Investigating the Influence of Procurement Method Selection on Project Performance in Libya

A Thesis Submitted for the Degree of Doctor of Philosophy

By

Alaeddin Ghadamsi

School of Engineering and Design

Brunel University

April 2016

وقل ربي زدني علما

'O lord! Increase me in knowledge.'
(*Surah Taha*: 114)

ABSTRACT

Construction Project Procurement Methods (PMs) define the roles, relationships and responsibilities of project team members and the sequence of the activities required to construct or provide a facility. A number of different PMs have evolved over the years, but each is characterised by a different set of features upon which the criteria for selecting the most appropriate method to procure a given project must be based, if successful project performance (PP) is to be ensured. The use of procurement method selection criteria (PMSC) to inform clients' decision on suitable PMs to adopt remains a recommended good practice in the construction industry. However, project clients in the Libya Construction Industry (LCI), continue to face great challenges when it comes to selecting the most appropriate PM for its projects. The general practice in this industry is largely dominated by a culture of clients' reliance on their familiarity and experience with a particular method to inform their PM choice, with no consideration of the plethora of other PMs and use of rational approaches to aid in this decision-making. This procurement issue has long been recognised as a major contributory factor to the frequent time and cost overruns often experienced by projects in the LCI.

Although the selection of an appropriate PM to procure any given project is known to result in success PP and (and vice versa), very little is known about the nature of this relationship from literature. Having persistently suffered a great deal of project failures over the years, the LCI stands to benefit from detailed knowledge and understanding of how exactly PM choice do actually influence PP. Stimulated by the dearth of this information, this thesis reports on a research investigation into this relationship with the aim of developing a model to explain the criteria functions in contributing to PP and their implications to PM selection practice in Libya.

The methodological approach adopted for this research was the mixed method, i.e., using a combination of both quantitative and qualitative approaches. Following a critical review of the extant relevant literature, a number of relevant hypotheses were first formulated, together with a conceptual framework, to establish the theoretical basis underpinning this research, namely the relationship between the selection of PMs (based on PMSC) and PP. The primary data collection stage involved an initial field questionnaire survey aimed at identifying and confirming the key areas of the research inquiry that needs focusing on. This was followed by a semi-structured questionnaire and interview surveys. With the aid

of SPSS and Excel, the collected data were analysed, followed by the development of a mathematical model (based on regression) that demonstrate the influence of PMSC on PP. Finally, the model was validated by expert interviews to test for its validity and reliability.

The key findings of the research include the identification of DBB and DB selection criteria that contributes to PP. The distinct contribution to knowledge arising from this research includes the development of a regression model to demonstrate this relationship between PMSC and PP. The benefit of these outputs lies not only in the ability of LCI's clients to make PM selection decisions much faster by virtue of the need for them to only focus on the criteria with significant influence on PP, they are also able to work out, in quantitative terms, the PP outcomes to be expected for each of the method being considered. This latter information would enable clients to compare the PP outcome values expected from their decisions to select DBB and DB, and then be able to conclude which of these two options represents a better procurement strategy for any given project at hand.

DEDICATION

This thesis is dedicated to my magnificent Mother, Mrs. Hlalia Azizi, my fabulous Wife, Mrs. Iman Hmadi, my children, Hedaya and Mlak, my wonderful brothers and sisters, and my best friends, who offered great love, prayers and endless support to me during my entire PhD work.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGMENTS

First, I acknowledge my huge debt to Almighty ALLAH, who had helped, guided and encouraged me successfully to finish this PhD Thesis.

My special thanks goes to my superb supervisor Dr. Nuhu Brimah, Brunel University, London, for his kindness, patience, encouragement, valuable guidance and pragmatic supervision provided throughout the period of the research. I acknowledge his good efforts and support, which helped and encouraged me in the conception of the structure and contents of this thesis. Also, my deep thanks to my wonderful wife, who was always there to guide and pray for me to be successful, accomplished and to achieve my study, and my children Hedaya and Mlak, who as a result of this programme were deprived of the necessary fatherly care and attention when they needed it most. Special thanks are also due to my great mother for her never-ending support, prayers and encouragement throughout the study period as well as my brilliant brothers and sisters for their support.

I would like also to thank the staff of the Organization of Developing Administrative Buildings (ODAC), the organisation of Housing and Utilities (HIP), the Project Public Authority (PPA), the National Consulting Office, and the consulting offices of the facilities who gave their time to participate and support in finishing both the questionnaire and interview surveys for the findings of this study; I really appreciated that.

Finally, my grateful thanks to Libya, my home country, for offering me this opportunity to accumulate and develop my knowledge and academic professionalism.

DECLARATION

I, Alaeddin Ghadamsi, declare that the ideas, research work, analyses, findings and conclusions reported in my PhD thesis ***Investigating the Influence Procurement Method Selection has on Project Performance in Libya*** are entirely my effort, except where otherwise acknowledged. Also, I certify that this thesis contains no material that has been submitted previously, in whole or in part, whether for the purposes of assessment, publication or for any other purpose such as for the award of any other academic degree or diploma.

Signature:………………………………….

Date:……………………………………….

LIST OF ABBREVIATIONS

α	Cronbach's alpha
ACR	Administrative contract regulation
AHP	Analytical hierarchy process
ANOVA	Analysis of variance
Beta	Standardised regression weight
BOQ	Bill of quantity
CBR	Case-based reasoning
CI	Construction industry
CM	Construction management
Cost Plus	Cost reimbursable contract
DB	Design-build
DBB	Design-bid-build
DBFO	Design build finance operate
DBOM	Design build operate maintenance
DM	Design and manage procurement method
F	Variance between groups
FMCDM	Fuzzy multi criteria decision making
FPSM	Fuzzy procurement selection model
GAE	General association of engineering
GDP	Gross domestic product
HIP	Organization of implementation housing and utilities
LCI	Libyan construction industry
LPCOMF	Libyan public committee of monitoring and follow up
MC	Management contracting procurement method
MRA	Multiple regression analysis
NEDO	National Economic Development Office
ODAC	Organization of development administrative building
P	Significant value
PF	Project failure
PMs	Procurement methods
PP	Project performance
PPA	Public Projects Authority
PS	Project success
PMSC	Procurement method selection criteria
R^2	the degree of variation of the dependent variable Relative
RFI	Relative frequency index
RII	Relative important index
RSI	Relative satisfaction index
SPSS	Statistical Package for social science
T	Significant contribution of predictor variables to model
VIF	Variance inflation factor
W	Kendall's coefficient of concordance

PUBLICATIONS

Journal papers

Braimah, N and Ghadamsi, A. (2014) "Relationship between Design and Build Selection Criteria and Project Performance", *Journal of international Real Estate and Construction Studies*, Vol 3, (1), pp. 1 - 12

Ghadamsi, A and Braimah, N. (2015) "Conceptual Framework On The Relationship Between DBB Selection Criteria And Project Performance", *NICMAR-Journal of Construction Management*, Vol, XXX, (3), pp. 1 - 10

Ghadamsi, A. and Braimah, N. (2016) "Examining Relationship between Design-Bid-Build Selection Criteria and Project Performance". This paper Accepted for publication in the *Journal of international Real Estate and Construction Studies* on 19th February 2016.

Ghadamsi, A and Braimah, N (2016) "*The Impact of Design-Bid-Build Procurement Methods on Project Performance in Libya*", *Journal of Construction Engineering and Project Management*, 6, (2), pp. 1-20

Ghadamsi, A and Braimah, N. (2016) "*Criteria Of Selection Design and Build Method And Project Performance", Accepted for publication in* NICMAR-Journal of Construction Management, in April 2016

Conference papers

Ghadamsi, A. and Briamah, N. (2011) "The impact of construction procurement methods on project performance in Libya: Design methodology", presented at Brunel University Graduate School Research Student Poster Conference, 13-14 March 2011.

Ghadamsi, A. and Braimah, N. (2012) "The Influence of Procurement Methods on Project Performance: A conceptual framework", Presented in *The CIB International Conference: Management of construction: Research to practice*, 26-29 June, 2012, Montreal, Canada. International Congress on Construction Management Research, pp.1-6

Ghadamsi, A. and Braimah, N. (2012) "The Impact of Construction Procurement Methods on Project Performance in Libya", presented in the *5th Annual Student Research Conference* by the School of Engineering & Design, Brunel University, June, 2012.

Ghadamsi, A. and Braimah, N. (2013) "Modelling for Predicting Project Performance in Libya", presented in the *6th Annual Student Research Conference 2013* by the School of Engineering & Design, Brunel University, June 2013.

Ghadamsi, A. and Braimah, N. (2013) "The Impact of Construction Procurement Method on project performance in Libya: Results and Findings", presented at *Brunel University Graduate School*, Research Student Poster Conference 29-30 April 2013.

CHAPTER 1: GENERAL INTRODUCTION

1.1 Introduction

The procurement of construction projects comprise of organized procedures, contractual relationships and processes by which clients' construction products such as houses, office buildings, shopping complex, roads, bridges, etc., are delivered by contractors (Love et al, 2012; Abdul Rashid et al., 2006). It also involves the gathering and organizing of multitude of separate individuals and companies to design and manage the building of such products (Abdul Rashid et al., 2006). In these contexts, the arrangement devised and followed to deliver a construction project is often termed "Procurement Method" (PM) or strategy (Love et al., 2012; Naoum et al., 2004; Love et al., 2008).

The traditional approach to procuring projects (known as Design-Bid-Build, DBB) typically involves a system whereby the client enters into a separate contractual arrangements with a consulting organisation and a contractor, commissioned to execute the design and construction works, respectively (Nikou et al., 2014). In recent times, however, the DBB approach has often been blamed for much of the poor project performance (PP) experienced in the construction industry on account of two main developments which, in some ways, make the approach less amenable to employ than hitherto was the case (Nikou et al., 2014; Doloi et al., 2013). First, modern construction and engineering projects have not only become highly complex to deal with, but also their nature and delivery processes are fraught with many uncertainties (Ericksson and Westerberg, 2011). Secondly, projects are now increasingly subjected to strict performance demands from clients, which typically call for contractors to deliver projects using limited resources over a shorter duration, while retaining a high level of quality (Francom et al., 2014; Alhazmi and McCaffer, 2000). The industry's response towards addressing these challenges has largely been limited to the development and promotion of an array of innovative procurement methods, including the design and build (DB), management contracting, construction management, private finance initiative and partnering, to mention but the notable ones (Francom et al., 2014; Ericksson and Westerberg, 2011).

In spite of the myriad PMs that are available to deal with, among others, the frequent changing clients' needs and increased project complexities (Love et al., 2012; Mohsini and Davidson, 1991), clients' dissatisfaction with the selection and use of appropriate procurement routes for any given project still remains a major concern, as persistently highlighted in numerous studies (see for example, Francom et al., 2014; Love et al., 2012; Abdul-Rashid et al., 2006; Chan et al., 2001). Such dissatisfaction remains quite problematic amongst many construction industries, particularly in developing countries, such as the Libyan Construction Industry (LCI), which has seen a number of studies and governmental reports lamenting this issue (Ngab, 2011; Grifa, 2005; General People's Committee, 1999). Literature, including El-Gayed (2013) and Omran (2012), for example, has also confirmed that one of the most important reasons responsible for LCI's poor PP relates to the use of inappropriate PMs by project clients. This is a deeply unsettling issue, given that a large number of construction projects in Libya, representing more than 70% of the country's projects, are reported to have suffered from a severe cost and time overruns in recent times (El-Gayed, 2013; PPA, 2010, Tumi et al., 2009).

