inputs into the design and will later reduce constructability hitches during the construction phase. Design-Bid-Build has a share 30.0%, this is realistic as the method is the traditional method of project delivery and it still remains the most popular of all. The

recent trend in project delivery is the construction management, with share of 16.3% it is gradually gaining acceptance in the Saudi Construction industry. A respondent identified Build-Operate Transfer (BOT), however it is mainly used in public infrastructural projects in some countries and not commonly in use in Saudi Arabia where the government has sufficient fund to execute public projects.

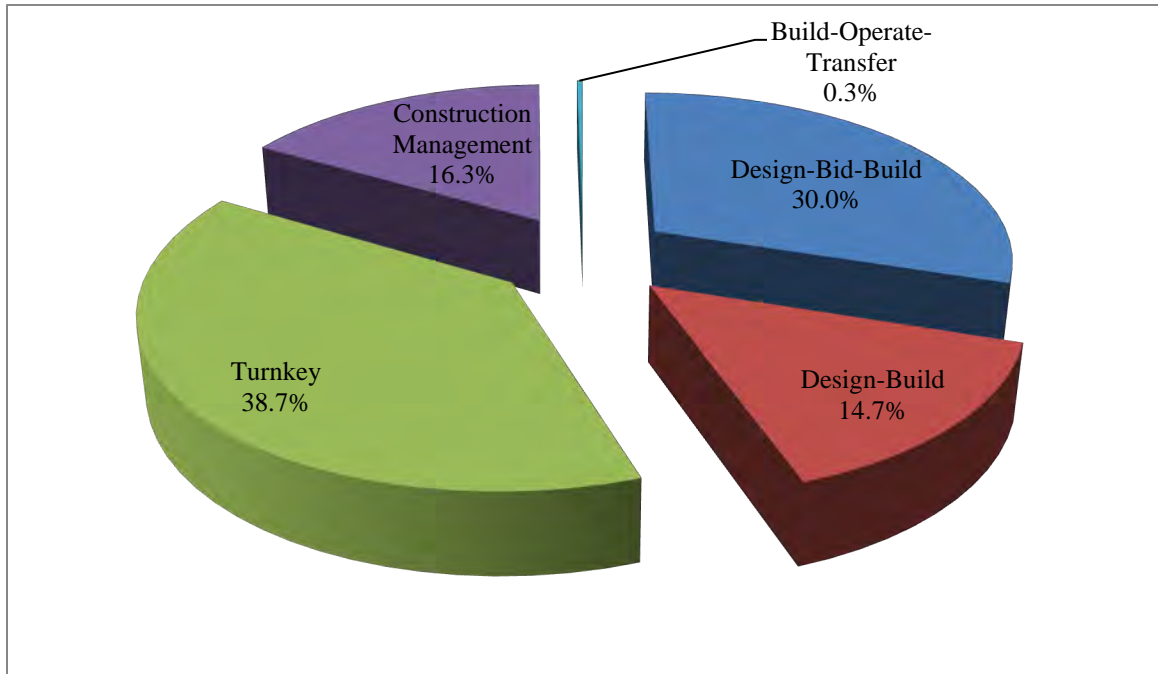


Figure 4.4: Owners Use of Project Delivery System

4.1.6 Contract Type Used for Subcontracting

Figure 4.5 shows the responses on the contract type used to sublet works to subcontractors on a typical industrial project. More than half of the projects (52.3%) are sublet using the lump sum contract and 44.2% using unit price contract, these implies the contractors usually transfer the risks associated with the sublet works to the subcontractor, in lump sum contract the subcontractor will bear all the risks while the unit price he bears the substantial part of the risk which is the risk associated with the cost he

estimates per unit of the project and the little risk left for the contractor is related only to the correctness of the amount of the work. Only a few minority of projects (3.5%) is sublet using any of the variations of the cost-plus contract, this may be due to more paperwork and protocols involved in such contracts as the contractor has to double-check the actual work done by the subcontractor in order to curb any excessive inflation of the construction cost.

In another perspective, the payment method employed by the contractors in this survey disproportionately tends to be price-based (96.5%) as compared to cost-based (3.5%). Fundamentally, Price-based payment method shift the risk to the seller (the subcontractor in this case) while the cost-based methods shift the risk to the buyer (the contractor in this case). The deduction is that contract types used in subcontracting in industrial projects in the Eastern province of Saudi Arabia as revealed from this survey generally push the risk to the subcontractor.

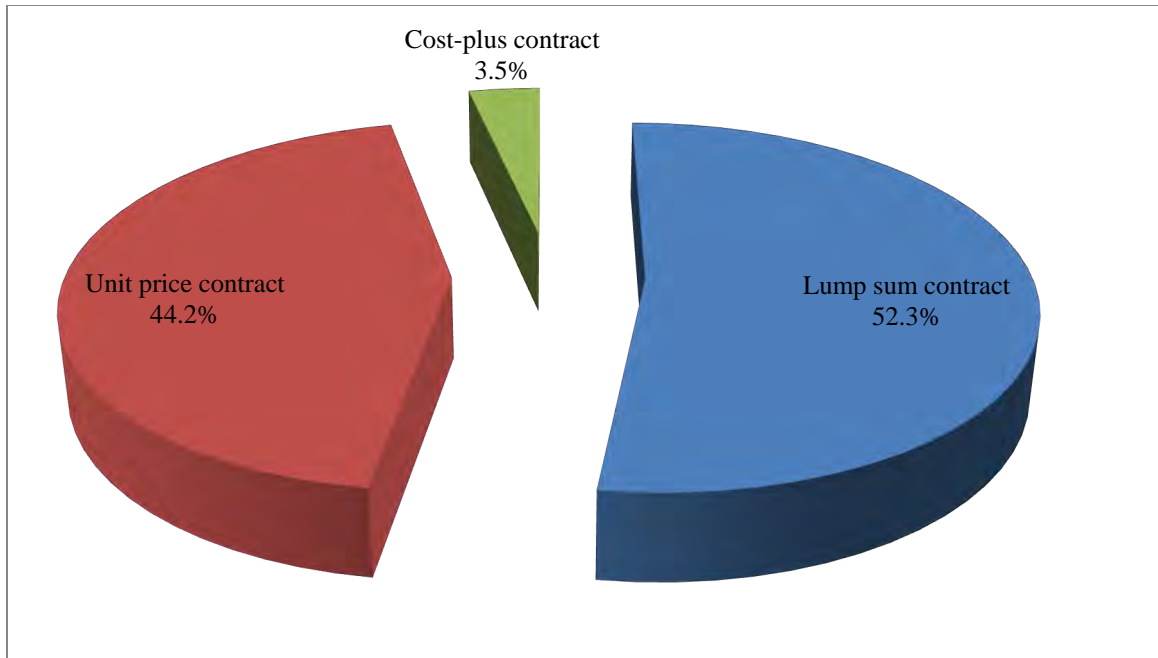


Figure 4.5: Contract Type Used to Sublet Work to Contractors

4.2 Factors Influencing Subcontracting Strategy

A contractor must delineate the scope, determine an appropriate awarding method, choose the contract type and specify the time to award the subcontract within the project schedule in order to formulate an effective subcontracting strategy on a given project. The factors influencing the subcontracting practices of contractors were thus structured under the four categories of scope and number of contracts, awarding method, type of subcontract pricing and timing/schedule of subcontracting in this study.

4.2.1 Factors Related to Scope and Number of Subcontracts

Defining the scope of the subcontract entails splitting the project tasks into smaller units with each unit forming a separate subcontract. The number of subcontract formed depends on how large the scope of the subcontract, smaller scopes results in fewer

subcontracts and vice-versa. The factors related to scope and number of contracts includes capabilities and workload of subcontractor, capabilities and workload of supplier, financing requirement, economies of scale, associated risks and liability exposure and contractor's current capability. Others are timing issues (project schedule), technological requirements/work sophistication, work interface requirements and contractor's tendency to involve in the works. The factors are exposed in detail in the following paragraphs.

To determine the number and scope of subcontracts, the contractor considers the capabilities of the subcontractor/supplier to handle each subcontract. Capabilities in terms of their financial buoyancy to fund the project, their possession of necessary equipments and plants required in the construction operation, whether they are licensed to carry out certain proprietary activities and if they have sufficient number of experienced and qualified staff required.

It can also extend to their background check on whether they have successfully completed similar works. All these will determine the level of confidence the contractor will develop in the ability of the subcontractor in the hitch-free and timely completion of the subcontract which will greatly influence the risks attached to the work by the contractor. In a situation when the above mentioned conditions favor the prospective subcontractor, the contractor may go ahead by awarding that 'unit of work' as a subcontract. However, if reverse is the case, the 'unit of work' in question will have to be broken down into smaller scopes (which implies more number of subcontracts) or allocation of higher risks etc. to the concerned work item.

In addition to fulfilling the above mentioned conditions, the workload of the subcontractor is also of utmost importance, this is because the resources (human, capital, machineries) etc. of a subcontractor which are on use on a project cannot be simultaneously utilized on a different project. Even when such subcontractor is eventually allotted the subcontract, he may likely sublet it again to other subcontractors or cause delay in the project execution.

Construction projects gulps huge amount of money, in most cases, third parties like banks and other financial institutions provides the required financial backing to the contractor. In considering the financial requirement of a project, the contractor examines the funding options available and their guidelines carefully with a view to making an optimum choice. In some cases, the financing body will stipulate the minimum or maximum value of work the contractor should accomplish in-house or sublet. Diverse reasons often accounts for this, it may be to solicit an absolute commitment of the parties (contractor, subcontractor) to a speedy and successful completion of the project, to spread the risks, to fulfill certain governmental regulations etc.

Economies of scale is the reduction in average cost per unit gained as scale increases, this is because the cost of producing additional units reduces as the production increases. When a contractor wants to enjoy the benefits of economies of scale, he may want to utilize fewer subcontractors and increase the scope of each subcontract. It implies the contractor pay less for each unit of work when the subcontracts are bigger in scope and awarded to fewer subcontractors than if the reverse case exists. This is practically observed in repetitive projects or unit of works which occur repetitive on a single project.