Yet, very little attention has been expended by way of research and governmental interventions towards improving construction procurement practice in the LCI, especially in the area PM selection process (PPA, 2010; Hassouna, 2008). The clients in this industry often rely on their past experience and familiarity with previous methods used to inform their future PM choices. Since the DBB is traditionally used for most projects, clients tend to consider it as the default PM for their projects regardless of whether it will be suitable for the given project at hand or not. It is worth mentioning that the available PMs have different features and characteristics (Jin et al., 2015; Ericksson and Westerberg, 2012) which make each appropriate to use under specific project circumstances (Jin et al., 2015; Perkins, 2009; El-wardani et al., 2006). Such features and characteristics are commonly reported in the literature as representing procurement method selection criteria (PMSC) upon which clients should rationally assess the suitability of a PM, if successful PP is to be achieved (Jin et al., 2015; Ericksson and Westerberg, 2012). Not surprisingly, doing otherwise, i.e., choosing PMs without following a scientific or systematic process but rather relying on just intuition or mere familiarity/experience with a method, as it prevails in the LCI, is a major contributory factor of poor PP (Bowen et al., 1999; Luu et al., 2003; Hashim et al., 2006; Turina et al., 2011).

Although the selection of an appropriate PM to procure any given project is known to result in successful PP (and vice versa), very little is known about the nature of this relationship from literature.Having persistently suffered a great deal of project failures over the years, the LCI stands to benefit from the availability of detailed knowledge and understanding of how exactly PM choice do actually influence its PP. Instigated by the dearth of this vital information, this thesis reports on a research investigation into this relationship with the aim of developing a model to explain the selection criteria functions in contributing to PP and their implications to PM selection practice in Libya.

1.2 Statement of the Problem

The use of an appropriate procurement method to deliver a project has long been recognised by many researchers (Jin et al., 2015; Love et al., 2012; Eriksson and Westerberg, 2011; Chan and Chan, 2000) as an essential requirement to ensuring successful performance of the project. A study by Jin et al., (2015) and Alhazmi and McCaffer (2000) found that using the most appropriate method can result in 5-10% reduction in project costs. Hashim et al, (2006) studied the effect of PMs on PP in Malaysia and found that one of the principal reasons for poor PP in the Malaysian construction industry is that project clients often do not take into consideration the right PMSC when deciding on which PMs to use. Also, Love et al. (2008) argued that many projects have suffered poor performance due to clients' disregard of PMSC when deciding on the right PM to adopt. In addition, Eriksson and Westerberg (2011) indicated that the construction industry of many countries frequently receive criticism regarding poor client satisfaction due to inadequate procurement practice relating to little or no focus on PMSC when deciding on the PM.

Whilst PM selection for any given project forms a crucial decision-making process (Love et al, 2012; Mohsini and Davidson, 1991), the judicious selection of an appropriate method poses a great challenge for clients. Clients tend to find this task quite daunting to grapple with, not least because it requires a meticulous consideration of a whole lot of factors (Jin et al., 2015; Laedre et al., 2006; Wardani et al., 2006) that are characterised by implicit interrelationships and complex relationships with project external factors (Luu et al., 2005). Furthermore, Thomas (2002) asserted that an appropriate PM selection depends largely on the accuracy of assessing each PMSC in the light of clients' requirements and the objectives of the project at hand. Therefore, the nature of the problem with PM selection thus implies that a rational and methodical decision-making tools or models, developed based on PMSC and PM features assessment (Popic and Moselhi, 2014; Alhazmi and McCaffer, 2000; Alkhalil, 2002), are necessary means for succeeding with the selection process.

However, the LCI lacks such suitable tools as all the available ones were purposely developed for specific industry settings of dissimilar environmental and cultural context to Libya. Thus, PM selection in the LCI is often informed by clients' mere familiarity and past experience with procurement methods, regardless of the project characteristics (Love et al. 2012; Eriksson, 2008; Rwelamila and Edries, 2007). Another procurement issue with the LCI is the fact that only a few of the existing PMs are known by clients in this industry, as they have very little awareness of more modern and innovative forms of PM (Omran et al., 2012; PPA, 2010; Hassouna, 2008). This issue has been perpetuated by clients' compliance of Decision No. 8 of 2004, which specifically requires that only DBB method should be considered as the first option for delivering Libyan projects (see Section 4.3.1). Due to this, DBB has often the most dominant method employed for Libyan project delivery, notwithstanding whether it will be appropriate to use or not in any given project.

In spite of the huge cost suffered by the LCI from inappropriate selection and use of PM (see Section 1.1), very limited studies in construction procurement have been undertaken in Libya. Grifa (2006), El-Hassia (2005) and HIB (2010) have lamented over this issue, indicating that decision-makers (or clients) in the LCI often follow unstructured or non-uniform processes to decide on PM, relying simply on their intuitive and experience, at best. This practice is unlike in some developed countries where more attention has been given to this area of procurement to aid clients in rightfully selecting the most appropriate PMs. A review of the literature has revealed that the studies undertaken and published so far have tended to focus on five areas of procurement issues. These studies, as listed below, were carried in countries whose construction operation environments and culture vary significantly from those of Libya, and hence their outcomes are unsuitable to employ directly as solutions for solving the afore-mentioned LCI procurement-related issues:

- Studies focusing on comparing existing PMs in order to find out their efficiencies as used in practice (e.g. Nikou et al., 2014; Ameyaw, 2009; Ibbs, 2003; Mohsini et al., 1995; Pramen et al., 2012; Turina et al., 2011).

- Studies conducted to identify and determine the criteria for selecting the most appropriate PMs (e.g. Cheung et al., 2001; Hashim et al., 2006; Love et al., 1989; Thomas et al., 2002).

- Studies dedicated to developing models for selecting the most appropriate PMs (e.g. Jin et al., 2015; Popic and Moselhi, 2014; Alhazmi and McCaffer, 2000;

Alkhalil, 2002; Chan, 2007; Griffith and Headley, 2008; Luu et al., 2003; Xia et al., 2011).

- Studies devoted to looking at the effect of different PMs on project performance as measured by key success criteria (e.g., Kumaraswamy and Dissanayaka, 1998; Hashim, 1999; Seng and Yusof, 2006; Abdul Rashid et al., 2006; Eriksson and Westerberg, 2011).

- Studies focusing on the effect that different PMs have on other performance related factors such as, project cash flow (Skitmore and Marsden, 1988), rework costs (Love et al., 2002), client satisfaction (Bowen et al., 1999); project changes (Ibbs et al., 2003).

As can be seen, very little research has so far been considered on the influence that PMSC have on PP, even although relying on such criteria to select PM is well-known to contribute to project success, as previously noted. A thorough understanding of this relationship would offer vital insights into PM selection, such as, knowledge on which of the selection criteria contribute significantly to PP improvements, and for that matter deserve much attention if quick and efficient selection process is to be achieved. This invaluable information will particularly benefit the LCI given that this industry is in dire need of guidance on how its PM can best be selected so as to improve on its PP, than hitherto has been the case. As a contribution towards fulfilling this need, and also to further develop the body of knowledge in this subject matter, the author seeks to examine the influence that PMSC exerts on PP in the LCI in order to fully comprehend how its procurement selection practice has contributed to PP and the insights this offers to improvements of the status quo.

1.3 Aim and Objectives

The aim of the research is to develop a model on the relationship between PMSC and PP taking into account the influence of PM. In pursuant of this aim, using the LCI as a case-study, the main research objectives embraced the following:

- To explore construction tendering and contracts procurement strategies in general and within the context of LCI;
- To explore procurement methods currently in use and their selection criteria;
- To identify the criteria for assessing and measuring project performance;

- To identify relevant hypotheses and developing a conceptual framework on the relationship between PMSC and PP as influenced by PM use;
- To develop a model on the relationship between PMSC and PP that demonstrates the criteria with significant influence on PP;
- To validate the developed model; and
- To explore the factors besides PMSC and PM that influence PP in the LCI.

1.4 Research Questions

To achieve the outlined objectives, the main research questions that this study sought to address include:

1. What are the common PMs used in the LCI and their selection criteria that inform their choice as suitable project delivery methods?

2. What is the relationship between PMSC and PP on account of PM usage in the LCI, and the significance of the influence of this linkage

1.5 Research Methodology

The methodological approach used in undertaking this research involved both qualitative and quantitative data. The application and justification of using these approaches is detailed in Chapter 5. An overview of the main steps followed in order to achieve the objectives of the research is given below.

A critical review of literature related to this research area was first undertaken to provide the theoretical background and context of the research. This review covered: (i) construction PMs currently in use, and factors influencing their appropriate use; (ii) the main criteria for selecting PMs; (iii) the criteria for assessing PP; (vi) comparing different PMs; and (vii) the effect of PMs on PP.

Following the review, a conceptual framework and relevant hypotheses were initially developed as a means of first, establishing the theoretical basis of the relationship between PMSC on PP criteria, and then developing a model to demonstrate how this link plays out. The review also informed the primary data collection methods used, which involved field surveys comprising of semi-structured interviews and structured questionnaire survey carried out with clients, consultants and contractor organizations across Libya over two separate and sequential periods of time. The data collected were analysed using a number of statistical techniques including descriptive statistics analysis, relative index analysis, Kendall's coefficient of concordance (*W*) and Chi-square test, one-way analysis of variance between groups (ANOVA test), and Pearson correlation test. Prior to conducting these statistical analyses, the data were first subjected to the test of normality to ascertain whether the distribution of the data is normal. The reliability of the data collection instrument used was also assessed.

The results from the data analyses were then used to draw up recommendations as to best practice and for developing a regression model on the relationship and influence PMSC have on PP. The model was then validated via case-study based on recent projects under taken in Libya. Interviews were also conducted with project managers, site engineers and general supervisor's highly involved in these projects as part of the validation. The justification behind the research methods and their procedural steps adopted in order to achieve the research objectives are all well explained and discussed in detail in Chapter 5.

1.6 Significance and Contribution to Knowledge

The absence of prior major study in the LCI regarding the importance of selecting the most appropriate PMs to deliver projects and their effect on the PP has resulted in the lack of experience and knowledge in this subject matter amongst project clients and consultants in Libya. The importance of this study lies in identifying and determining the major criteria for selecting the most common PMs and subsequently examining the impact they have on PP in the context of LCI. The outcomes of the research offer many potential benefits and contributions to the existing body of knowledge on construction procurement methods and their selection effects. A summary of the major research achievements and knowledge contributions arising from this study are enumerated below:

1- This research is the first of its kind to quantitatively examine and explain the theoretically perceived influence of PMSC on the performance of Libyan construction projects. The findings from this study thus contribute useful additions to the existing body of knowledge regarding PM selection issues that enhance PP. It also fills a major gap in PM literature due to the lack of studies that have looked at the influence of PMSC on PP.

2- An innovative model for explaining the influence of PMSC on PP has been developed. Among others, this model demonstrates the selection criteria that contribute significantly to PP. In terms of application, the developed model is intended to help LCI's clients:

- with information on the important factors for PM selection (i.e. those criteria with significant influence on PP) that project clients in Libya should focus more on during PM selection by, at least, helping them to decide on the appropriateness of using DBB and/or DB for any future project;
- to make PM selection decisions at a much faster rate by virtue of the need for them to only focus on the criteria of significant influence on PP, which are fewer than the longer list of criteria recommended in the literature;
- to work out, in quantitative terms, the PP outcomes to be expected for each of the method being considered for a project delivery. This information would enable clients to compare the PP outcome values expected from their decisions to select DBB and DB, and then be able to conclude which of these two options offer a better procurement strategy for any given project; and,
- to work out, prior to and during construction, the best measures and provisions (on the basis of the characteristics/nature of the significant criteria) that are necessary to implant or consider if successful PP of their DBB and DB projects are to be ensured.

3- Although the study focused on the LCI, it offers some valuable insights into existing PMSC and the kind of influence they wield on PP, of which other developing countries with similar construction settings as Libya's can benefit immensely from.

4- This study has identified other factors besides procurement issues that affect the performance of the projects in Libya and later ranked them based on the level of their importance. This, together with the critical review of PMs and their selection criteria provides an up-to-date information which would be very useful to the researchers and practitioners operating in this area.