Subcontracts involve many risks, the scope and number of subcontracts awarded on a project can also be a tool for risk allocation on such projects. This depends on the value of such risks involved and the attitude of the contractor to risk (risk taker or risk averter). Generally, a risk averter contractor may tend to distribute the risks among many subcontractors thus having a larger number of subcontracts, while a risk-taker contractor may be satisfied with a fewer subcontractors handling jobs of larger scopes. In addition, the nature of the subcontractors involved, are they well known to the contractor? How confident is the contractor in their ability to perform etc. also influences the decision of the contractor.

The project schedule specified the proposed sequence of work on site and the relationships between them i.e. the dependencies. While the sequence of work and dependencies are often dictated by logical sequence e.g. foundation before excavation, most of the relationships are defined rationally by schedulers' initiatives and experience as two or more possible arrangements are possible. For example in the construction of two similar buildings, excavation of building 1 can be followed by excavation of building 2 and not necessarily foundation for building 1.

Hence, in a project where both excavations for buildings 1 & 2 are scheduled sequentially, the contractor may prefer a single contract for both excavations and separate contracts when both excavations are scheduled simultaneously assuming the resources (e.g. excavator) of the subcontractor can efficiently be utilized only on one building at a time.

Technological requirements is very pertinent in industrial constructions where heavy manufacturing plant facilities are being built to stipulated specifications and precision is

always required. The contractor may on the fear of any superficial discrepancy in the complete construction restrict the number of subcontractors (and hence subcontracts) on a project, invariably increasing the scope of each subcontract. The work specifications in some instances often preclude the availability of competent subcontractors on a work item. Hence, the contractor will be prompted to utilize a larger scope of work with the few available subcontractors thus reducing the number of subcontracts.

How the work or workers affect each other also influences the decision on the number of works issued as subcontracts. Works that are closely related or the one which its actual amount depends on the completion of the other are often joined together in a subcontract, this ensures continuity and a smooth flow of work. Workers interface problems are associated with different crews of workers working simultaneously on the same part of a construction project. Interference of the workers may ensue; this may lower their morale and thus reduce their productivity. Thus the contractor may increase or reduce the scope of work of a subcontract to avoid this situation.

4.2.2 Factors Related to Awarding Method

The awarding method here means the subcontractor/supplier selection process either by competitive bidding or negotiation. Competitive bidding can be open competition whereby any subcontractor can bid for the job and a best proposal is then chosen based on some laid down criteria. In pre-qualification, the invitation to bid is made available only to pre-selected subcontractors. Negotiation can be sole source negotiation involving a single subcontractor/supplier or competitive negotiation involving more than one subcontractor or supplier.

The factors related to awarding method include main contract requirement, availability of appropriate subcontractors, availability of appropriate suppliers, external issues (government regulations etc.). Others are project's schedule requirements (available time), the degree of significance of the price, current state of the market and scope of subcontract (equipment supply or service). The factors related to the awarding method are expounded further in the following paragraphs.

The contract can be regarded as the constitution of a construction project whereby all parties involved must abide by all its terms and conditions. It is not an overstatement to mention that the overall success of the project relies on how far each of the parties involved acts within the stipulations of the contract. A contractor who is contemplating on the awarding method to be employed in a subcontract must therefore properly scrutinize the terms and conditions of the contract and follow any method stipulated.

In the absence of a mention of a specific method, the contractor may still go further by examining the pros and cons of each method and try and see any correlation between them and the contract clauses with an ultimate aim of choosing a contract award method that best align with the main contract requirement. This is highly essential because in case of any disputes, the contract shall be the final resort.

The availability of appropriate subcontractor/suppliers also plays a significant role in the method of award adopted. Competitive bidding is practicable in the presence of many qualified and appropriate subcontractors/suppliers who favorably compete with each other through their bids. When only one subcontractor/supplier is available or is the only one qualified and appropriate for the job, who will he compete with? By default negotiation must be utilize in such instance.

In addition, in the presence of many qualified and appropriate subcontractors/suppliers who all met all the prequalification criteria, negotiation with all of them will be cumbersome to be administered objectively. The realistic method in such a case is to use competitive bidding.

Some issues although external to the project may also influence the decisions taken on the project including the method of award. Government regulations must be obeyed in all aspects of the project, this is particular significant when the client is a public corporation which have special guidelines in place to ensure transparency and accountability to the citizens.

The project's schedule requirements (available time) influences not only the scope and number of subcontracts but also the awarding method, type of subcontract pricing approach and timing/schedule of subcontracts depending on how the situation is analyzed. Moreover, all the four decisions are closely intertwined and an objectively informed combination of choices in all actually determines the success of the project.

The contracting and the subcontracting firms are business enterprises who are not only keen to satisfy their customers but also to maximize their profits, Hence the significance of money in all their actions and inactions. Special considerations are given to subcontracts which constitutes a 'big chunk' of the project while choosing the method of award. This is necessary in order to ensure all issues related to that 'major subcontract' are explicitly scrutinized and favored to the self (contractor or subcontractor).

The level of activity in the construction industry has a direct relationship with the level of economic activity in a country at a particular time. Thus we have periods of construction boom and doom respectively when there is economic boom and doom in a particular

country. In periods when there are many ongoing construction projects, the contractor may be simultaneously engaged in many projects and hence may find it onerous to be unnecessarily preoccupied with the nitty-gritty of a particular project. Thus intricate examination of all the awarding method may be impossible and the contractor may just go for a popular method or an award method he presumes to be 'simpler' to utilize.

4.2.3 Factors Related to Type of Subcontracts (Pricing Approaches)

The contract pricing approaches fall into a range between a firm fixed price at one end and one of the variations of cost plus at the other end. The contract pricing utilized depend largely on the type of projects being undertaken. Reimbursable contracts type are often used for projects where design work is involved, for small well-defined projects fixed-price contracts are mostly used and unit-price contracts are often prioritize for projects involving measurements e.g. earthwork.

The factors related to type of subcontracts (pricing approaches) includes accuracy of the estimated cost, accuracy of the estimated time, extent of potential changes, comprehensiveness of the scope definition, risk allocation and ability to control the costs. Others include main contract requirement, availability of appropriate subcontractors, availability of appropriate suppliers, external issues (government regulations etc.), project's schedule requirements (available time), the degree of significance of the price, current state of the market and scope of subcontract. The factors are exposed in detail in the following paragraphs.

The contractor may only utilize the pricing approach that promises to put him at an advantage over the subcontractor on a project because the contractors always give

priority to money matters. The estimates for each subcontract were initially prepared by the specialty contractors i.e. subcontractors before being adjusted to include overhead and management fees and later incorporated to the project final estimate. Meanwhile, the contractor should have his in-house estimating personnel who will judge the subcontractors bids and choose the most appropriate bid for the inclusion in the final estimate. The contractor's estimator will know the accuracy of the estimated bid and will provide such information to the contractor who will depend on it to determine the pricing approach.

The different pricing approaches has some relationship with the estimated time for example the time unit rate measures the amount of work done per unit time to calculate the fees. It is essential for the contractor to evaluate the accuracy of the estimated time and take advantage of such information in determining the right pricing approach to use on a project.

Changes are inevitable in construction contracts; the extent of changes in a contract depends on a number of factors such as the accuracy of estimated time, the accuracy of estimated cost, type of work e.g. there is likelihood of change in the volume of underground earthwork, level of details provided in the contract drawings etc. However, the various pricing approaches respond differently to changes, some approach can quickly accommodate changes faster than the others. Thus the contractor also considers the extent of potential changes in a contract in his bid to determine the best pricing approach.

The comprehensiveness of scope definition will also affect many other issues such as the extent of potential change expected, accuracy of the estimated cost and time, gap or

double coverage of work items etc. Hence, the contractor has to define scope at a level that will provide all required details and exclude any redundant facts. The contractor will equally depend on the comprehensiveness of scope definition to choose an appropriate pricing approach because of the associated risks.

Generally, the contractor will want to transfer most of the risks to the subcontractor whenever possible, when this is impossible he tries to share the risks with them. The risk nature of the contractor, the magnitude of risks involved etc. will greatly be considered by a contractor in his choice of pricing approaches noting fully well that the pricing approach is the most significant tool used to allocate risks in any contract.

In situations when the contractor thinks he has the ability to control the cost, he may prefer to choose a form of reimbursable contract as the pricing approach in order to save some cost to himself; otherwise he chooses any other pricing approaches. The contract award method (competitive bidding or negotiation) also plays a major role in the choice of the pricing approach. In fact, some awarding methods are more favorably disposed to a particular approach to an extent that people often think they must be used together e.g. LSTK – lump sum turnkey is popular among contractors, the pricing approach is lump sum while the award method is turnkey.

The triple constraint of time, cost and quality are traditionally known to affect most of the contract decisions including the choice of a pricing approach, the contractor will decide on the importance of quality performance and give it a preference in his choice of a pricing approach as some approach can motivate the subcontractor to give more priority to quality at the expense of other performance criteria. For example, it has been established that the reimbursable approach can encourage the subcontractor to give more

emphasis to quality performance at the expense of cost performance with an understanding that he shall be compensated for all costs incurred.

In addition, the contractor will consider the time available to prepare the contractual documents as well. This is true in the sense that some pricing approach requires more detail documents than the others. This implies that it will take longer time to prepare documents using such approaches. This may also influence the approach used by the contractor.

4.2.4 Factors Related to Timing/Schedule of Subcontracting

The timing/schedule of subcontracting implies the time each subcontract is issued out to the subcontractor and the subcontract agreement signed. In many cases, not all the subcontracts are issued out at the commencement of the project; some are further delayed till a time very close to the commencement of that particular work item on site.

The factors related to timing/schedule of subcontracting include project time schedule, the origin of subcontractor/supplier (local or foreign), contract award method (competitive bidding or negotiation) and associated risks. Others are availability of required resource to prepare request for proposals (RFP's) and to evaluate the proposals, work interface requirements and the difficulty of RFP's preparation process. The factors related to the timing/schedule of subcontracting are expounded further in the following paragraphs.

Subcontracting firms nowadays participates in construction activities not only in their respective countries of locations but also in the various international locations. At times, the expertise required on a project is not locally available and have to be outsourced from

foreign firms. It takes more time for a foreign subcontractor to relocate its workforce and equipments and to secure their necessary local permits for working than for a local subcontractor. Thus, the contractor has to award subcontracts of foreign subcontractors earlier than that of local subcontractors in order to avoid unnecessary delays.

The contract award method (competitive bidding or negotiation) also influences the timing/schedule of subcontracting. This is because competitive bidding takes more time than negotiation to be accomplished. The request for proposal (RFP) is the document utilized to source for the interest of subcontractors on a project and to obtain their bid proposals. When the process of preparation of RFP is difficult or there is dearth of workforce to prepare RFP and to evaluate proposals, it will take more time to accomplish and this will subsequently influence the timing/schedule of subcontracting. Thus the contractor will have to consider the difficulty involved in the RFP preparation process along with the availability of required resources to prepare and to evaluate proposals on his timing/scheduling of subcontracting decisions.

4.2.5 Respondents View on the Importance of the Factors of Subcontracting

The list of potential factors influencing subcontracting practices was collated from an extensive review of literatures on the topic with particular reference to the work of Zadeh et al (2010). The respondents ranked each of the factors on a Likert scale corresponding to 1= not important; 2= slightly important; 3= moderately important; 4= highly important and 5= extremely important. Table 4.3 shows the ratings of each of the factors as collated from the questionnaires, their mean score were calculated and the importance value (IV) and relative importance weight (RIW) of each of the factors was obtained using equations

1 and 2 in section 3.3 and they were subsequently ranked based on the values of their RIW.

Table 4.3: Ratings of Potential Factors

FACTORS	1	2	3	4	5	Mean score	IV (%)	RIW (%)	Rank
Scope and Number of Subcontracts									
Capabilities and workload of subcontractor	0	0	0	7	8	4.53	88	11.9	1
Capabilities and workload of supplier	0	0	2	6	7	4.33	83	11.2	3
Financing requirement	0	0	3	4	8	4.33	83	11.2	3
Economies of scale	0	0	8	6	1	3.53	63	8.5	8
Associated risks and liability exposure	0	2	7	3	3	3.47	62	8.3	9
Contractor's current capability	0	0	4	9	2	3.87	72	9.6	6
Timing issues (project schedule)	0	0	0	8	7	4.47	87	11.7	2
Technological requirements/work sophistication	0	0	4	7	4	4.00	75	10.1	5
Work interface requirements	0	1	8	5	1	3.40	60	8.1	10
Contractor's tendency to involve in the works	0	1	6	3	5	3.80	70	9.4	7
Awarding Method									

Main contract requirement	0	1	2	6	6	4.13	78	13.1	2
Availability of appropriate subcontractors	0	1	4	4	6	4.00	75	12.5	4
Availability of appropriate suppliers	0	1	4	4	6	4.00	75	12.5	4
External issues (government regulations etc)	0	0	7	4	4	3.80	70	11.7	7
Project's schedule requirements (available time)	0	0	4	5	6	4.13	78	13.1	2
The degree of significance of the price	0	0	4	4	7	4.20	80	13.3	1
Current state of the market	0	0	6	6	3	3.80	70	11.7	7
Scope of subcontract (equipment supply or service)	0	0	5	6	4	3.93	73	12.2	6
Type of Subcontracts (Pricing Approaches)									
Accuracy of the estimated cost	0	0	2	6	7	4.33	83	10.1	1
Accuracy of the estimated time	0	0	3	6	6	4.20	80	9.7	4
Extent of potential changes	0	0	6	7	2	3.73	68	8.3	9
Comprehensiveness of the scope definition	0	2	0	10	3	3.93	73	8.9	7
Risk allocation	0	1	2	7	5	4.07	77	9.3	5
Ability to control the costs	0	0	4	6	5	4.07	77	9.3	5

Contract award method (competitive bidding or negotiation)	0	0	6	4	5	3.93	73	8.9	7
Importance of the schedule performance	0	0	1	9	5	4.27	82	9.9	2
Importance of the quality performance	0	0	2	7	6	4.27	82	9.9	2
General contractor involvement requirements	0	0	8	6	1	3.53	63	7.7	11
Available time to prepare the contractual documents	0	0	7	7	1	3.60	65	7.9	10
Timing/Schedule of Subcontracting									
Project time schedule	0	0	2	4	9	4.47	87	18.1	1
The origin of subcontractor/suppliers (local or foreign)	0	3	6	2	4	3.47	62	12.9	6
Contract award method (competitive bidding or negotiation)	0	1	4	4	6	4.00	75	15.7	2
Associated risks	0	2	5	4	4	3.67	67	13.9	3
Availability of required resource to prepare RFP's and to evaluate the proposals	0	0	6	8	1	3.67	67	13.9	3
Work interface requirements	0	0	6	9	0	3.60	65	13.6	5
Difficulty of RFP's preparation process	0	3	6	5	1	3.27	57	11.9	7

The following paragraphs further enunciate the three or four most highly ranked factors in each category of factors to shed more light on their importance. From table 4.3, the four highly rated factors under the category of scope and number of subcontracts which have significantly contributed to the companies subcontracting strategies are capabilities and workload of subcontractor, timing issues (project schedule), capabilities and workload of supplier and financing requirements.

When the subcontractors/suppliers are capable of successfully handling works of larger scope and it can be confirmed they are not at the same time preoccupied with much workload, the contractor will tend to issue a small number of subcontracts with larger scopes to a few contractors in order to reduce communication problems and their managerial effort, enjoy economy of scale and improve coordination on site.

When a contractor is under duress to execute a project within a short period of time, he is likely going to reduce the scope of each subcontract thus increasing the number of subcontracts thereby reducing the workload of each subcontractor and facilitating more workforces on site which will eventually leads to a speedy completion of the project. This is usually witness on fast track projects where overlapping completion of project phases occurs.

Financing requirements are also very critical to the scope and number of subcontracts issued on a project. In most cases the contractor seeks the help of banks and other financial institutions to finance projects, these bodies may stipulate the value of project that can be sublet which the contractor must strictly obey. This will later influence the scope and number of subcontract issue on a project.

The top three highly rated factors under the category of awarding method of subcontracts which have significantly contributed to the companies subcontracting strategies are the degree of significance of the price, main contract requirement and project's schedule requirements (available time) (see Table 4.3).

Compared to negotiation, competitive bidding requires more time and resources to accomplish, when the price of a subcontract amounts to an insignificant proportion of the total contract price, the contractor may prefer the use of negotiation which will require lesser time and resources to accomplish.

In many cases, the main contract will stipulate the awarding method to be used on subcontracts on the project, the contractor has to abide by this contract term and utilize the specified award method. As mentioned earlier, competitive bidding takes more time, if the project's schedule requirement is tight with little time available for bidding, the contractor may opt for negotiation as the subcontract awarding method.

Also, from Table 4.3, the top three highly rated factors under the category of type of subcontracts (pricing approaches) which have significantly contributed to the companies subcontracting strategies are the accuracy of the estimated cost, importance of the schedule performance and the importance of the quality performance.

When the contractor has absolute confidence in the values of the estimated cost, he may likely favor a cost reimbursable pricing approach for the subcontract. Conversely, price-based approach may be adopted to shift the risk regarding the accuracy of the estimated cost to the subcontractor in cases of inaccurate cost estimates.

Progress payments for reimbursable contracts are always tied to the project's schedule, when high priority is given to schedule performance on a project; the contractor may

decide to utilize cost-base pricing on such projects helping to integrate the schedule performance of the subcontractor with the payments.

Cost-base pricing approaches always give incentive to subcontractors to attain high standard quality no matter how much it costs. When a contractor understands that quality performance is of utmost importance on a project, he may go for a cost-base pricing approach to encourage subcontractors to attain high quality work on such projects.

From table 4.3, the four highly rated factors under the category of scope and number of subcontracts which have significantly contributed to the companies subcontracting strategies are project time schedule, contract award method (competitive bidding or negotiation), associated risks and availability of required resources to prepare request for proposals RFP's and to evaluate proposals.

The timing of subcontracting is based upon the time schedule of the project, the project time schedule should allow ample time for subcontracting decisions to be finalized after the award of the main contract prior to the commencement of work on site. Since competitive bidding takes more time than negotiation to accomplish, the timing of subcontracting on work items using either of the two will vary depending on which award method is utilized.

When the risks associated with a particular task is very high, the contractor may likely award the subcontract as soon as possible to quickly transfer the risks. Furthermore, when there is sufficient number of workforce to prepare request for proposals and to subsequently evaluate it, the work is delivered faster and the award is made earlier.

Table 4.4 show the overall mean score, overall importance value (OIV) and overall relative importance weight (ORIW) of the factors categories using equations 3-5 in

section 3.3, With an ORIW of 25.7%, 25.6%, 25.4% and 23.4% respectively, it could be observed that the factors related to awarding method, subcontract pricing, scope and number of subcontract, timing/schedule of subcontracting are almost equally significant in the view of contractors while making subcontracting decisions.

Table 4.4: Mean, OIV and ORIW of Categories of Factors

Factors	Mean	OIV (%)	ORIW (%)
Factors related to awarding method	4.00	75	25.7
Factors related to type of subcontract pricing	3.99	75	25.6
Factors related to scope and number of subcontract	3.97	74	25.4
Factors related to timing/schedule of subcontracting	3.73	68	23.4

4.3 Problems Affecting Subcontracting Strategy

The problems militating against the contractor on his subcontracting strategy cut across the planning of subcontracts, its' awarding and the contracting phases. Thus this study structures the problems under the three categories of problem related to planning, awarding and contracting issues.

4.3.1 Problems Related to Planning Issues

The problems related to planning issue include inadequate planning of subcontracting practices, incompatibility of the subcontractor/ supplier's time schedule with the project's time schedule, lack of information/imprecise data from previous practices, too much interfaces between subcontractors/suppliers works and insufficient period/squeezed

schedule for subcontract's arrangement activities. Others are inaccurate cost estimates of subcontract packages, inconsistency in subcontractor/ suppliers schedules, gap or double coverage in the scope of work of subcontractors/suppliers compared to the project scope of work, financing and other regulatory constraints and requiring too much management and coordination effort. The problems were exposed in detail in the following paragraphs. Most problems related to inadequate planning of subcontracting practices results because there is no subcontracting plan to follow, many contracting firm had not actually realized the importance of having subcontracting plan, others do not have sufficient human resources to made the plan while others who knew the importance and have the staff to carry it out cannot achieve an effective plan because the staffs are not equipped with the state-of-the-art project management required to produce a reliable subcontracting plan.