As the study was based on LCI, the model developed might not be applicable in developed countries. This is because the operating environment of construction industries in developed countries is totally different from that prevailing in Libya. However, the model has important implications and useful application in Libya itself, as well as comparable countries with similar socio-cultural, economic and geographical factors, such as elsewhere in the Middle East and North Africa (MENA) (e.g. Egypt, Tunisia, Algeria and the Arabian Gulf).

1.7 Structure of the Thesis

The thesis is organised in chapters as briefly described below. Figure 1.1 shows the major processes of the research and how each process links with these Chapters.

Chapter One - General Introduction:

This introductory chapter presents a general overview of the thesis, comprising a statement of the problem, the research aim and objectives, research questions, the methodology adopted, significance and contribution to the knowledge and the structure of the thesis

Chapter Two – Construction Procurement Methods and Project Performance

This chapter provides detailed reviews on construction PMs currently in use and the criteria influence the most appropriate use. It also reviews the main criteria of evaluating and measuring PP. Classification of procurement systems and their processes are also discussed in this chapter. Furthermore, the chapter reviews some previous study on selecting PMs and their criteria, comparing various PMs and the effect of PMs have on PP.

Chapter There - Conceptual Framework of Construction Procurement Influence on Project Performance:

This chapter presents a conceptual framework that demonstrates the theoretical basis relationship and the influence of DBB and DB selection criteria have on PP based on literature review.

Chapter Four - Libyan Construction Industry:

This chapter gives an overview on the current state of the LCI. It covers the institutional and legal/regularity context within which construction procurement in Libya take place and public sector construction procurement processes and time line. This chapter also covers the identification of the most common PMs used to deliver projects in Libya, and the criteria for selecting them. Furthermore, the types of contracts and tenders and the most common problems that leads to time and cost overruns.

Chapter Five - Research Methodology:

This chapter explains the methodology and approach adopted in carrying out the research, which is an essential element in achieving the research aim and objectives. It presents the different research paradigms, the methodological approach adopted and its justification and the processes involved in the research. This includes: literature review carried out, data collection and procedures used in analysing data collected

Chapter Six – Data collection and Analysis

This chapter firstly presents the data collection and analysis of the initial survey undertaken to explore the key LCI's procurement matters that are necessary in helping to confirm and establish the scope of main PM issues under investigation in this research. Secondly, it presents the data collection and analysis carried out in relation to this main aspect of the research that sought to establish, in the main, how PMs currently employed to deliver projects in Libya influence PP. Both quantitative and qualitative methods, namely questionnaire survey and interviews were the main data collection approaches used.

Chapter Seven - Modelling and validation:

This chapter considers the development of a model that demonstrates the significant contributions of PMSC to PP. these criteria is considered very useful for predicting PP. The model was developed using multiple regression analysis (MRA) technique. The chapter also explains the steps used to validate the model

Chapter Eight – Discussion, Conclusions and Recommendations:

This chapter provides detailed discussion of the research findings as well as it provides the major outcomes of the thesis and considers the extent to which the aims have been achieved. The chapter highlights the research recommendations for future works and the limitation of the research

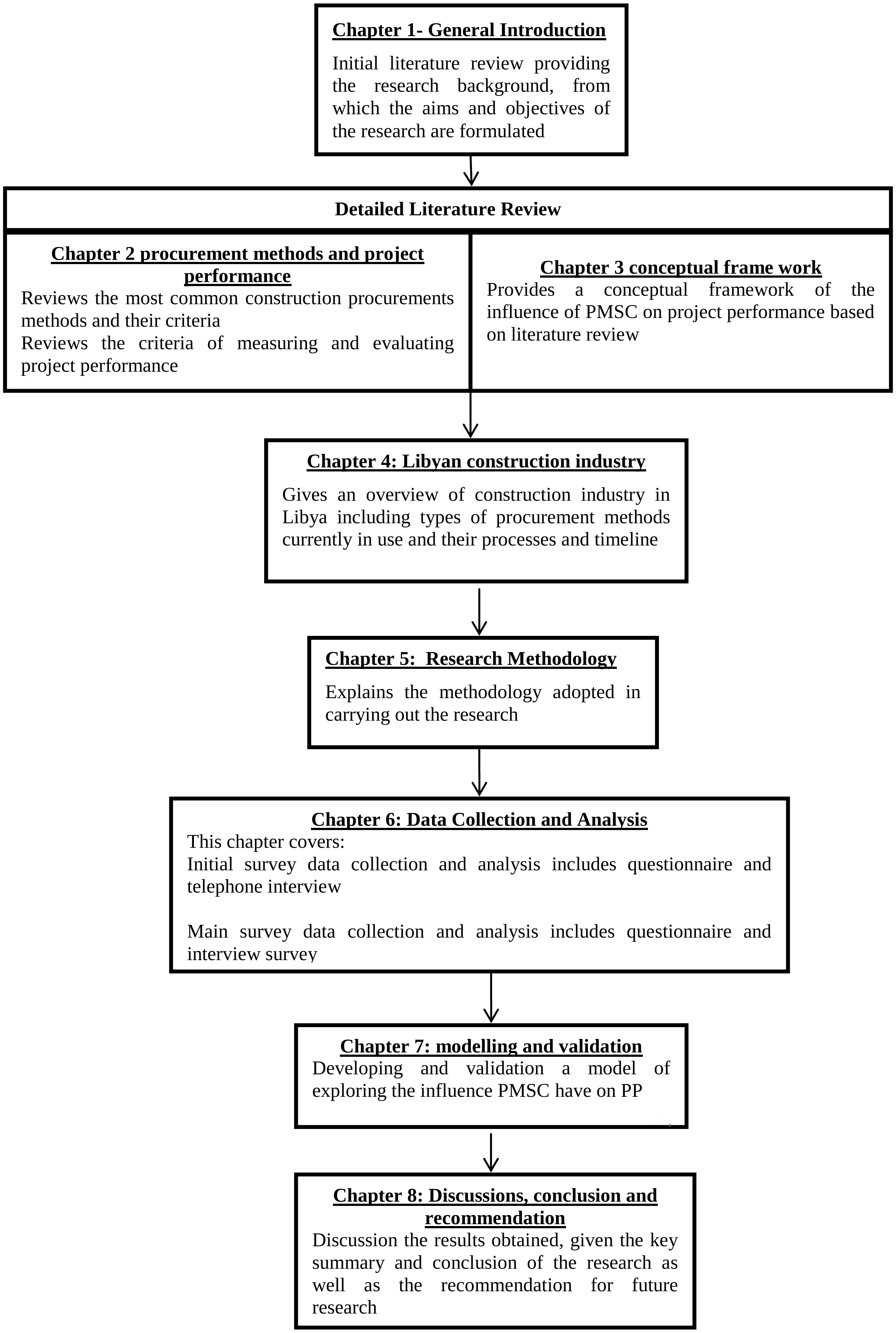

Figure **1.1: Flow diagram of the thesis**

CHAPTER 2: CONSTRUCTION PROCUREMENT METHODS AND PROJECT PERFORMANCE

2.1 Introduction

The key objective of this chapter is to review literature that are pertinent to the research subject area (construction PMs and PP) with the view to offer an appreciation of what the broader picture underpinning this research is. This chapter also seeks to present an up-to-date review of information pertinent to the key issues associated with the research topic, to further illuminates the basis for undertaking this research, gaps in the literature, and the rationale behind the research conceptual framework developed.

The chapter is divided into nine sections. The section following this introduction presents an overview of construction PMs, covering the definition and classifications of PMs, and the processes involved in applying the different procurement systems or route. The third section focuses on the selection of appropriate PMs when contemplating on the right procurement strategy for any given project. Section four looks at comparing the existing PMs. Section five identifies the criteria used for selecting PMs. However, section six focuses on PP. This section states the factors that influence PP, consider project success issues and discuss the measuring and evaluation of PP. Section seven discusses the influence of PMs on PP while section eight states the research gab left of the previous studies. The last section is the summary

2.2 An overview of Construction Procurement Methods

In recent years, the term ‘procurement method’ has become a fashionable and common phrase in the construction industry (Jin Lin et al, 2015; Rwelamila and Edries, 2007). It is regarded as one of the most significant parameters that contributes to projects’ success and hence client satisfaction (Love et al., 2012; love et al., 2008). Moreover, PMs play an important role in defining and clarifying the shape of contractual arrangements and the relationships between project parties. These reasons go to explain the popularity of the term. In principle, procurement systems determine the overall framework outlining the responsibilities and authorities of project parties in the construction process (Rwelamila and Edries, 2007).

2. 2. 1 Procurement method definitions

The term ‘construction procurement method’ has been given different definitions in construction management literature (Francom et al., 2014). For instance, Chan (2007) defined it as the system that represents the organizational structure adopted by clients for the implementation of project processes and eventual operation of the project. On the other hand, Molenaar et al. (2009) and Rwelamila (2000) defined it as a comprehensive process by which designers, constructors, and various consultants provide services for design and construction to deliver a complete project to the client. Poplic et al. (2014) stated that PM is “*a strategy to satisfy client's development and/or operational needs with respect to the provision of constructed facilities for a discrete life-cycle*”. Francom et al. (2014) defined PM as the comprehensive process by which a facility of the project is designed and constructed, whereas Root and Hancock (1996) defined it as the manner in which clients buy specialist activities and resources from the building industry to create a new building. Mante et al. (2012) defined PM as the process of acquiring new services or products and includes contract method used, contract documentation and contractor selection process. Park et al. (2009) reported that project procurement can be defined as “*the set of relationship, roles, and responsibilities of project team members and the sequence of activities required for the development of a capital project*”.

As the various definitions suggest, a wide range of processes are involved in a procurement strategy. These processes are often interrelated and sequential in nature and their effectiveness and efficiency impact considerably on the success or failure of projects. The definitions also point to the fact that there is no a single commonly accepted definition of what PM actually means within construction management circles. However, for the purpose of this research, procurement method definition can be summed up from the various given descriptions as embodying the set of procedures and relationships that govern the services and activities undertaken by contractors and consultants in order to plan, design, assess and construct projects and deliver the end product to the client.

2. 2. 2 Procurement methods classifications

The last few decades have witnessed the proliferation of numerous different types of construction PMs for delivering projects (Jin Lin et al., 2015). The most common types include: the Traditional Method, also known as Design, Bid and Build (DBB) approach, Design and Build (DB), Management Contracting (MC), Construction Management (CM), and Project Finance and Partnering (PFP). They differ from each other on the basis of allocation of parties' roles and responsibilities, activities sequencing, process and procedures, and the organizational approaches followed in project delivery (Jin Lin et al., 2015; Abdul Rashid et al., 2006).

The various procurement methods can be classified into three main categories based on the kind of relationship and interactions exhibited between design and construction processes, as follows: Separated and Cooperative procurement system, Integrated Procurement System and Management Oriented System (Abdul Rashid et al., 2006; Love et al., 2008; Mante et al., 2012). Figure 2.1 shows these categories and their sub-classifications as commonly presented in the literature.