In some cases, it may be simply because there is insufficient time between the award of subcontract and the start of the work at site that prevents the available, competent staff from preparing the subcontracting plan. In essence, absence of subcontracting plan impacts the schedule performance of a project negatively and this can lead to impacting the cost performance of the project negatively as well.

One obvious reason for incompatibility of the subcontractor/supplier's time schedule with the project time schedule is the fact that subcontractors works with more than one contractor at the same time. They also try to satisfy all of them within their limited resources. Late communication of the project's master schedule by the contractor to the subcontractor might equally be a reason.

Changes in the general scope of work or scope of work allotted to the subcontractor may equally complicate the problem while the seasonal variation in the volume of

construction works due to harsh weather etc. This restricts the flexibility of some subcontractors and thus constitute to the incompatibility of their schedules with the project time schedule. Both the schedule and cost performance of a project are negatively impacted by the incompatibility of the subcontractor/supplier's schedule with the project's time schedule.

Records of past projects should be a good source of information for succeeding projects, however, lack of information/imprecise data from previous practices often hamper this idea. Most contractors are plagued with poor record keeping system which prevents them from having a database of lesson learnt from previous projects. Worse still, some contractors have not yet realized the need to have such system in place while some displays non-chalant attitude towards the closing out phase of projects when such information ought to have been documented.

Frequent changes in project management personnel may also prevent some implicit knowledge gained from a project from being utilized in the future. The use of a database management system utilizing knowledge management techniques will assist the contractor in a long way to abort most of the issues emanating from lack of information/imprecise data from previous practices. Both the cost and schedule performance of the project are negatively impacted by the problem of lack of information/imprecise data from previous practices.

Interface problems between subcontractors/suppliers' works can be adduced to many reasons, excessive fragmentation of contract into too many subcontracts can be a chief source, one other related cause can be multilayer subcontracting system whereby several layers of subcontractors are employed on site. Poor coordination of works of

subcontractors by the contractor can complicate the interface problem even when there are few contractors on site.

Poor communication also manifests as a result of lack of coordination and can worsen the matter. Some project management strategy like crashing, fast tracking, resource leveling by any of the subcontractor can initiate interface problem when not properly monitored. Some other likely causes of interface problems includes; inaccurate estimation of duration leading to extension of time, inaccurate estimation of quantity of works which results in having more volume of work than expected, lateness in getting approvals for some work items, lateness in getting results of tests e.g. soil tests for foundation purposes, lateness in delivery of essential materials needed for job, lateness in clearance of exported materials from the port. All these causes delay which might cause interface problems thereby impacting schedule and cost performance of the project negatively.

Insufficient period/squeezed schedule for subcontract's arrangement activities often results from lack of subcontracting plan, short time interval between the award of contract and the commencement of work on site, utilization of time reduction project management strategies such as fast tracking etc. The overall negative effects of insufficient period/squeezed schedule for subcontract's arrangement activities manifest on cost, schedule and quality performance on a project.

Inaccurate cost estimates of subcontract packages can find its' root from incomplete project drawings, unclear scope of work in the specifications, errors due to omissions and commissions, double coverage or gap coverage of work item, incorrect work breakdown structure, the use of wrong estimation techniques, late submissions of bids by

subcontractors etc. The effect is notably felt negatively on the cost performance of the project.

Inconsistency in subcontractor/supplier schedule results from merging of two different but related scope of work into a single subcontract, also some work item requires time in between to mature e.g. concrete takes 28 days to attain the design compressive strength. Also some work items are required at multiple stages at different phase of the construction. Schedule performance is negatively impacted by the inconsistency in subcontractor/supplier schedule.

Gap or double coverage in the scope of work of subcontractor/supplier compared to the project scope of work can be as a result of unclear scope of work, incomplete drawings and specifications, incorrect work breakdown structure and frequent changes to the scope of work. It impacts both the cost and schedule performance of the project negatively.

Financing problems and other regulatory constraints encountered by contractors are inevitable considering huge amount of money required to finance construction projects. However, the impacts of some of the problems can be reduced if the contractors/subcontractors increase their capital base or a government regulation stipulates this as a condition for registration of prospective contractors/subcontractors. This will enhance the performance of the contractors.

The long payback period of most completed projects also had sore to the financial wound of contractors, the unstable value of currency coupled with perennial inflation in the world also affects the contractors. In some cases, the contractors do not have the required properties as collateral and hence could not benefit from certain loans. Some governmental regulations also restrain the contractors. In effect, the cost and schedule

performance of the project are negatively affected by the financing and other regulatory constraints suffered by contractors.

Some contractual arrangements require too much management and coordination efforts from the contractor, this can be caused by many factors such as too much fragmentation of work, non utilization of project management softwares, inadequate project management training of contractor's staff, the use of inexperienced subcontractors' etc. It will take extra efforts in terms of money and time from the contractors to effectively coordinate such projects hence this problem will have negative impacts on both the cost and schedule performance of a project.

4.3.2 Problems Related to Awarding Issues

The problems related to awarding issues include incomplete request for proposals, inappropriate request for proposals, lack of an appropriate vendor list, lack of an updated vendor list, external issues/regulatory restrictions, imposed vendor list by the client, inappropriate subcontractor evaluation criteria and inappropriate suppliers evaluation criteria. Others are insufficient number of subcontractors to allow for competitive biddings, insufficient number of suppliers to allow for competitive biddings, lack of subcontractors performance history, lack of suppliers performance history, inappropriate company procedures, communication problems and unethical practices. Subsequent paragraphs expound the problems in details.

The request for proposal (RFP) is issued by the contractor to solicit bids from the subcontractor, when the request for proposal is incomplete or inappropriate; it means the resulting bids will be defective. This is because the subcontractor will only respond to

items as specified in the RFP – drawings and specifications. The problem is apparent when the scope of work is unclear or the work breakdown structure is improperly used. Incomplete/inappropriate request for proposals will impact both the cost and schedule performance of a project negatively.

Vendors list are maintained by the government and some major clients, it contains the list of approved firms to undertake certain category of job with the government corporations and some big companies. The list is generated based on the firms having met some certain criteria e.g. financial strength, manpower, successful completion of project of a particular magnitude, meeting some safety and quality standards etc. In most cases, the list is categorized into different grades with each grade restricted to certain kind/volume of work.

The essence of the vendor list is to have a list of tested, trusted and dedicated firm among which the client can handpick subcontractor(s) anytime to conveniently handle any project that emerges. When the list is not available, not appropriate and/or not updated, the contractor will spend extra time searching for befitting subcontractor(s) thus impacting the schedule performance of the project negatively.

In addition, when the client imposed a vendor list on the contractor, the contractor can only choose from that list for subcontracting, this applies even when the contractor initially have another set of contractor in mind or who have submitted lower bids, this will make the subcontractor to pay more for the same job thus impacting the cost performance of the project negatively.

When prequalification of the subcontractor/supplier is done, certain criteria are employed to screen the subcontractor/supplier so that those who scaled through the screening are

reliable and capable of doing the job successfully. Many different criteria are employed for this purpose and the criteria depend on the nature/size of the job and other circumstantial factors. However, when inappropriate criteria are used to evaluate the subcontractor/supplier the quality of job expected is undermined and this negatively impacts the quality performance on a project.

Competitive bidding remains the most widely used contractor/supplier selection method. When there is insufficient number of contractor/supplier to allow for competitive bidding, the contractor may be forced to use negotiation which may impact the cost, schedule and quality performance on a project negatively.

Performance history also remains a major criterion in the evaluation of subcontractors/suppliers. When this is not available and the contractor based his decision on other factors, he may have chosen an inappropriate subcontractor/supplier evaluation criteria and compromise quality standard on the job. This may impact the quality performance on the job negatively.

Each firm has its own policies and procedures used for different activities including subcontracting. The company's procedures often reflect the organization's aim and objectives tailored to suit the expectation of their customers. When a contracting firm has inappropriate procedure in use, it will take longer time to accomplish his tasks. Thus, inappropriate company procedures negatively impact the schedule performance on a project.

Delay in communication, distortion of information, communication gap between site and office, ineffective communication etc. results from a barrier in communication between the sender and the receiver. It will take more time for the message to be delivered/ sent

again thus communication problems impact schedule performance of a project negatively.

4.3.3 Problems Related to Contracting Issues

The problems related to contracting issues include inappropriate contract pricing (lump sum, unit price, cost-plus), time consuming contract negotiations, incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions, renege of subcontractors on the previous agreements during contract negotiation and renege of suppliers on the previous agreements during contract negotiation. Others are improper contractual terms and conditions (terms of payment, liquidated damages etc.), inconsistency in the different parts of subcontract's documents and management and coordination problems. The problems are further exposed in the following paragraphs.

Contract pricing approaches available are many but each is identified to be better use on a particular type of contract. The pricing approach is a tool to transfer or share risks, seek the commitment of subcontractor in the contract, encourage the contractor to perform quality job that not only meet but exceed the customer's satisfaction. If properly utilized, it can equally be used to prevent some of the setbacks of construction such as claims and litigation.

In general, the detail of each approach must be understood by the contractor, studied along with the details of the project and the circumstances of the contractor in order to adopt an optimum approach. The use of inappropriate contract pricing approach (lump sum, unit price, cost-plus) will definitely affect the cost performance of the project negatively.

Time consuming contract negotiations will impact the schedule performance of a project negatively. Also is the renege of subcontractor/suppliers on the previous agreements during contract negotiation. Both should be avoided in order to judiciously utilize the precious time available in a contract.

Incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions results from the use of different contract forms, award method and/or pricing approach for the main contract and the subcontract. Since the contractor does not control the contents of the main contract, he should try to align the subcontract terms and conditions with the main contract's terms and conditions as much as possible to prevent the negative impacts of cost and schedule this might have caused. The same thing applies to the use of improper terms and conditions (terms of payment, liquidated damages etc.) on a subcontract.