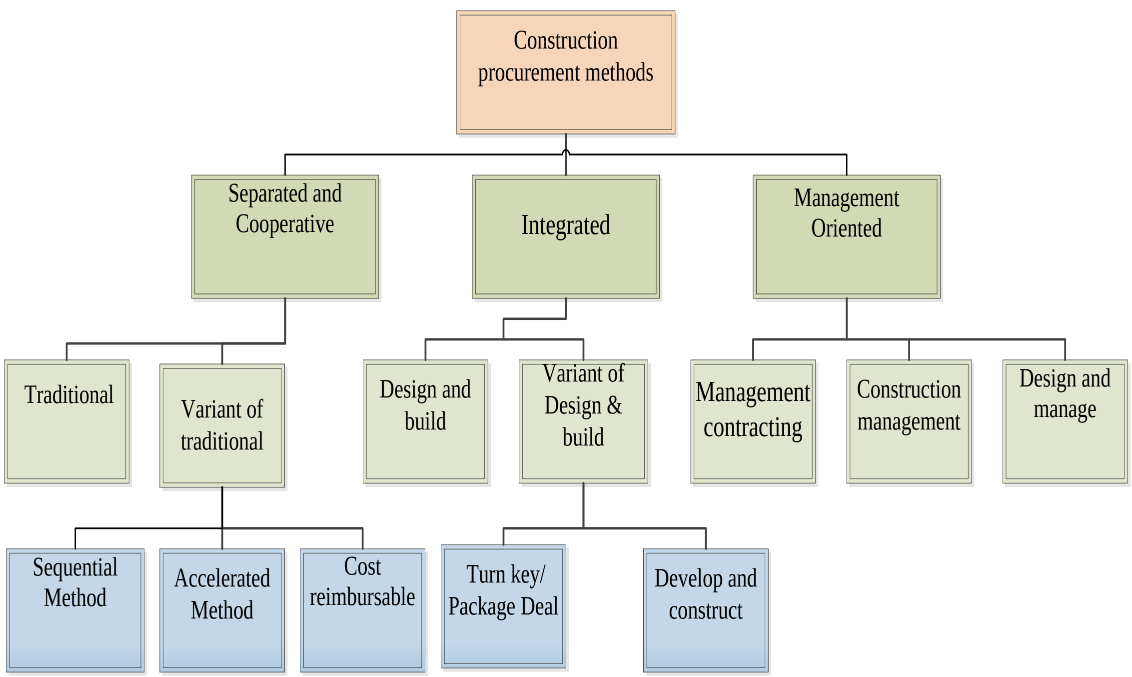

Figure 2.1: Classification of procurement methods

Source: Rwelamila and Edries (2007), Abdul Rashid et al. (2006) and Love et al. (2008)

2. 2.2.1 Separated and Cooperative Procurement System

Nikou et al. (2014) stated that this system is a project delivery system whereby the project development activities are carried out by different independent organizations, namely the consultant and contractors, in a sequential order one after the other. The activities here start from feasibility study, preliminary and detailed design, construction activities and handover of the project (Rwelamile and Edries, 2007). Mante et al., (2012) indicated that the defining characteristic of the separated and cooperative procurement system is that the design phase is separate from the construction phase, resulting in little or no interaction between design and construction organisations involved. In this procurement system the majority of the drawings and designs have to be completed prior to the commencement of site work (Nikou et al., 2014; Rwelamila and Edries, 2007). This procurement system includes DBB and its variants as Figure 2.1 depicts. Under this system, the client is thus required to go into separate contracts, first with consultants for the design and preparation of contract documents, and then with the contractor for carrying out the construction works (Thwala and Mathonsi., 2012; Eriksson and Westerberg, 2009).

2. 2.2.2 Integrated Procurement System

According to Migliaccio et al. (2009), integrated procurement system is a project delivery method where the design phase and construction phase are carried out in parallel, or with significant overlap of activities of these phases. Ramsey et al. (2014) indicated that integrated procurement system combines or integrates the responsibilities of design and construction of the project wherein both responsibilities are contracted out to a single contracting organization. Nikou et al. (2014) also stated that the main characteristic of integrated procurement system is that the design and construction stages are integrated; thus a single agreement exists between the client and the contractor to design and implement the project. This procurement system comprises DB and its variants which are Turnkey/Package Deal and Develop and Construct (Mante et al., 2012).

2. 2.2.3 Management-oriented procurement system

According to Rwelamila and Edries, (2007), management-oriented procurement system is the type that lay greater emphasis on the management and integration of the design and construction of projects. This procurement system includes MC, DM and CM. Thwala and Mathonsi (2012) stated that "*under a management-oriented procurement system, the management of the project is carried out by an organisation working with the designer and other consultants to produce the designs and to manage the construction work which is carried out by contractors*". They also confirmed that the conception of management-oriented procurement system is that the management firm overseeing the project has more expertise to manage the design and construction of a project.

2. 2. 3 The processes of the Procurement Systems

According to Nikou et al. (2014), construction procurement processes describe the procedures to be followed as determined by the roles of the project parties involved, the relationships among the parties, the timing of events, and the management practices and techniques adopted. The processes of the various procurement systems can be either sequential or integrated in nature (Ramsey et al., 2014). They span the whole life-cycle of projects from the initial concept until the end of project implementation, typically consisting of distinct stages such as briefing, design, tendering, contracting, construction and commission. These processes related to each other through a technological structure and greatly affect the duration and starting point of construction projects (Abdul Rashid et al., 2006; Rwelamila and Edries, 2007). For instance, in sequential procurement process, delay in any of the project stages inevitably delays the subsequent stages that follow, as each stage depends on the other (Rwelamila and Edries, 2007).

The following figures (Figure 2.2, Figure 2.3, and Figure 2.4) show the processes of procurement system as presented by Abdul Rashid et al. (2006).

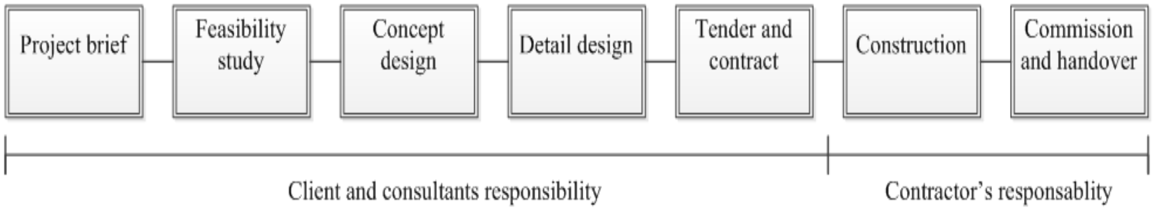

Figure 2.2: Linear process of traditional procurement system

Source: Abdul Rashid et al. (2006)

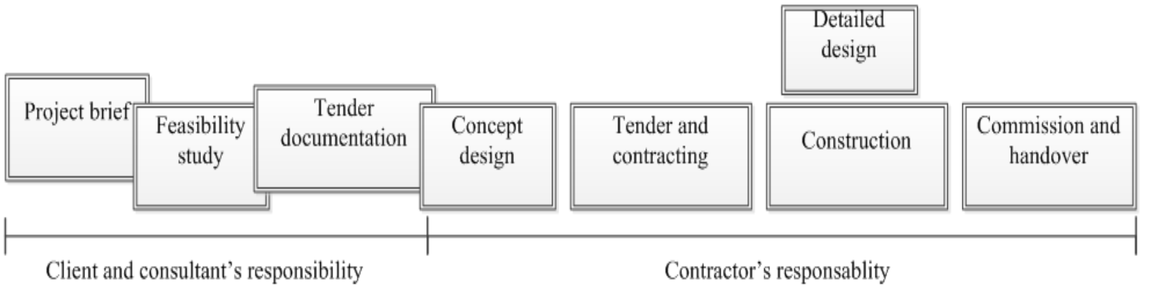

Figure 2.3: Integrated process of design and build procurement system

Source: Abdul Rashid et al. (2006)

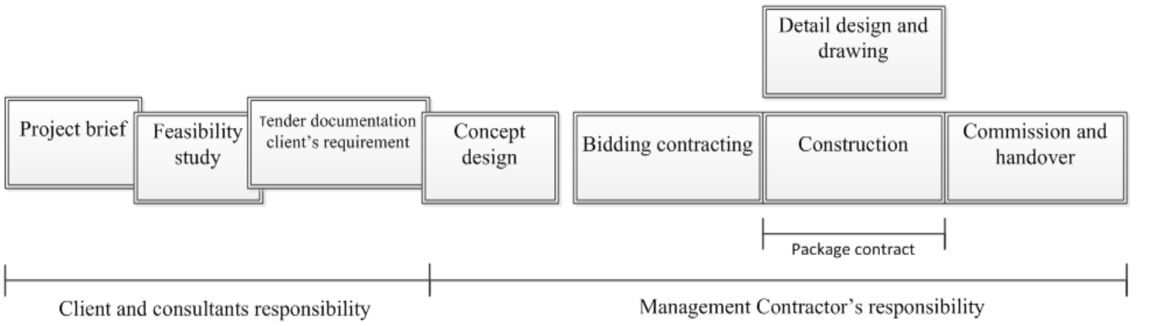

Figure 2.4: Design and construction in professional construction management system

Source: Abdul Rashid et al. (2006)

2.2.4 Types of construction project delivery commonly in use

A review of the literature (Nikou et al., 2014; Love et al. 2012; Thwala and Mathonsi, 2012; Molenaar et al., 2009 and Masurier et al., 2006) indicates that the most common and preferable PMs for delivering construction projects are the DBB and DB methods, whilst CM method is rarely in use as compared to the former two.

2. 2.4.1 Traditional procurement method (DBB)

According to Francom et al., (2014) DBB method is the oldest form of construction procurement, but still remains the most popular form of separated and cooperative procurement system. Thwala and Mathonsi (2012) stated that, DBB method is called '*Traditional*' because, not only is it the earliest method, it has also been widely used throughout the world for many years to procure public and private construction projects.

Shrestha et al. (2014) indicated that under DBB method, the project is separated into design phase and construction phase. The design phase should first be completed, followed often by a competitive tendering (open) process for contractor selection and contract letting, before the construction phase commences (Pishdad-Bozorgi et al., 2012; Eriksson and Westerberg, 2009; Ibbs et al., 2003). In addition to competitive (open) tendering, clients also make use of selective and negotiation tendering approaches when using DBB method for their projects (Thwala and Mathonsi, 2012 and Rosmayati et al., 2010).

In spite of the separate responsibilities required from the client and the contractor parties for these phases, the method allows for cooperation between the parties. It is for this reason that the DBB method earned its other, less popular though, name, "Separated and Cooperative" method (Masterman, 2001). The method also involves the sharing responsibilities and financial risks (Francom et al., 2014); clients often assume full responsibility of all the risks involved with the preconstruction stage, whilst contractors bear those under construction stage.

An Additional feature of the DBB method is the fact that it usually requires the client to monitor the contractor's activities so as to ensure that the construction works meet contractual requirements and specifications (Al-Khalil, 2002; Ibbs et al., 2003). Yet, Liv (2012) states that in DBB method the designer does not have a direct link with the supplier and all communication is via the main contractor, who in many cases will not accept design liability. He also indicated that, the designer (the Architect/Engineer) is often the leader of the project and the client's representative. Figure 2.5 shows the project organisation structure for DBB procurement method as presented by Seng and Yusof (2006) and Maricopa (2011).

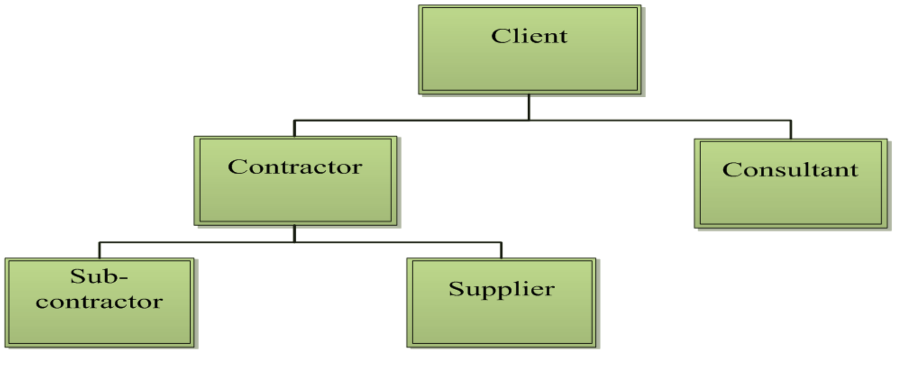

Figure 2.5: Project organisation structure for DBB procurement method

Source: Seng and Yusof (2006), Maricopa (2011)

However, the DBB have been heavily criticised by many authors (for e.g. Francom et al., 2014; Pishdad-Bozorgi et al., 2010; and Masurier et al., 2006) as being an ineffective and inefficient PM for its penchant to yield not only high project time and cost overruns, but also foster adversarial relationships among the project parties. Love et al. (2012) describe the cause of the issues with this method as follows: "*DBB procurement has contributed to the so-called "procurement gap" whereby design and construction processes are separated from one another. This procurement gap is considered to inhibit communication, coordination, and integration among project team members and can adversely affect project performance*".

2. 2.4. 1. 1 Types of contracts assigned under DBB procurement method

Antoniou *et al*. (2012) indicated, among others, that "*construction contracts are essentially written documents which seek to ensure some element of predictability and control on people's actions during the course of a construction project".* According to Kate (2010) and Rodriguez, (2011), contract is fundamental to any project, as the right selection and application of it is the first step towards protecting clients from projects failures. In other words, the reason why the choice of contract must be selected properly is to ensure project success (Kata, 2010). The main common types of contracts that are assigned under DBB procurement method as stated by (Antoniou et al., 2012; Kate, 2010; Grifa, 2006) are Unit Price/Bill of Quantities, Lump Sum and Cost Reimbursement.

a) Unit Price or Bill of Quantities

A unit price contract is a fixed-price contract by which the contractor submits a price per unit of each item of work during the estimating process. The total expected quantity of works for each item is multiplied by their corresponding unit prices, and the results from all the items are sum totalled to determine the total project cost (Antoniou et al., 2012). The estimated unit price includes overhead costs and profit. The final price of the project is dependent on the quantities needed to carry out the work (Abd-Elshakour, 2011; Wong et al., 2006). During construction phase, contractors are paid on the basis of units of work actually done and measured in the field multiplied by the unit prices.

Rodriguez (2011) mentioned that in a unit price contract, the work to be performed is broken into different parts based on the type and the size of the project, such as concrete works, building works, plastering works and panting works etc. Abd-Elshakour (2011) confirmed that the main characteristics and features of the unite price are that: it is appropriate for competitive bidding; it facilitates easy selection of contractors, and allows for changes to be made easily to contract documents by clients.

b) Lump Sum

Abd-Elshakour, (2011) defines lump sum contract as the most basic form of agreement between client and contractor, whereby the former agrees to undertake all the specified contract works for a specific fixed price, whilst the latter agrees to pay this price upon successful completion of the work according to a negotiated payment schedule. Essentially, the contract typically requires the client to pay a fixed price irrespective of the actual cost incurred on the project, unless contractual provisions on risk sharing between the parties stipulate otherwise (Kate, 2010). In addition, the contractor is free to use any means and methods to complete the work and he is responsible for proper work performance (Ibbs et al., 2003). However, the risks of this type of contract weigh heavily against the contractor, whereas and client's financial risk is low and fixed at the outset (Abd-Elshakour., 2011; Kate, 2010).

Antoniou et al. (2012) noted that in developing a lump sum bid, contractors usually estimate the costs of labour and materials and add to a standard amount for overhead costs and the desired amount of profit. Alternatively, the profit and overhead can be estimated as a percentage of the project cost. These mark-up items may be increased depending on the level of contractor's risk assessed.

A lump-sum contract is appropriate in case the scope and schedule of the project are well defined to allow the contractor to fully estimate project costs (Ibbs, 2003). Other features of this contract are that: the final price is known by clients before work commences, and contractors have greater incentive to complete the project quickly in order to reduce overheads and maximize profit.

c) Cost Reimbursable Contract (cost plus)

According to Kate (2010), cost plus contract is a contractual agreement whereby the purchaser/procurer agrees to pay the cost of all labour and materials plus an amount for contractor overheads and profit (usually as a percentage of the labour and material cost). This type of contract is preferred where the scope of the work is unclear or highly uncertain, and the kinds of work, material and equipment needed are also uncertain. Under this arrangement complete records of all time and materials spent by the contractor on the work must be maintained (Kate, 2010; Antoniou et al. 2012; Veld and Peeter 1989).

Rodriguez (2011) indicated that cost plus involves payment of the actual costs, purchases or other expenses generated directly from the construction activity. It must contain specific information about certain pre-negotiated amount (for instance some percentage of the material and labour costs) covering contractors' overheads and profit. Costs must be detailed and should be classified as direct or indirect.

Cost plus contracts are widely used for some important projects that need to be finished early and in limited time (Antoniou et al. 2012). It is also used for projects with unknown technologies or major changes. The cost of the project is not initially defined, and the client is required to reimburse all allowable and reasonable costs that the contractor can prove has been incurred (Abd-Elshakour, 2011). The main features of cost plus contract are that: it gives no incentive for the contractor to inflate cost through contingencies, while there is incentive for the contractor to complete work as quickly as possible, since his fee remains constant (Antoniou et al. 2012; Abd-Elshakour, 2011). However, one of the main disadvantages of cost plus is the poor control of materials selection (Masurier et al., 2006).

2.2.4.2 Design and Build procurement method (DB)

DB method of procurement has been used extensively throughout the world within various construction industries for many years (Ramsey et al., 2014; Turina et al., 2008; Seng and Yusof, 2006). It is considered one of the most favoured project delivery methods (Minchin et al., 2013; Ibbs et al., 2003) on accounts of its time and cost saving reputations, reduced conflicts and enhanced communication between project participants (Ramsey et al., 2014). DB method is also held to be effective for delivering complex projects (Park, 2009), and allows for project works to start even before fully detailed design is complete (Morledge et al., 2006, p.116).

The basic concept of DB entails contracting a project out to a single organization that would be responsible for the design, procurement, engineering and commissioning (Ramsey et al., 2014; Seng and Yusof, 2006). In line with this concept, the contractor assumes the responsibility for both the design and construction of projects for the client under DB method (Lo and Chao, 2007; Masterman, 2001; Turina et al., 2008). DB method has been given different definitions in the literature. For instance, Ramsey et al. (2014) defined it as *"an alternative project delivery system that is distinguished by a DB team acting as the single point of responsibility for a project where the design and construction phases overlap. There are two main methods used to procure DB services: single-step procurement and two-step procurement".* However, Shrestha et al. (2012) and Akintoye and Fitzgerald (1995) defined it as purchase of a building from single contractor who undertakes both the design and construction. Other researchers (Shapiro and Knutson, 2013; Migliaccio et al., (2006); Seng and Yusof, 2006) defined it as an arrangement whereby one organization designs and constructs the project for the client for a single financial transaction.

Seng and Yusof (2006) confirmed that, the DB method comprises three main elements: single responsibility of a particular organization, reimbursement generally being by means of a fixed-price lump sum, and the project being designed and built specifically to meet the needs of the client . This method of procurement can be organized in three different ways: pure design and build, integrated design and build and fragmented design and build (Turina et al., 2008). Shrestha et al. (2012) and Turina et al. (2008) stated that, the DB is particularly successful in cases where the scope is clearly defined, the design is a standard, repetitive design, and the schedule is tight

In light of the above definitions it can be thus understood that, DB method is a project delivery system in which one organization (i.e. the contractor) carries out all processes (design works as well as construction works) of the project and is responsible directly to the client. In this respect the client executes a single, fixed-fee contract for both architectural/engineering services and construction. Figure 2.6 shows the project organization structure of DB procurement method as presented by Turina et al. (2008), Seng and Yusof (2006) and Maricopa (2011)

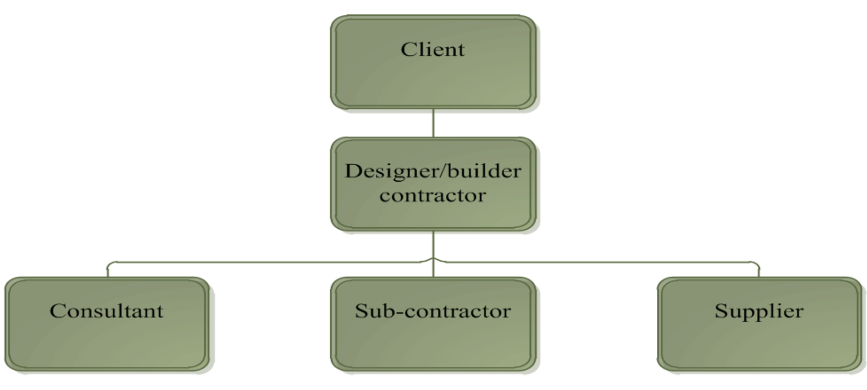

Figure 2.6: Project organisation structure for DB procurement method

Source: Maricopa (2011), Seng and Yusof (2006) and Turinaet al. (2010)

2.2.4.3 Construction management procurement method (CM)

CM procurement method is considered one of the relatively new methods of construction procurement (Thwala and Mathonsi, 2012). It is categorised under management oriented form of procurement system (Thwala and Mathonsi, 2012; Seng and Yusof, 2006), whereby the client employs a professional construction manager as a construction consultant to be part of the client’s team to oversee, on his behalf, the processes of project development (design and construction phases) (Al-Khalil, 2002; Liv, 2011). The construction manager works with the design team to help ensure that, the design is something that can in fact be built for a reasonable cost, and that the builders will be able to understand the design drawings and specifications (Thwala and Mathonsi, 2012). The construction manager or construction consultant plays important role in involving overseeing scheduling, cost control and construction, in addition, to coordinating the contractor's activities and control project (Thwala and Mathonsi, 2012).

Lo and Chao, (2007) stated that several duties can be fulfilled by using CM method. For instance, it can offer constructability reviews, value engineering studies, construction estimates, and contract packaging (Alkhalil, 2002). CM procurement method can be applied to a large, complex project which requires a good deal of oversight and coordination (Tawiah and Russell, 2005). It also can be applied in projects where the client requires additional services, such as fast track schedule (Alkhalil, 2002).

Various definitions have been given to CM procurement method. Masurier et al. (2006) defined it as approach where an additional role of construction manager or project manager is added in the organisation to look after the project objectives. Other researchers (Mahon, 2011; Lo and Chao, 2007; Tawiah and Russell, 2005) defined it as a project delivery method based on the client's agreement with a qualified construction firm to provide leadership and perform administration and management for a defined scope of services.

The main feathers of using CM method is that: (i) it helps the client to control costs and avoid delay on complex projects; (ii) the client can often be more involved in the selection of sub-contractors; (iii) the schedule is controlled during the design phase to ensure that design efforts are integrated with construction phase requirements; (vi) the client has single prime responsibility for construction; and (vii) no additional client personnel are required to monitor construction (Mahon, 2011; Masurier et al., 2006; Alkhalil, 2002; Education, 2011).

2. 3 Selection of the Most Appropriate Procurement Method

According to Jin Lin et al, (2015) "*Selecting the most appropriate PM for delivering project is a key decision that has to be made by the client during the early stages of a project, usually under conditions of uncertainty*". Love et al. (2012) also indicated that, the decision of which PM should be adopt in construction projects is considered the most complex and challenge task for clients, because if a client makes a wrong choice, the penalty may be time and cost overrun and general client dissatisfaction (Jin Lin et al., 2015). For clients to be in a position to select the right method of procurement that best meets a particular type of works, the realistic measures of performance or suitability of each PM available must be considered (Love et al., 2012)

Sundar (2012) indicated that, selecting an appropriate PM is an essential step in any construction project process. It entails the client's clear brief and delivery from the consultant and contractor. According to Ratnasabapathy et al. (2006)

> "*In deciding which procurement system to apply, there is a need to take into consideration various factors before any practical decisions can be made. Because, the wrong selection of construction procurement approach usually leads to project failure or general client's dissatisfaction. Therefore, a systematic approach for the selection of the most appropriate system is essential to aid the clients to achieve their ultimate project goals, thus to ensure best value for their money*" (Ratnasabapathy et al., 2006).

A number of authors including for example Naouma and Egbua, (2015), El-Hassia, (2005), Masterma, (2002) and Love et al. (1989) indicated that, the three key elements of selection the PMs are: determine client's requirements, project characteristics and project environment. Naouma and Egbua, (2015) and El-Hassia, (2005) stated that, the fundamental decision sequence that are considered in the selection of the most appropriate PM is shown in Figure 2.7 below. Ideally the selection of the most suitable form of PM reduces construction project costs and enhances the probability of project success (Naouma and Egbua, 2015; Love et al., 2012).