The different parts of the contract must be consistent with each other. The drawings, specifications, shop drawings etc. must describe the same thing although in different ways. In the absence of this, chaos is envisaged on the construction site among the different subcontractors/workforce as each will be acting differently. This can lead to unacceptable job from the client, lateness in completion of job etc. thereby impacting the cost, schedule and quality performance of the project negatively.

4.3.4 Respondents View on the Significance of the Problems of Subcontracting

The list of the potential problems affecting subcontracting practices was collated from an extensive review of literatures on the topic with particular reference to the work of Zadeh et al (2010). The respondents rated the impact of the listed problems on project

performance on a Likert scale corresponding to 1= no impact; 2= low impact; 3= moderate impact; 4= high impact and 5= extremely high impact. Table 4.5 shows the ratings of each of the problems as collated from the questionnaires, their mean score was calculated and the importance value (IV) and relative importance weight (RIW) of each of the problems was obtained using equations 1 and 2 in section 3.3 and they were subsequently ranked based on the values of their RIW.

Table 4.5: Ratings, Mean, IV, RIW and Ranking of Potential Problems

PROBLEMS	1	2	3	4	5	Mean Score	IV (%)	RIW (%)	Rank
Problems related to Planning issues									
Inadequate planning of subcontracting practices	0	1	3	5	6	4.07	77	11.2	2
Incompatibility of the subcontractor/supplier's time schedule with the project's time schedule	0	0	3	5	7	4.27	82	11.9	1
Lack of information/imprecise data from previous practices	0	2	6	6	1	3.40	60	8.8	7
Too much interfaces between subcontractors/suppliers works	0	3	6	4	2	3.33	58	8.5	10
Insufficient period/squeezed schedule for subcontract's arrangement activities	0	1	3	6	5	4.00	75	10.9	4
Inaccurate cost estimates of subcontract packages	0	1	2	7	5	4.07	77	11.2	2
Inconsistency in subcontractor/suppliers schedules	0	0	4	8	3	3.93	73	10.7	5
Gap or double coverage in the scope of work of subcontractors /suppliers compared to the project scope of work	0	0	7	8	0	3.53	63	9.2	6

Financing and other regulatory constraints	0	2	6	6	1	3.40	60	8.8	7
Requiring too much management and coordination effort	0	2	7	4	2	3.40	60	8.8	7
Problems related to awarding issues									
Incomplete request for proposals	0	2	6	2	5	3.67	67	7.1	4
Inappropriate request for proposals	0	2	5	6	2	3.53	63	6.7	8
Lack of an appropriate vendor list	0	5	6	3	1	3.00	50	5.3	14
Lack of an updated vendor list	0	5	6	3	1	3.00	50	5.3	14
External issues/regulatory restrictions	0	2	6	3	4	3.60	65	6.9	7
Imposed vendor list by the client	0	4	6	2	3	3.27	57	6.0	13
Inappropriate subcontractor evaluation criteria	0	0	7	4	4	3.80	70	7.4	2
Inappropriate suppliers evaluation criteria	0	1	6	4	4	3.73	68	7.3	3
Insufficient number of subcontractors to allow for competitive biddings	0	0	7	6	2	3.67	67	7.1	4
Insufficient number of suppliers to allow for competitive biddings	0	1	7	6	1	3.47	62	6.6	9
Lack of subcontractors performance history	1	1	7	3	3	3.40	60	6.4	12

Lack of suppliers performance history	1	3	4	2	5	3.47	62	6.6	9
Inappropriate company procedures	0	1	8	4	2	3.47	62	6.6	9
Communication problems	0	1	5	7	2	3.67	67	7.1	4
Unethical practices	0	1	5	4	5	3.87	72	7.6	1
Problems related to contracting issues									
Inappropriate contract pricing (lump sum, unit price, cost-plus)	1	0	4	7	3	3.73	68	13.9	2
Time consuming contract negotiations	1	3	4	6	1	3.20	55	11.2	6
Incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions	0	2	3	6	4	3.80	70	14.3	1
Reneged of subcontractors on the previous agreements during contract negotiation	1	3	9	0	2	2.93	48	9.9	8
Reneged of suppliers on the previous agreements during contract negotiation	0	3	9	1	2	3.13	53	10.9	7
Improper contractual terms and conditions (terms of payment, liquidated damages etc.)	0	1	7	4	3	3.60	65	13.3	4

Inconsistency in the different parts of subcontract's documents	0	2	4	9	0	3.47	62	12.6	5
Management and coordination problems	0	0	6	7	2	3.73	68	13.9	2

The following paragraphs further enunciate the three most highly ranked problems in each category to shed more light on their importance. It is observed from Table 4.5, under the categories of problems related to planning issues that the three highly rated problems with negative impacts on project performance are incompatibility of the subcontractor/suppliers time schedule with the project schedule, inadequate planning of subcontracting practices and inaccurate cost estimates of subcontract packages respectively. Since the relationship between the subcontractor/supplier and the contractor is not exclusive (i.e. subcontractor/supplier works with more than one contractor concurrently) many cases of conflict of priority with respect to project schedule are bound to occur.

When the subcontractor is expected to commence working on a project and his workforce are engaged on another project at the same time, the work activity will be delayed and any other successive tasks will be delayed thus creating a schedule performance problem. To avert this problem, subcontractors often rationalize their workforce amidst competing projects at hand, this could result in slow pace of work on site and/or the use of lesser skilled workforce to execute job tasks which may lead to poor quality of work done and resulting into rework which will eventually impact the project quality, cost and schedule performance negatively.

‘To fail to plan is to plan to fail’, like all business affairs, subcontracting has to be precisely planned ahead of time to forestall negative impacts on schedule performance, subcontracting plan has to be formulated early in the project and should be judiciously followed. Many contractor firms has not inculcate the production of subcontracting plan

as part of their company procedures /methods, in some cases lack of necessary personnel to produce an efficient subcontracting plan may be the case.

The impact of project-specific issues such as unclear scope of work, project tight schedule etc. often premeditates the absence of subcontracting plan on projects. The initial subcontracting plan produced should be subjected to a rigorous risk analysis and the plan be modified to reflect any identified risk before being adopted for use. Inadequate planning of subcontracting practices may impact the cost and schedule performance of a project negatively.

The presence and effective use of subcontracting plan on a project depends on the accuracy of cost estimates of subcontract packages. In its absence, multiple hitches will crop up ranging from incomplete and/or double coverage of work items, unreliable schedule, variations in expenditures, change order, claims, etc which could negatively impact schedule and cost performance of a project. Inaccurate cost estimates of subcontract packages results from unclear scope definition, inadequate use of work breakdown structure, errors inherent in the actual estimate used for bidding etc.

In the category of problems related to awarding issues, unethical practices, inappropriate subcontractor evaluation criteria, and inappropriate suppliers' evaluation criteria (Table 4.5) were respectively the three highly rated problems with negative impacts on project performance. Practices such as pre or post bid, bid peddling and bid shopping still abounds in the construction industry.

Although not illegal but unethical, they could frustrate the good intentions of a contractor and completely reverse his decisions on the choice of a subcontractor, this could lead to shoddy performance of work at site, poor safety at site, use of a substandard

material/equipment resulting in execution of work which does not meet up with the client's requirement. This will definitely leads to rework thereby negatively impacting quality, cost and schedule performance of the project respectively. Ray et al (1999) identified withdrawal, cover pricing, collusion, and compensation of tendering costs and declaration of conflict of interest as other issues with ethical implications during the tendering process in the construction industry.

All subcontractors are not appropriate for all jobs, some are befitting for specific project size within a certain price range. Subcontractor selection criteria often used include price, past performance, health and safety record, financial capability, current workload, reputation, past relationships, resources (physical and human), technical and managerial capability, numbers of years of experience, references, location of firm, firm's experience of similar projects and appropriate insurance cover (Lavelle et al, 2007). The list could be inexhaustive depending on type / size/ nature of the project, the awarding method, the pricing approach etc.

The above makes the subcontractor selection more of art than science; in fact none of the numerous objective selection models developed by researchers has been identified to be all-embracing for different situations. Despite this the contractor has to ensure the use of appropriate criteria, giving necessary priority to the prevailing factors to select subcontractors/suppliers as a wrong choice of subcontractor could result in higher capital cost of construction operations, unnecessary request for extension of time, reduced quality of workmanship etc. thereby impacting the cost, schedule and quality performance of the project negatively.

Incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions, inappropriate contract pricing approach (lump sum, unit price, and cost-plus) and management and coordination problems were the three highly rated problems with negative impacts on project performance under the category of problems related to awarding issue (see Table 4.5). A subcontract is a contract between a contractor and a subcontractor, it is a separate legal entity from the main contract with its' own terms and conditions. However, its' hitch-free and successful execution largely depends on the outcome of the main contract between the client and the contractor.

Hence all efforts must be geared towards the alignment of the subcontract terms and conditions with the main contract terms and condition. The rights and obligations of the contracting parties are usually specified in the contract conditions, Incompatibility in subcontract and main contract arises when different standard contract forms were used, a different contract method or pricing approach (cost based, price based etc) is used, difference in selection approach (competition and negotiation), substantial difference in size of work / total contract price etc. The resultant effect is a project plagued with claims and disputes which often lead to suspension of work at site and or delays which impact both the schedule and cost performance of the project negatively.

The determination of an appropriate contract pricing approach is a factor of the clarity of scope of work, time urgency, technical complexity, risk allocation, flexibility for changes in project etc. The contractor should employ an approach that will be attractive to the subcontractor, enable him to submit competitive prices and, complete the work efficiently. However, the pricing approach should equally minimize the total cost for the

contractor; produce an acceptable quality work completed within a reasonable amount of time.

The wide variety of options available often makes the selection cumbersome – lump sum, unit price (work unit rate and time unit rate) and reimbursable contracts (cost plus percentage of cost, cost plus fixed fee, cost plus percentage of cost with maximum price, cost plus fixed fee with a guaranteed maximum price etc.). Hence the contractor should have a hands-on experience on the most proper situation to utilize each variation and act accordingly. Inappropriate contract pricing approach may result in substandard work, claims and dispute which could impact quality, schedule and cost performance of a project negatively.

Management and coordination problems which occur on construction site directly impact schedule performance of a project negatively, on the long run they may negatively impact the cost and quality performance of a project as well. They are deeply rooted in lack of project management skills, knowledge and experience of construction project managers. They manifest within all phases of the project life cycle and their effect may be specifically pronounced during the contracting phase of the subcontract. Good record keeping and the use of project management tools and softwares can drastically reduce their occurrence.

Table 4.6 show the overall mean score, overall importance value (OIV) and overall relative importance weight (ORIW) of the problem categories using equations 3-5 in section 3.3, With an ORIW of 35.8%, 32.6% and 31.6% respectively, It could be observed that the problems related to planning, awarding and contracting are almost equally significant in the view of contractors while making subcontracting decisions.

Table 4.6: Mean, OIV and ORIW of Problem Categories

Problems	Mean score	OIV (%)	ORIW (%)
Problems related to planning issues	3.74	69	35.8
Problems related to awarding issues	3.51	63	32.6
Problems related to contracting issues	3.45	61	31.6

4.4 Problems and Project Performance Matrix

From the analysis on section 4.3, it could be observed that all the three problem categories are related to have negative impacts on all the project value drivers (cost, time and quality) in different combinations. Table 4.7 shows a summary of the relationships between each of the potential problems and the project value drivers with which they have negative impact(s).

Table 4.7: Potential Problems and their Project Value Drivers

S/N	PROBLEMS	CATEGORY
A	<i>Problems which has negative impact on cost, time and quality.</i>	
1	Insufficient period/squeezed schedule for subcontract's arrangement activities	Planning
2	Insufficient number of subcontractors to allow for competitive biddings	Awarding
3	Insufficient number of suppliers to allow for competitive biddings	Awarding

4	Inconsistency in the different parts of subcontract's documents	Contracting
B	<i>Problems which has negative impact on cost and time only</i>	
1	Inadequate planning of subcontracting practices	Planning
2	Incompatibility of the subcontractor/supplier's time schedule with the project's time schedule	Planning
3	Lack of information/imprecise data from previous practices	Planning
4	Gap or double coverage in the scope of work of subcontractors/suppliers compared to the project scope of work	Planning
5	Financing and other regulatory constraints	Planning
6	Requiring too much management and coordination effort	Planning
7	Incomplete request for proposals	Awarding
8	Inappropriate request for proposals	Awarding
9	Incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions	Contracting
10	Improper contractual terms and conditions (terms of payment, liquidated damages etc.)	Contracting
C	<i>Problems which has negative impact on cost and quality only</i>	
1	Unethical practices	Awarding
D	<i>Problems which has negative impact on time and quality only</i>	
1	Management and coordination problems	Contracting
E	<i>Problems which has negative impact on cost only</i>	
1	Inaccurate cost estimates of subcontract packages	Planning

2	Imposed vendor list by the client	Awarding
3	Inappropriate contract pricing (lump sum, unit price, cost-plus)	Contracting
F	<i>Problems which has negative impact on time only</i>	
1	Too much interfaces between subcontractors/suppliers works	Planning
2	Inconsistency in subcontractor/suppliers schedules	Planning
3	Lack of an appropriate vendor list	Awarding
4	Lack of an updated vendor list	Awarding
5	External issues/ regulatory restrictions	Awarding
6	Inappropriate company procedures	Awarding
7	Communication problems	Awarding
8	Time consuming contract negotiations	Contracting
9	Reneged of subcontractors on the previous agreements during contract negotiation	Contracting
10	Reneged of suppliers on the previous agreements during contract negotiation	Contracting
G	<i>Problems which has negative impact on quality only</i>	
1	Inappropriate subcontractor evaluation criteria	Awarding
2	Inappropriate suppliers evaluation criteria	Awarding
3	Lack of subcontractors performance history	Awarding
4	Lack of suppliers performance history	Awarding

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary of the study, the summary of the major and minor findings drawn from the results of the study. Appropriate recommendations were suggested and some recommendations for further studies were also included.

5.1 Summary of the study

Subcontracting is a prominent tool employed for the accomplishment of construction contracts. This study investigated the process of subcontracting practices in industrial projects with a prospect of identifying the factors affecting subcontracting practices and the level of significance of such factors. It further identified the problems encountered by contractors, their effects on project value drivers (cost, quality and time) and the magnitude of each of the identified problem on subcontracting practice.

A questionnaire survey was utilized to garner hands-on information from industrial contractors practicing in the Eastern Province of Saudi Arabia on relevant issues regarding subcontracting strategies employed on projects. Data from the completed questionnaires were collated and analyzed using basic statistical formulas and salient features of the subcontracting practices of the contractors were identified along with the effects of the problems on project performance and the significance of the factors in subcontracting decisions of contractors.

5.2 Summary of Major Findings

This section presents the major findings of the study.

1. It was possible to find many factors which affect subcontracting scope and number of subcontracts used by contractors on industrial projects. The followings are the most significant factors
 - Capabilities and workload of subcontractor
 - Timing issues (project schedule),
 - capabilities and workload of supplier and
 - financing requirements
2. It was also possible to find many factors which affect the awarding method used by contractors on industrial projects. The most significant factors are
 - The degree of significance of the price,
 - Main contract requirement and
 - Project schedule requirements (available time)
3. It was also possible to find many factors which affect the type of subcontracts (pricing approaches) used by contractors on industrial projects. The most significant factors are:
 - Accuracy of the estimated cost
 - Importance of schedule performance and
 - Importance of quality performance
4. It was also possible to find many factors which affect the timing/schedule of subcontracting on industrial projects. The most significant factors affecting are
 - Project time schedule

- contract award method (competitive bidding or negotiation)
 - associated risks and
 - availability of required resources to prepare RFP's and to evaluate proposals
5. It was also possible to identify the problems related to planning of subcontractors that have negative impact on one or more the project drivers including schedule, cost and quality performance of industrial projects. The most significant problems are
- Incompatibility of the subcontractor\suppliers' time schedule with the project's time schedule
 - Inadequate planning of subcontracting practices and
 - Inaccurate cost estimates of subcontract packages
6. It was also possible to identify the problems related to awarding of subcontracts that have negative impact on one or more the project drivers including schedule, cost and quality performance of industrial projects. The most significant problems are
- Unethical practices
 - Inappropriate subcontractor evaluation criteria and
 - Inappropriate supplier's evaluation criteria
7. It was also possible to identify the problems related to contracting of subcontracts that have negative impact on one or more the project drivers including schedule, cost and quality performance of industrial projects. The most significant are

- Incompatibility of subcontracts' term and conditions with the main contract's terms and conditions
- Inappropriate contract pricing approach (lump sum, unit price, and cost-plus) and
- Management and coordination problems

5.3 Summary of Minor Findings

It was also possible to find number of findings that the researcher believes of importance to the readers. The following is a list of minor findings:

1. An average of 20% of work, measured relative to the total contract price is sublet to subcontractors on a typical project in Saudi Arabia; this is very low compared to 80% (Chiang, 2008) of the value of building works being undertaken by subcontractors in Hong Kong.
2. The project delivery system in use by the owners to award contract to contractors in industrial project in Saudi Arabia is on an average of 38.7%, 30%, 16.3% and 14.7% respectively for Turnkey (EPC), Design-bid-build, Construction Management and Design-build methods respectively.
3. The pricing approach used by contractors to sublet works to subcontractors in industrial projects is on an average of 52.3%, 44.2% and 3.5% respectively for lump sum, unit price and cost-plus approach respectively.
4. The factors related to awarding method, subcontract pricing, scope and number of subcontract, timing/schedule of subcontracting are almost equally significant with an ORIW of 25.7%, 25.6%, 25.4% and 23.4% respectively in the view of contractors while making subcontracting decisions.

5. The problems related to planning, awarding and contracting are almost equally significant in the view of contractors while making subcontracting decisions with an ORIW of 35.8%, 32.6% and 31.6% respectively.
6. The project value drivers of cost, time and quality are being impacted negatively by problems encountered during planning, awarding and contracting of subcontracts in industrial projects.

5.3 Recommendations

Based on the findings of this research the following recommendations are being suggested

1. Contractors are advised to prioritize the capabilities and workload of subcontractor, timing issues (project schedule), capabilities and workload of supplier and financing requirements while determining the scope and number of subcontracts to be issue on a project.
2. Contractors are advised to give preference to the degree of significance of the price, main contract requirement and project schedule requirements (available time) while determining the awarding method on industrial projects.
3. Contractors are advised to critically consider the accuracy of the estimated cost, importance of schedule performance and importance of quality performance while choosing the type of subcontracts (pricing approaches) to be used on industrial projects.
4. Contractors are advised to give priority to project time schedule, contract award method (competitive bidding or negotiation), associated risks and availability of

required resources to prepare RFP's and to evaluate proposals while determining the timing / schedule of subcontract on industrial projects.

5. Contractors are advised to give equal consideration to the factors related to scope and number of subcontracts, awarding method, subcontract pricing, and timing/schedule of subcontracting while making subcontracting decisions.
6. Contractors are advised to avoid incompatibility of the subcontractor\suppliers' time schedule with the project's time schedule, inadequate planning of subcontracting practices and inaccurate cost estimates of subcontract packages during the planning phase of subcontracting in industrial projects.
7. Contractors are advised, as much as possible, to avoid the problems most critical to the awarding phase of subcontracting which are unethical practices, inappropriate subcontractor evaluation criteria, and inappropriate supplier's evaluation criteria.
8. Top problems which the contractor should minimize or eradicate during the contracting phase of subcontracting in industrial projects includes incompatibility of subcontracts' term and conditions with the main contract's terms and conditions, inappropriate contract pricing approach (lump sum, unit price, and cost-plus) and management and coordination problems
9. Contractors are advised to equally prioritize the problems related to planning, awarding and contracting for avoidance while making subcontracting decisions.
10. Contractors are advised to critically evaluate the schedule performance, cost performance and quality performance of industrial projects during the planning, awarding and contracting phase of subcontracting in industrial projects.