Figure 2.7: The decision sequence that guides PMs selection

Source: Naouma and Egbua, (2015) and El-Hassia, (2005)

Over the past two decades, a number of studies and researches on construction PMs have been carried out to find out systematic approach or tools to aid client in selection the most appropriate PM. For instance, Griffith and Headley (1997) developed a weighted score model as an aid to selecting PMs for small building works. The results showed that implementation of a weighted score model to aid procurement selection is advocated to place the client in the best possible position to select the right method of procurement for the works, given the organizational situation at that particular point in time. Alhazmi and McCaffer (2000) proposed a model called project procurement system selection model (PPSSM) for assisting government agencies in Saudi Arabia to select the most appropriate PM. The model consists of four screening levels to be followed in selection process: feasibility ranking, evaluation by comparison, weighted evaluation and analytic hierarchy processes. Based on a Delphi study, a multi-attribute decision analysis was used to develop a procurement selection model by Chan et al. (2001). Four rounds of Delphi were conducted. The first and second rounds identified a set of exclusive criteria for the selection of procurement method. The third and fourth round was to derive a statistically significant assent on the weighting of the utility factors. As result of these four rounds a procurement selection model was developed.

Tookey et al. (2001) produced generic, prescriptive rules for clients and advisers to use to select the ‘best’ procurement route for their projects in the UK. The study sought to identify whether prescriptive procurement guidance was adhered to on a set of case study projects. The results showed that, clients usually select suitable procurement systems, and where an unsuitable system is selected, changes were made in contract form to combine aspects of the ‘best’ procurement route. Alkhalil (2002) developed a model using the analytical hierarchy process (AHP) to select the most appropriate project delivery method. Several factors considered to be relevant to the selection decision were used to the rank of the project delivery methods. The model developed is simple to use and also allows the client to consider all decision-relevant factors. It is based on an intuitively appealing methodology, an AHP. Luu et al. (2003) developed a procurement selection model based on case-based reasoning (CBR) approach. It was found that using CBR model to select PM appeared to be an appropriate approach to meeting the requirements of procurement selection process. The suitability of CBR approaches was subsequently examined by Luu et al. (2005), who indicated that the approach has the potential to ensure high quality decisions on procurement selection. The approach was also found to deal effectively with variability in the characteristics of the clients, project and extremely environment.

Ola et al. (2006) studied two different software tools developed for selecting the most appropriate PM for public building in Norway. They also reviewed documentation of major 22 public building and construction projects of the Norwegian Public Roads Administration (NPRA). The results indicated that, public clients use the same procedure to select the procurement route for their projects, and they do not consider the procurement route most suitable for their projects. Chan (2007) developed a procurement selection model called fuzzy procurement selection model (FPSM). It is a mathematical rank model that is adaptable to local circumstances. The proposed model was presented for review by six construction/quantity surveying professionals with more than 10 years' experience in construction procurement practice in Hong Kong. As a result of that, the model was found to be a useful tool to aid decision-making in selection of PM.

Love et al. (2008) examined how and why PMs are selected by public sector clients in Queensland and Western Australia based on focus groups, case studies, and a questionnaire survey with senior managers. The findings revealed that, DBB method is the most preferred, although alternative forms could be better suited for a given project. The clients usually use their experience in selection PM. It was perceived that only a limited number of contractors have the resources and experience to deliver projects using the non-traditional methods. Rwelamila (2011) identified the subject of PMs as an area that has been neglected for far too long and then developed guidance to aid the process of choosing the most appropriate PM. Based on procurement systems research conducted within the Southern African Development Community (SADC), it was found that majority of clients are totally dependent on consultants' expertise for advice when selecting procurement methods. The absence of suitable training in this specific aspect of construction management amongst all construction consultants has resulted in many consultants remaining devoid of any real expertise in this area. Due to this, most clients have suffered from poorly conducted selection process largely based upon biased past experience and conservative decisions of their experts.

Xia et al. (2011) established a fuzzy multi criteria decision-making (FMCDM) model for selecting the most suitable DB operational variation. A three-round Delphi questionnaire survey was conducted. The model was developed using the weighted-mean method to aggregate the overall performance of DB operational variations with regard to the selection criteria. The results of this study indicated that FMCDM model aids clients to objectively select the most appropriate operational variation of the DB system under different situations. Chan and Chan (2012) assessed the feasibility of applying some of the procurement selection models developed in the Hong Kong construction industry. They compared two models in order to determine the forecasting power of the models and check whether they can be applicable in the Hong Kong environment: Bennett and Grice's model and Chan's model. The reliability of the procurement selection models have tested by using normative decision chart. The results revealed that Chan's model is more applicable as it has a better forecasting power and confirms the feasibility of developing a Hong Kong-based procurement selection model.

Jin lin et al. (2015) presented a study of PM selection in building maintenance management for public university in Malaysia. Multiple criteria decision making and particularly the analytic hierarchy process (AHP) was used in this study. This study aimed to discover the current practices followed to use available PMs for building maintenance work in public universities, as well as to identify PMSC towards developing an efficient decision-making framework. Filed survey includes questionnaire and semi-structured interviews covers some of construction management experts in 20 public university in Malaysia was conducted. The finding of this research revealed that the PMs selection by university organizations is neither strategic nor systematic as there is no guidance available for the decision maker to aid him to select the most appropriate PM.

2. 4 Comparing the Existing PMs

Pishdad-Bozorgi et al. (2012) indicated that "*The proliferation of PMs used for construction projects has inevitably resulted in comparisons being made between the performances associated with each of them. The challenge for researchers in this field has been largely based on how to compare PMs to find out their efficiencies as used in practice*". A review of the literature showed that a number of researches and studies undertaken over the past years aimed to compare the use of different types of PMs in practice (Nikou et al., 2014). Ibbs (2003) conducted a comprehensive analysis of 67 global projects from the construction industry institute's database in order to compare the effectiveness of an alternative project delivery method (DB) with the traditional project delivery method (DBB), and to examine the relationship that project change have on performance impacts by applying different project delivery approaches. The findings showed that DB projects may not provide all the expected benefits to project performance. For instance, in terms of timesaving the results show a definitive advantage of DB method, however in terms of cost and productivity changes the results did not show convincing positive effects. Generally the project outcome greatly depended on the project management expertise and experience of the contractor in design and construction.

Turina et al. (2008) studied the possibility of the application of DB project delivery in the Croatian construction industry. The paper's main objective was to describe the basic characteristics, the project phase and possibility of implementing buildability concept in projects being conducted by DB method. Based on the conclusions from the research about PMs in the Republic of Croatia at the end of 2007, it was found that, DB method appeared as an alternative to DBB method. The dominant PM used in construction projects is the DBB and this explains why construction projects in Croatia were not procured by new, modern procurement methods which would positively influence the integration of the phases and participants in the project. Ameyaw (2009) evaluated 62 DBB and 17 DB completed projects in the Greater Accra, Ashanti and Brong Ahafo in Ghana. The main purpose of this study was to assess and compare the performance of the existing PMs with regards to their ability to produce within budget, within time and high quality level, and to ascertain whether there is a significant difference between the performance of the similar DBB and DB projects studied. The study revealed that in terms of cost performance, most DB projects are completed within their respective budgets, whereas a large number of DBB projects suffer cost overruns. In terms of time performance, the results showed that DB projects outperform DBB projects in terms of completion on schedule. However, the study concluded that there is no significant difference between the qualities of completed projects executed under the two procurement methods.

Darren et al. (2009) surveyed 39 projects procured by DBB method and 38 projects procured by DB in the US in order to compare the effectiveness of their project delivery and investigated which one is better in terms of time and cost. Statistical analyses were used to perform the empirical comparison of DBB and DB and to determine if one project delivery method is generally better than the other. The results revealed that DB method is better than DBB in terms of both time and cost. Pramen et al. (2012) compared DBB method and that of DB regarding their performance in large highway projects in terms of time, cost and change orders. 130 projects of the State Highway derived from work undertaken by the Texas Department of Transportation were studied in order to compare the performance of these projects. The results revealed that, the construction speed and project delivery speed per lane mile of projects procured by DB were significantly faster than that of DBB method. The flexibility of the change orders for projects procured by DB method is more than those procured by DBB method.

Minchin et al. (2013) conducted survey on highway and bridge construction projects in Florida in order to compare which of the two PMs (DBB and DB) have delivered these projects at lowest cost and shortest time. The data was collected from data base of the florid department of transportation. Data collected was analysed statically using SPSS. The results of the study showed that, DBB method performed significantly better than DB method in terms of cost. However in terms of time DB method performed significantly better than DBB. Nikou et al. (2014) reviewed the construction literature that quantifies the differences between delivering projects using DBB method and DB method in terms of project cost, time, and quality. A meta-analysis format was used to analysis data. The results showed that, although there have been several research efforts, few of them did present statistically significant comparative results for all performance metrics (time, cost and quality). This study identifying the range of project performance values that can be achieved using DB, which help for an improved understanding of DB performance

2. 5 Criteria for Selecting PMs

As highlighted in Section 2.2.2, the construction industry has developed a number of alternative PMs to satisfy its clients need. As result of these alternatives/options, it has become important that construction industry clients needed to use a set of well-defined criteria to aid selection of the most appropriate PMs (Mahon, 2011). El-Hassia, (2005) stated that *"The use of multiple criteria to derive a suitable procurement method for a construction project will assist the client in identifying its principal goals and objectives for the project".*

PMSC have been defined by Thanh et al. (2003) as "*the set of project specific requirements that have most weighting when deciding upon a procurement path*". However, Mahon (2012) defined it as "*a set of rationalistic decisions within a closed environment aiming to produce generic, perspective rules for clients to use to select the best procurement route for their project*."

Extensive literate review identified several studies relating to the criteria for selecting the most appropriate PMs in the last few decades. Hibberd and Djebarni (1998) surveyed the criteria for the selection PMs in the UK construction industry and the issue of satisfaction with PMs based on questionnaire survey of 122 clients and consulting organizations. The results revealed that, the nine major procurement selection criteria used are: predictable cost, accountability, dissatisfaction with previous procurement process, knowledge of the process, punctuality, speed of commencement, speed of completion, transference of risk and working relationship.

Love et al. (1998) conducted survey with a sample of 41 clients, 34 contractors and 35 consultants in order to obtain the experiences and attitudes to a variety of PMs and the criteria used for selection. The findings showed that the criteria which are generally adequate and sufficient for procurement path selection are: speed of project completion, cost and certainty, flexibility of changes, quality, complexity, controllable variation, risk allocation/avoidance, responsibility, price competition and conflicts and arbitration. Cheung et al. (2001) reviewed literature from 1983 to 1994 (e.g. Franks, 1990; Hewitt, 1985; Masterman and Gameson, 1994; Skitmore and Mardsen, 1988; Chan et al, 2001). The results indicated that, there are a number of factors have been proposed by the aforementioned authors for use as procurement criteria this includes the following attributes: speed, certainty, flexibility, quality, complexity, risk allocation/avoidance, responsibility, price competition, project functionality, controllable variation and disputes and arbitration. Thomas et al. (2002) reported the findings of an Australian study focusing on PMSC to improve people understanding of the importance of using these criteria and objectiveness in the selection of PMs. This study identified ten PMSC, which are the same criteria as those identified by Love et al. (1998) with the exception of conflicts and arbitration criterion.

Thanh et al. (2003) also studied the PMSC in Australia. They surveyed a sample of construction projects in order to identify the criteria used for selection the method used for delivering these projects. The results identified 34 significant criteria in the procurement system, which were categorised into eight groups: external factors, client's long-term objectives, project's physical characteristics, client's short-term objectives, client's characteristics, client's involvement, risk allocation, building's aesthetics and complexity. Sing and Yusof (2006) identified 13 criteria for selecting PMs. These are scope definition, quick project delivery, quick project commencement, effective communication, flexibility in design, responsibility, complexity, risk transfer, reducing project time and cost, working relationship, effective planning and contractor experience. Hashim et al. (2006) surveyed the factors influencing the selection of PMs in the Malaysian construction industry and identified a simple set of seven criteria. Six of these criteria (quality level, price competition, responsibility, risk avoidance, controllable variation and cost certainty) confirmed the findings of Love et al. (1998), Cheung et al. (2001) and Thomas et al. (2002). The other criterion (time certainty) was not presented in the aforementioned studies. Chan (2007) also identified a set of ten PMSC which are almost the same of those identified by Cheung et al. (2001). It has been noticed in the above studies that a number of criteria were reported by multiple researchers, for use as procurement criteria such as speed of project completion, quality level, flexibility of changes, complexity, price certainty, time certainty, price competition, allocation of responsibility, risk avoidance, working relationship, project functionality, controllable variation and speed of commencement. That means these criteria are more important than others in the selection of PMs.

2.6 Project Performance

The subject of project performance measurement or assessment has become an important matter of concern in the CI for both developed and developing countries (Enshassi et al., 2009). Most of these countries try to do their best to improve and enhance the project specification to achieve a good PP. Traditionally, a project is considered to have achieved good performance if it has met its objectives in terms of time, cost and quality. These consider the major criteria to measure and evaluate the performance of projects (Bassioni et al., 2004). According to Asiedu (2009) "*Several countries at various levels of socio-economic development have recognized the need and importance of taking measures to improve the performance of their construction industry. One of the means to this end has been to ensure performance efficiency in construction project execution*". The author also indicated that assessing PP can be defined as how to determine through the performance measurement that on-going project is succeeding or failing to meet the objectives. Time, cost, and quality are still the prime project objectives, and they are considered to constitute the iron or eternal triangle (Chan et al., 2002).

2.6.1 Factors that influence PP

Even though PM selection and their use in project delivery are known to affect the performance of projects, there are a number of other factors reported in the literature as also responsible for PP impacts. It is worth reviewing these factors as well, as presented in the below

Asiedu, (2009) defined the factors that influence PP as the set of circumstances, facts or influences which contribute to the success or failure of a project. Enshassi et al., (2009) indicated that many factors influence PP, and that they have received significant attention from researchers because they play an important role in the success or failure of projects and in improving their performance outcomes.

In the last few decades a number of studies have been conducted to identify the factors influencing PP in developing countries. For instance, Lim and Mohmed (1999) identified six critical project factors that influence PP: corporate understanding of project management, poor contract management, organisational adaptability, project manager selection criteria, project manager's leadership style, and commitment to planning and control. Arditi and Gunaydin (1998) studied the factors affecting process quality in Indian construction projects. They found that management commitment to continuous quality improvement, leadership skills and experience, construction mistakes and defective work, efficient teamwork to promote quality issues at the corporate level, quality training of all personnel and effective cooperation between parties taking part in the project are the common factors that affect process quality in the three phases of a building project (design, construction, and operation).

Chua et al. (1999) have developed a hierarchical model for construction project success for different project objectives. In terms of quality objectives, they found that the performance of quality is influenced by four main project aspects: project characteristics, contractual arrangements, project participants, and interactive processes. Bubshait and Al-Atiq (1999) observed that, a contractor's quality assurance system, which ensures consistent quality, is essential in preventing problems and improving quality of the project. They also pointed out that the lack of documentation of a quality system for the contractors adversely effects quality performance.

Walker and Vince (2000) studied the factors that significantly affecting construction time performance (CTP) for multi-unit residential projects in Melbourne, Australia. They found that the CM team's effectiveness in managing the construction process has a major but not predominant role in influencing CTP. Team communication effectiveness and teamwork factors are also essential factors influencing CTP. Other factors found to affect CTP include the design team's management style, intra-team working relationships and the degree of contractor experience and expertise for the same type and size of project. Such factors as effective communication, working relationship and contractor experience mentioned above are considered the major features of DB project delivery, as it provides the ability to reduce project time and cost (Albert, 2000; Pinto and Slevin 1998; Seng and Yusof, 2006).

Chan and Kumaraswanmy (2002) presented the findings of a survey undertaken to determine the significance factors causing time overrun in Hong Kong construction projects. The results showed that, the factors affect duration of construction project were classified into four broad categories: (i) project scope, including construction cost, building type, contract system and variations; (ii) project complexity, including clients' attributes, site condition, site access problems, quality of design, and quality management; (iii) project environment, including physical, economic, political and industrial relations; and (iv) management attributes, including project client/design team management attributes, construction team management attributes, communication management for decision-making, organization structures and human resources management, and productivity.

Hanson et al. (2003) examined causes of client dissatisfaction in the South African building industry and found that conflict between project participants (client and contractor), poor workmanship and incompetence of contractors are among the top factors which would negatively impact project performance. Iyer and Jha (2004) presented the finding of the survey questionnaire conducted on factors effecting PP of Indian construction projects. The results revealed that, the main top factors affecting the performance of projects are: conflicts among project participants, ignorance and lack of knowledge of project manager, poor project-specific attributes and non-existence of cooperation between project parties and inappropriate contract type and payment method.

Faridi and El-Sayegh (2006) conducted a questionnaire survey with professional contractors and consultants in the UAE to find out the main factors influencing project performance. It was found that contractors and consultants were in agreement that shortage of skills of manpower, poor supervision and site management, conflicts between project parties, unsuitable leadership and shortage and breakdown of equipment are among the main factors that influence PP in the UAE, mainly because they contribute to construction delays. Alaghbari et al. (2007) presented the possible factors affecting time performance of Malaysian construction projects as those related to the responsibility of contractors such as, delay in delivery of materials to site, shortage of materials on site, construction mistakes and defective work and shortage of site labour; and those related to the client responsibility such as, slowness in making decision and lack of coordination with contractors.

Enshassi et al. (2009) conducted field survey with 120 participants comprising of clients, consultants and contractors in the Gaza Strip, Palestine, to investigate the factors that affect project performance. The findings indicate that, the top significant factors affecting performance of construction projects are: (i) delays because of closure leading to materials shortage; (ii) unavailability of resources as planned through project duration; (iii) low level of project leadership skills; (iv) unavailability of highly experienced and qualified personnel; and (v) poor quality of available equipment and raw materials (vi) inappropriate contract type and payment method. Olupolola et al. (2010) conducted a questionnaire survey with construction professionals such as architects, builders, engineers, project managers and quantity surveyors to assess the effects of the identified factors affecting project duration. They found 23 key factors as having a stronger influence on the time performance of building projects. These include delay in subcontractor works, ineffective planning and scheduling of project by contractor, delay delivery materials on the site, poor skills of the labourers, difficulty of project site and improper construction methods used by contractors.

Pola et al. (2014) conducted extensive literature review to find out the most significant factors that may bring about cost overruns in construction projects. 38 factors were investigated cause cost overruns. These factors categorized in 7 groups which are contract related factors, time related factors, communication related factor, quality related factors, risk related factor, human recourse and communication related factor

In light of the above, it can be concluded that different researchers have highlighted various factors affecting PP of building projects in the construction industry in numerous countries and assayed their relative importance; many of them are similar and could be attributed mainly to the project-related, client-related, contractor-related, consultant-related, project team related, communication and relationships and management related. Each one of them contributes to the delays in the projects, causing time overrun and consequently contributing to the cost overrun of and poor quality of construction projects.

2.6.2 Project Performance Evaluation (PPE)/ Measurement

Although theoretically it may appear simple, measuring the performance of any construction project in terms of success or failure is a very complex process, and it has been subject to a considerable amount of research attention over the past years (Polat et al., 2014; Iyer and Jh, 2005). In construction, project performance evaluation (PPE) or measurement is used as a methodical way of evaluating and judging PP by evaluating the inputs and outputs in construction activities and the final project outcomes; it also acts as a tool for continuous improvements (Zavadsks et al., 2014; Enshassi et al., 2009; Takim et al., 2003)

In recent decades, several researches and studies within the multidimensional construct of project performance have proposed different criteria or indicators for evaluating and measuring construction performance. In this regards, Williams et al. (2015), Cserhati and Szabo (2014) and Enshassi et al. (2009) studied the criteria of evaluating PP. They stated that PP can be evaluated and measured using a large number of performance indicators that could be related to various dimensions groups, such as time, cost, quality, health and safety, environment and others, but the 'iron triangle' of time, cost and quality are the three major performance evaluation dimensions for PP. Iyer and Jha (2005), Bassioni et al. (2004), Albert et al. (2002) and De wit (1988) confirmed that, construction projects are typically evaluated in terms of time, cost and quality. According to Bryde and Brown (2004), the traditional distinction between good and poor PP focus on the meeting of cost, time and quality. PP outcomes based on these criteria are the dependent variables as they have been normally used to assess PP. Polat et al. (2014) and Edmond et al. (2008) went further and identify five new criteria these include health and safety, profitability, communication, human resource and risks.

Konchar and Sanvido (1998) and Molenaar and Songer (1998) defined ten performance metrics to measure the performance of project procured by DBB method. These performance measures address the different facets of project success. The three main project objectives of cost, time and quality were covered, and include an element about client satisfaction. The performance metrics has been classified as follows:

- In terms of cost they include unit cost and cost growth.
- In terms of time they include construction speed, delivery speed and schedule growth.
- In terms of quality they include workmanship quality, material and equipment quality and system quality.

The performance metrics also included component about client's administrative burden and client satisfaction.

Cheung et al. (2004) developed a Web-based construction Project Performance Monitoring System (PPMS) that aims to assist project managers in exercising construction project control. Eight categories are used to evaluate and monitor project performance: cost, time, quality, safety and health, people, environment, client satisfaction, and communication. The use of the PPMS can aid senior project management (project directors, project managers etc) in monitoring and assessing project performance. Jin et al. (2007) studied the relationship-based factors that affect performance of general building projects in China. They identified eight performance metrics that may be used to measure PP. These metrics have been categorized into two groups, namely hard performance (HP) indicators such as cost, duration and quality performance; and soft performance (SP) indicators related to relationship-building, such as level of client satisfaction and incidence of litigation.

Asiedu (2009) concluded that the key performance measures comprise objective measures and subjective measures. The objective measures include: construction time, speed of construction, time variation, unit cost, accident rate and environmental impact, while the subjective measures include quality, functionality, end-user satisfaction, client satisfaction, design team satisfaction and construction team satisfaction. Shamas and Stephen (2010) surveyed the key performance indicators for measuring project PP for large construction projects in Thailand. The findings of the survey indicated that, the significant criteria for evaluating and measuring PP in perspective of client, contractor and consultant are time, cost and quality. However, the other criteria such as safety, client satisfaction and communication are less important.

According to the above study it can be noticed that measuring and evaluating projects were restricted to PP outcomes based on time, cost and quality criteria. Although PP can be measured and evaluated using a large number of performance indicators or criteria, time, cost and quality remain the three commonly preferred performance evaluation dimensions. The consideration of the additional criteria such as environmental, health and safety, innovation, client satisfaction and communication is as a result of the subjective nature by which project success is seen or measured by different project stakeholders.

The three most dominate criteria for measuring PP has been defined by many authors (Williams et al., 2015; Arti et al., 2013; Lai and Lam, 2010; Shamas and Stephen, 2010; Asiedu, 2009; Cheung et al., 2004 and Konchar, 1997) as following:

a) Cost performance:

It is defined as the degree to which the general conditions promote the completion of a project within the estimated budget. The cost is limited to the design and construction of the project. It can be measured by unit cost, cost growth and cost overrun.

1) Unit Cost can be measured by the formula below

Unit Cost = [Final project cost / Area] / Index

Where: Final cost is the final design and construction cost of the project whereas

A cost index is essential to make accurate comparisons of project built in different cities in different years

2) Cost Growth (%) can be defined by the formula below:

*Cost Growth (%) = [(Final project cost – Contract Project Cost) / Contract Project Cost] * 100*

Where*:* Final project cost is the Actual cost of the project:

Contract project cost is the design and construction project contract cost

b) Time performance:

It is defined as the degree by which the general conditions promote the completion of a project within the allocated duration. It can be measured by time overrun, construction time and speed of construction, delivery speed and schedule growth.