5.4 Recommendations for Further Studies

The following are areas of related interest, which if explored, would provide increased validity to the findings of this research:

1. Since this study were limited to industrial projects, similar investigations can be carried out on residential (housing), building (non-residential) and infrastructural projects and the results compared.
2. Also, similar studies can be done in other parts of Saudi Arabia e.g. Western Province and Central Province and the results should be compared.
3. In addition to the cost, time and quality considered in this research, additional project value drivers of scope, risk and customer satisfaction can be considered in a new research.

REFERENCES

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

Arslan, G., Kivrak, S., Talat Birgonul, M. and Dikmen, I. (2008) "Improving subcontractor selection process in construction projects: Web-based subcontractor evaluation system (WEBES)" *Automation in Construction*, 17(2008), 480-488.

Asharqia Chamber (2008) "Why Invest in Eastern Province", Chamber of Commerce and Industry, Eastern Province, Dammam.

Ashworth, A (2001) *Contractual Procedure in the Construction Industry, 4th edition*, Peterson Education Limited, Essex.

Ayers, C (1984) *Specifications: for Architecture, Engineering, and Construction, 2nd edition*, McGraw-Hill, New York.

Bu-Khamsin, M.A.S (1999) "Safety performance measurements: A PC-based evaluation tool for industrial contractors in Saudi Arabia" MS thesis, Construction Engineering and Management Department, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

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

Cheung, S.O., Yiu, K.T.W and Chim, P.S (2006) “How relational are construction contracts?” *Journal of Construction Engineering and Management*, 132(1), 48-56.

Cheung, S., Lam, T., Wan, Y. and Lam, K. (2000) “Improving Objectivity in Procurement Selection” *Journal of Management in Engineering*, 17(3), 132-139.

Clough, H.R., Sears, A.G. and Sears, S.K. (2005) *Construction Contracting, 7th edition*, John Wiley, New Jersey.

Construction Sponsorship Directorate (1995) *Fair construction contract*, Department of the Environment, London, in Ashworth, A (2001) *Contractual Procedure in the Construction Industry, 4th edition*, Peterson Education Limited, Essex.

Edum-Fotwe, F.T., Mccaffer, R. and Abd Majid, M. Z. (1999) “Sub-contracting or Co-contracting: Construction Procurement in Perspective” *Proceedings of the 2nd International Conference on Construction Industry Development, CIB TG 29, 27-29 October 1999*, National University of Singapore, pp. 157-163.

Elazouni, A. M. (2006) “Classifying Construction Contractors Using Unsupervised-Learning Neural Networks” *Journal of Construction Engineering and Management*, 132(12), 1242-1253.

Elazouni, A.M. and Metwally, F.G. (2000) “D-SUB: Decision Support System for Subcontracting Construction Works” *Journal of Construction Engineering and Management*, 126(3), 191-199.

El-Sawalhi, N., Eaton, D. and Rustom, R. (2007) "Contractor Pre-Qualification Model: State- of- the- Art" *International Journal of Project Management*, 25(2007), 465-474.

Eom, C.S.J., Yun, S. H. and Paek, H.J. (2008) "Subcontractor Evaluation and Management Framework for Strategic Partnering" " *Journal of Construction Engineering and Management*, 134(11), 842-850.

Gonzalez-Diaz, M., Arrunada, B. and Fernandez, A. (2000) "Causes of subcontracting: evidence from panel data on construction firms" *Journal of Economic Behavior and Organization*, 42(2000), 167-187.

Hartmann, A., Ling, F. Y .Y. and Tan, J. S .H. (2009) "Relative Importance of Subcontractor Selection Criteria: Evidence from Singapore" *Journal of Construction Engineering and Management*, 135(9), 826-832.

Harris, F. and McCaffer, R. (2001) *Modern Construction Management, 5th edition*, Blackwell Science, Oxford

Hinze, J. (2001) *Construction Contracts, 2nd edition*, McGraw-Hill, New York.

Hinze, J., and Tracey, A. (1994) "The contractor-subcontractor relationship: the subcontractor's view" *Journal of Construction Engineering and Management*, 120(2), 274-287.

Hsieh, T. Y., (1998) "Impact of subcontracting on site productivity: lessons learned in Taiwan" *Journal of Construction Engineering and Management*, 124(2), 91-100.

Kimura, F (2001) "Subcontracting and the performance of small and medium firms in Japan", The International Bank for Reconstruction and Development/The World Bank, Washington, D.C, U.S.A

Kish, L. (1995) *Survey Sampling*, John Wiley and Sons Inc., New York.

Kumaraswamy, M.M. and Matthews, J.D. (2000) "Improved Subcontractor Selection Employing Partnering Principles" *Journal of Management in Engineering*, 16(3), 47-57.

Lavelle, D., Hendry, J. and Steel, G. (2007) "The selection of subcontractors: is price the main factor?" *In* Boyd, D (Ed) *Proceedings 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK, Association of Researcher in Construction Management, 65-73.

Lee, H., Seo, J., Park, M, Ryu, H and Kwon, S. (2008) "Transaction-cost-based selection of appropriate general contractor-subcontractor relationship type", *Journal of Construction Engineering and Management*, 135(11), 1232-1240.

Lehtinen, U (2001) "Changing Subcontracting", Department of Industrial Engineering, University of Oulu, Finland

Love, S. (1997) "Subcontractor Partnering: I'll believe it when I see it" *Journal of Management in Engineering*, 13(5), 29-31.

- Maturana, S., Alarcon, 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(1), 67-73.
- Mudorch J. and Hughes W. (2008) *Construction Contracts: Law and Management*, 4th edition, Taylor and Francis, London.
- Ng, S.T., Skitmore, M. and Chung, W.F (2003) "Ten basic factors to identify suitable subcontractors for construction projects", *Proceedings CIB TG International Conference*, October 2003, Hong Kong.
- 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(2009), 736-744.
- Ng, S.T. and Tang, Z. (2009) "Labor-intensive construction sub-contractors: Their critical success factors", *International Journal of Project Management*, doi:10.1016/j.ijproman.2009.11.005, Article in Press.
- Ochieng, E. and Price, A. D. F. (2006) "Reforming the management of industrial projects in developing countries: the role of strategic planning". In: Boyd, D (Ed) *Proceedings 22nd Annual ARCOM Conference*, 4-6 September 2006, Birmingham, UK, Association of Researcher in Construction Management, 93-102.
- Olsson, R. (1998) "Subcontract coordination in construction", *International Journal of Production Economics* 56-57(1998), 503-509.

- Proctor, J.R. (1996) "Golden rule of contractor-subcontractor relations" *Practice Periodical on Structural Design and Construction* 1(1), 12-14
- Puddicombe, M.S. (2009) "Why Contracts: Evidence" *Journal of Construction Engineering and Management*, 135(8), 675-682.
- Ray, R.S, Hornibrook, J.F and Skitmore, M.R. (1999) "Ethics in tendering: A survey of Australian opinion and practice" *Construction Management and Economics*, 17(2) 139-153.
- Rowlinson, S. and McDermott, P. (1999) *Procurement Systems: A Guide to Best Practice in Construction*, E & FN SPON, London.
- Shash, A. A. (1998a) "Subcontractors' bidding decisions", *Journal of Construction Engineering and Management*, 124(2), 101-106.
- Shash, A. A. (1998b) "Bidding practices of subcontractors in Colorado" *Journal of Construction Engineering and Management*, 124(3), 219-225.
- Tam, V.W.Y., Shen, L.Y., and Kong, J.S.Y. (2010) "Impacts of multi-layer chain subcontracting on project management performance" *International Journal of Project Management*, doi:10.1016/j.ijproman.2010.01.005, Article in Press.
- Tserng, H.P and Lin P.H. (2002) "An accelerated subcontracting and procuring model for construction projects", *Automation in Construction*, 11(2002), 105-125.

Yik, F.W.H and Lai, J.H.K. (2008) "Multilayer subcontracting of specialist works in buildings in Hong Kong" *International Journal of Project Management*, 26(2008), 399-407.

Zadeh, M.T., Ruwanpura, J.Y and Gholami, F. (2010) "Factors affecting subcontracting strategy in industrial mega projects" *Proceedings of AACE International 54th Annual Meeting*, June 2010, Atlanta.

Zwick, D.C and Miller, K.R. (2004) "Project Buyout" *Journal of Construction Engineering and Management*, 130(2), 245-247.

APPENDIX 1

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS CONSTRUCTION ENGINEERING AND MANAGEMENT DEPARTMENT

SURVEY ON SUBCONTRACTING STRATEGY IN INDUSTRIAL PROJECTS IN THE EASTERN PROVINCE OF SAUDI ARABIA

Dear respondent,

A study is being conducted on Subcontracting Strategy of Contractors on Industrial Projects in the Eastern Province of Saudi Arabia. As a leading Contractor in the Province, your company is selected to participate in the study.

The objective of the study is to investigate the process of subcontracting works in Industrial Projects. The Questionnaire is designed for Construction Management Personnel (i.e. Construction/Project Managers, Job Superintendent, Project Engineers etc.) who have hands-on experience in subcontracting practices.

The Questionnaire is divided into four sections and should take less than 10 minutes of your valuable time to complete. The information that you provide shall be kept strictly confidential and shall be used only for research purpose and will be presented in the research in aggregate. Your contribution towards this study is greatly appreciated, as it will add significantly to the value of the research and the research results will be of great benefits to the industry including your organization. Enclosed is a self-addressed envelope to return the questionnaire.

Thank you in anticipation of your cooperation.

Abideen A. Ganiyu, PMP
Research Assistant, CEM Department,
KFUPM BOX #8587, Dhahran 31261
E-mail: abideen@kfupm.edu.sa
Telephone: 03-860-3275; Mobile: 0558341024

About Industrial Projects: *Industrial Constructions includes the erection of projects associated with the manufacture of commercial products or services. Such structures are require a highly technical approach and are frequently built by large specialized contracting firms. Petroleum refineries, steel mills, chemical plants, electric power-generating stations, heavy manufacturing facilities, ore-handling installations are examples of industrial construction (Clough et al, 2005).*

Please check this box if you want to receive a summary report and analysis of this survey.

SECTION 1: GENERAL INFORMATION

This section collects basic information needed to identify the various responses received.

ALL INFORMATION WILL BE KEPT SECURELY AND WILL REMAIN CONFIDENTIAL.

1.1 Respondent Information

Name(optional)	
Company Name	
Company Address	
E-Mail Address	
Telephone No.	

1.2 Specify the classification of your company according to the Ministry of Municipal and Rural Affairs.

Grade 01		Grade 02		Grade 03 or Below	
----------	--	----------	--	-------------------	--

1.3 Position in company

Construction manager		Project Manager	
Job Superintendent		Project Engineer	
Others(Please specify)			

1.4 How many years of experience do you have in industrial projects?

Less than 5 years		5 - less than 10 years		10 - less than 15 years	
15 - less than 20 years		20 - less than 25 years		25 years and more	

1.5 How many years of management experience in subcontracting practices do you have?

Less than 5 years		5 - less than 10 years		10 - less than 15 years	
15 - less than 20 years		20 - less than 25 years		25 years and more	

1.6 Approximately, what percentage (measure relative to the total contract price) of work does your company sublet to subcontractor(s) on a typical project?

Less than 10%		10 - less than 20%		20 - less than 30%	
30 - less than 40%		40 - less than 50 %		50 - less than 60%	
60 - less than 70%		70 - less than 80%		80% and more	

1.7 From your experience, approximately how often do owners use each of the following project delivery system to award industrial projects to contractors

(Please be sure to make the total equal 100%)

Design-bid-build _____

Design-build _____

Turnkey (EPC) _____

Construction Management _____

Other (Specify) _____

TOTAL 100%

1.8 From your experience, approximately how often do your company use the following contract type to sublet works on industrial projects to subcontractors

(Please be sure to make the total equal 100%)

Lump sum contract _____

Unit Price contract _____

Cost-Plus contract _____

Other (Specify) _____

TOTAL 100%

SECTION II: PROBLEMS & PROJECT PERFORMANCE MATRIX

The following is a list of potential problems related to subcontracting practices which may have negative impact on one or more of the project value drivers (Cost, Time, and Quality). Based on your experience, you are kindly requested to indicate the project drivers that are affected by placing a check in the appropriate box.

PROBLEMS	COST	TIME	QUALITY
Problems related to Planning issues			
Inadequate planning of subcontracting practices			
Incompatibility of the subcontractor/supplier's time schedule with the project's time schedule			
Lack of information/imprecise data from previous practices			
Too much interfaces between subcontractors/suppliers works			
Insufficient period/squeezed schedule for subcontract's arrangement activities			
Inaccurate cost estimates of subcontract packages			
Inconsistency in subcontractor/suppliers schedules			
Gap or double coverage in the scope of work of subcontractors/suppliers compared to the project scope of work			
Financing and other regulatory constraints			
Requiring too much management and coordination effort			
Others (Please specify)...			
Others (Please specify)...			
Problems related to awarding issues			
Incomplete Request for Proposals			
Inappropriate Request for Proposals			
Lack of an appropriate vendor list			
Lack of an updated vendor list			
External issues/ regulatory restrictions			
Imposed vendor list by the client			
Inappropriate subcontractor evaluation criteria			
Inappropriate suppliers evaluation criteria			
Insufficient number of subcontractors to allow for competitive biddings			
Insufficient number of suppliers to allow for competitive biddings			
Lack of subcontractors performance history			
Lack of suppliers performance history			
Inappropriate company procedures			
Communication Problems			
Unethical Practices			
Others (Please specify)...			
Others (Please specify)...			
Problems related to contracting issues			
Inappropriate contract pricing (lump sum, unit price, cost-plus)			
Time consuming contract negotiations			
Incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions			
Reneged of subcontractors on the previous agreements during contract negotiation			
Reneged of suppliers on the previous agreements during contract negotiation			
Improper contractual terms and conditions (terms of payment, liquidated damages etc.)			
Inconsistency in the different parts of subcontract's documents			
Management and coordination Problems			
Others (Please specify)...			
Others (Please specify)...			

SECTION III: RATING OF THE PROBLEMS

You are kindly requested to rate each of the problems on a Likert scale of 1 to 5, the magnitude of the problem on project performance. The corresponding scale shall be 1= No impact; 2= Low impact; 3= Moderate impact; 4= High impact and 5= Extremely High impact. Check in the appropriate box.

PROBLEMS	1	2	3	4	5
Problems related to Planning issues					
Inadequate planning of subcontracting practices					
Incompatibility of the subcontractor/supplier's time schedule with the project's time schedule					
Lack of information/imprecise data from previous practices					
Too much interfaces between subcontractors/suppliers works					
Insufficient period/squeezed schedule for subcontract's arrangement activities					
Inaccurate cost estimates of subcontract packages					
Inconsistency in subcontractor/suppliers schedules					
Gap or double coverage in the scope of work of subcontractors/suppliers compared to the project scope of work					
Financing and other regulatory constraints					
Requiring too much management and coordination effort					
Others (Please specify)...					
Others (Please specify)...					
Problems related to awarding issues					
Incomplete Request for Proposals					
Inappropriate Request for Proposals					
Lack of an appropriate vendor list					
Lack of an updated vendor list					
External issues/ regulatory restrictions					
Imposed vendor list by the client					
Inappropriate subcontractor evaluation criteria					
Inappropriate suppliers evaluation criteria					
Insufficient number of subcontractors to allow for competitive biddings					
Insufficient number of suppliers to allow for competitive biddings					
Lack of subcontractors performance history					
Lack of suppliers performance history					
Inappropriate company procedures					
Communication Problems					
Unethical Practices					
Others (Please specify)...					
Others (Please specify)...					
Problems related to contracting issues					
Inappropriate contract pricing (lump sum, unit price, cost-plus)					
Time consuming contract negotiations					
Incompatibility of subcontracts' terms and conditions with the main contract's terms and conditions					
Reneg of subcontractors on the previous agreements during contract negotiation					
Reneg of suppliers on the previous agreements during contract negotiation					
Improper contractual terms and conditions (terms of payment, liquidated damages etc.)					
Inconsistency in the different parts of subcontract's documents					
Management and coordination Problems					
Others (Please specify)...					
Others (Please specify)...					

SECTION IV: RATING OF THE FACTORS

You are kindly requested to rate the importance of the factors on project performance on a Likert scale of 1 to 5, The corresponding scale shall be 1= Not important; 2= Slightly important; 3= Moderately important; 4= Highly important and 5= Extremely important. Check in the appropriate box.

FACTORS	1	2	3	4	5
Scope and Number of Subcontracts					
Capabilities and workload of subcontractor					
Capabilities and workload of supplier					
Financing requirement					
Economies of scale					
Associated risks and liability exposure					
Contractor's current capability					
Timing issues (project schedule)					
Technological requirements/work sophistication					
Work interface requirements					
Contractor's tendency to involve in the works					
Others (Please Specify)...					
Others (Please Specify)...					
Awarding Method					
Main contract requirement					
Availability of appropriate subcontractors					
Availability of appropriate suppliers					
External issues (government regulations etc)					
Project's schedule requirements (available time)					
The degree of significance of the price					
Current state of the market					
Scope of subcontract (equipment supply or service)					
Others (Please Specify)...					
Others (Please Specify)...					
Type of Subcontracts (Pricing Approaches)					
Accuracy of the estimated cost					
Accuracy of the estimated time					
Extent of potential changes					
Comprehensiveness of the scope definition					
Risk allocation					
Ability to control the costs					
Contract award method (competitive bidding or negotiation)					
Importance of the schedule performance					
Importance of the quality performance					
General contractor involvement requirements					
Available time to prepare the contractual documents					
Others (Please Specify)...					
Others (Please Specify)...					
Timing/Schedule of Subcontracting					
Project time schedule					
The origin of subcontractor/suppliers (local or foreign)					
Contract award method (competitive bidding or negotiation)					
Associated risks					
Availability of required resource to prepare RFP's and to evaluate the proposals					
Work interface requirements					
Difficulty of RFP's preparation process					
Others (Please Specify)...					
Others (Please Specify)...					

APPENDIX II

LIST OF COMPANIES THAT PARTICIPATED IN THE SURVEY

S/N	Name of Contractor	P.O.Box	Town	Code
1	Almangour International	1644	Dammam	31441
2	Gulf Consolidated Construction Co. GCC	895	Dammam	31421
3	Hadl H. Al Hammam Establishment	3	Rahima	31941
4	A. A. Turki Corporation	718	Dammam	31421
5	Global Suhaimi Company	2162	Dammam	31451
6	Thrustboring Construction Company	31803	Al-Khobar	31952
7	ARCON	3001	Al-Khobar	31952
8	Technical Sources	35455	Jubail	31961
9	Nesma and Partners Contracting Co. Ltd	1498	Al-Khobar	31952
10	Al-Awan Contracting & Maintenance Co. Ltd	1351	Al-Khobar	31952
11	Dhahran Global for Oil & Gas	31131	Al-Khobar	31950
12	Khaleel Al Jubail Establishment	1789	Jubail	31951
13	Electrical Works Establishment for Contracting	68586	Dammam	31537
14	Abdullah A.M. Al-Khodari Sons Co.	3589	Al-Khobar	31952
15	M.S. Alsuwaidi Industrial Services	991	Jubail	31951

VITA

Abideen Adekunle Ganiyu was born in Ibadan, Nigeria on May 7, 1978. He obtained National Diploma in Civil Engineering from the Polytechnic, Ibadan, Nigeria in 2000 and Bachelor of Technology in 2005 from Ladoké Akintola University of Technology, Ogbomoso, Nigeria in the same discipline. He participated in the National Youth Service Corps program in Dutse, Jigawa state, Nigeria and had internship and/or worked with some leading Civil Engineering consulting firms in Ibadan, Nigeria for a period totaling 4 years before joining King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia as a Research Assistant/ graduate student in August 2008. Abideen is a graduate member of Nigerian Society of Engineers (NSE), a certified project management professional (PMP) and an active member of the Project Management Institute, PMI and the Arabian/Gulf chapter of the institute.

Abideen can be reached on abideenganiyu@yahoo.com