1) Construction Speed can be defined by the formula below:

Construction Speed = [Area / ((As Built construction End Date – As Built construction start Date)/30)]

2) Delivery Speed is the rate at which the construction team built the project. It can be defined by the formula below

Delivery Speed = [Area / (total time / 30)]

3) Schedule growth can be defined by the formula below

*Schedule Growth (%) = [(Total Time – Total As Planned Time) / Total As Planned Time] * 100*

Where:

Total time is the actual time of the design and construction of the project

As Planned time is the period from the as planned design date to the as planned construction end date

Quality performance:

The quality of the project in its simplest form can be defined as meeting the client's expectations or compliance with the client's specifications. It can be measured by conformity with expectations, overall client satisfaction, workmanship quality, contractor experience and skills of project staff.

2.6.3 Project Success

The study of the project success (PS) considers the most important aspects to improve the effectiveness of the project (Arti et al., 2013). PS is the ultimate goal for every project (Chan and Chan, 2004). According to Csehati and Szabo (2014) PS is a subject that is widely studied and discussed and yet hardly ever agreed upon. Chao and Hsiao (2012) indicated that "*Project success measurement should address not only the quantitative aspects of a project, namely time and cost, but also the aspects about functionality and other goals of the client, which are qualitative in essence and measured by the degree of satisfaction or attainment"*. The concept of PS has remained vaguely defined in the construction industry. On top of this, PS has been given different definitions in the literature. For instance, Frimpong et al. (2003) stated that "*project success can be defined as meeting goals and objectives as prescribed in the project plan*". On the other hand, Albert (2002) concluded that PS is defined as meeting users' requirements, meeting project budget and time and achieving project purpose. Chan et al. (2002) concluded that "*traditionally, a project is considered successful if the building is delivered at the right time, right price and good quality level. In addition, it should provide the client with a high level of satisfaction*".

According to Arti et al. (2013) project success can be defined as "*meeting the required expectation of the stakeholders and achieving its intended purpose. This can be attained by understanding what the end result would be and then stating the deliverables of the project*". Csehati and Szabo (2014) stated that project can be considered as successful as long as the outcome of the project is much better than expected in terms of time, cost, quality and safety. Al-Tmeemy et al. (2010) indicated that "*project success is a strategic management concept where project efforts must be aligned with both short and long-term goals of the company. They also observed that project success should be viewed from different perspectives of individuals and the goals related to a variety of elements, including technical, financial, education, social, and professional issues"* Bradley (2008), stated that project success is defined as organizational impact and project completion on time and under budget. He also indicated that the perception of successful construction projects mainly based on project participants, complexity of the project, the scope and size of the project, as well as the experience of the client relative to the design and construction work and their technological implications. Al-Tmeemy et al. (2010) argued that project success is a strategic management concept where project efforts must be aligned with both short and long-term goals of the company.

In the light of the above definitions it can be understood that a project can be classified as successful if it is meets the technical performance specification and mission to be performed as well as if there is high level of satisfaction concerning the outcome of the project between the project parties.

PS is the main target of all project parties. This success could be viewed from different perspectives depending on the goals related to a variety of elements, including technical, financial, education, social, and professional issues (Min et al., 2010). Min et al. (2010) indicated that PS can mean different things to different people involved in the project. This is because the requirements of each of them are different and therefore their perceptions of what constitutes success will vary (Min et al., 2010). For instance, Koelmans (2004) stated that:

> "*Client may consider success in terms of whether the project has accomplished its technical performance, maintained its schedule and completed within budgetary costs and quality. An architect and designer may consider success in terms of aesthetic appearance of the project, an engineer in terms of technical competence, a human resources manager in terms of employee satisfaction and so*" Koelmans (2004).

Csehati and Szabo (2014) also confirmed that the success criteria of the project parties usually changes from project to project based on the characterises of the project in terms of the scope, size, location, and the experience of the client. He also indicated that the criteria of measuring success differ between project parties as following:

- *Client criteria for project success are*: on schedule, on budget, good quality
- *Designer criteria for project success are***:** satisfied client, quality architectural product, met design fee and profit goal, professional staff fulfilment, met project budget and schedule, minimal construction problems
- *Contractor criteria for measuring success are*: meet schedule, profit, under budget, quality specification met or exceeded, no claim, client satisfaction

Adam and David (2004) conducted a survey of different industry project success. The results showed that, clients put more emphasis on satisfying the needs of the project users, while contractors lay emphasis more on minimizing project cost and duration. They also found that, all project stakeholders put owners’ satisfaction of the final product as their first criteria. Min et al. (2010) found out that, project managers consider success in terms of whether the project has met allocated budget, time and also has achieved the purpose of the project development.

Based on the above, it can be clearly appreciated that project success is judged from the perspectives of project parties (i.e. clients, contractors, consultants and others). However, the objectives or goals of all participants are not always the same, even within a single given project. Hence, to define the success or failure of a project without specifying the participants and the criteria for judging the performance holds no meaning. Success for one participant may be a failure for another, depending on the perspective with which each one is looking at the outcome. Budget, schedule and quality are the major goals in a construction project and they are considered the core criteria of PS.

2.7 The Influence of PMs on PP

According to Arti et al. (2013) project performance is highly influenced by the type of construction PMs used to deliver the project. By virtue of this relationship, project clients often seek to select the best method that will help achieve better PP. A number of studies and researches have been conducted in last few decades in order to investigate the influence of PMs on PP (Erikson and Westerberg, 2011). For instance, Skitmore and Marsden (1988) studied the effect of different procurement methods (DBB, DB and MC) on project cash flow. Historical data relating to the periodic cost of 150 construction projects were collected. In order to classify the projects, four criteria were identified: type of project, size, company and type of procurement. A series of simulation tests were conducted to evaluate the extent of variation in cash flow, given different contract conditions. Results showed that, in some cases, the variation in procurement routes has a significant effect on contract cash flows.

Kumaraswamy and Dissanayaka (1998) discussed the linkages between PMs and performance outcomes at the project level, which is the principal concern of clients. They compared the impacts of various procurement variables and non-procurement-related variables, such as project conditions and team characteristics, on PP in Hong Kong. In this regard, a model to link the PMs variables to project outcome was developed. The results showed that, cost and time overruns were not significantly influenced by the chosen intervening variables. Time over-runs appear to be greatly influenced by non-procurement related factors, however cost over-runs appear to be greatly influenced by both procurement and non-procurement related factors. Moreover, such observations led to the identification of particular needs to further probe the impacts of team performance levels, as well as of procurement sub-systems. This assessment of the other relationships in this planned model will help clients and their advisers to design more suitable procurement systems that should be geared to their certain project priorities.

Molenaar and Songer (1998) developed a model for predicting project performance in terms of (cost growth, schedule growth, administrative burden, conformance to expectations, and overall user satisfaction). 122 DB projects in US have been surveyed in order to find out the variable that influences the performance of the projects. Based on statically significant correlation and regression the results showed only 4 variable influences the performance of the projects and this included project definition, agency experience and staffing, contractor prequalification, and contractor selection method.

Bowen et al. (1999) studied the impact of the project briefing and procurement selection processes on the result level of client satisfaction with their building in South Africa. The results of a questionnaire survey of clients, architects, quantity surveyors, engineers, project managers and general contractors in a South African construction organization showed that, the clients do not always effectively communicate their requirements in terms of building function and performance, and they do not always know which PM to use. Moreover the negotiated contracts were generally thought to be the best procurement system in terms of satisfying the time, cost and quality objectives of clients.

Hashim (1999) studied the influence of PMs have on PP in Malaysia. A field survey comprising semi-structured interviews and questionnaires with clients and consultants were conducted. The results showed that private developers and investors prefer DB method because their emphasis is always on the early completion of the project and fast return on investment. Government organizations and agencies tend to choose the DBB method. Although the DBB method gives the client more control of the project design and cost, it has negative effect on time as it leads to longer project duration. Clients with greater experience in handling large and complex projects prefer the MC method. MC provides high managing, controlling and monitoring the design and construction phases which reflects positively on the performance of the project.

Love (2002) surveyed 161 construction projects in Australia in order to determine the impact of different project types and PMs on rework costs in construction projects. The results indicated that, contrary to the expectation, rework costs do not differ relative to project type or PM. Moreover, it was found that rework contributed to 52% of a project's cost growth, and 26% of the variance in cost growth was attributable to changes due to direct rework.

Ling et al. (2004) developed multivariate linear regression models for predicting a construction and delivery speed of DB and DBB projects. 87 building projects were surveyed in order to collect the research data. Data collected was analysed statistically using SPSS. The results presented a set of criteria that influence construction speed of these projects. For DBB projects, contractors' design ability, and adequacy of plant and equipment positively influences speedy completion of the projects. For DB the contractor experience, skills and financial ability as well as, health and safety and the project management are the main factors that positively influence project speed completion.

Abdul Rashid et al. (2006) discussed the effect of different procurement systems, including DBB, DB, MC and CM on PP in Malaysia. It was found that various PMs were widely used in the construction industry and that contractors are always trying to meet clients' needs. It is very important at the beginning of a project to carefully consider all factors when selecting the most appropriate PM. This is because the different PMs have different effects on PP in terms of cost, time and quality. For instance, DBB method usually provides an opportunity for clear accountability and better design and control by the clients, as well as offering more time to client and project team to review designs before construction stage. All these opportunities can positively influence PP in terms of time, cost and quality and subsequently contributes to the PS. On the other hand, DB method provides an opportunity for project construction to start early by, for instance, allowing for overlap of design and construction works. Under the DB approach, the contractor is able to to utilize his knowledge and experience to develop a more compact and coherent work. These aspects reflect positively on PP. In CM method the experience and knowledge of construction manager to manage and control the project renders them more capable and effective in guaranteeing high quality and reducing time and cost overruns.

El-Wardani (2006) examined the potential correlation/relationships between the PMs of DB teams and PP in the US. Research data was collected through 351 projects delivered under a DB delivery method for public and private owners. Three steps were used to achieve the project objectives, including a survey of DB projects to gather data on methods for procuring DB teams; determining the correlation between the owner's selected PMs for the DB team and the PP metrics; and recommendations were developed based on the identified trends and patterns, to guide clients during the DB procurement method selection decision. The results showed a significant correlation between DB procurement team and PP. This correlation has a positive effect on PP by way of reducing the cost and time of the projects.

Seng and Yusof (2006) surveyed 75 clients and contractors of the private and public construction organizations in Malaysia, in order to explore the effectiveness of the DB procurement on the projects. The results showed that, the characteristics of DB make it different from other PMs due to the advantages of offering single-point responsibility, fixed time and money, communication and risk allocation. Proper exploitation of these characteristics positively influences PP and subsequently leads to the success project. For instance in terms of cost it was found DB method has effect on cost saving of the projects. The most significant cost saving is made through the reduction of the overall development period. In terms of time and quality the overlapping of design and construction works leading to the completion of the project within a shorter amount of time and allows the contractor to be innovative to further improve the construction process and techniques, thus allowing for better work and process quality.

Eriksson and Westerberg (2011) developed a testable procurement model that on the general level proposes that collaborative procurement procedures influence project outcomes in a positive way. The purpose of the study was to increase the understanding of how various procurement procedures affect different aspects of PP and simplify project goals. Based on a comprehensive literature review, it was found that, cooperative procurement procedures such as joint specification, selected tendering, soft parameters in bid evaluation, joint subcontractor selection, incentive-based payment, collaborative tools and contractor self-control generally have a positive influence on project performance (e.g. cost, time, quality, environmental impact, work environment and innovation).

Chao and Hsiao (2012) used fuzzy model to predicating PP through different PMs. Field survey covers a sample of 96 projects delivering by DBB and DB method were used to test the data for model development. 48 input variables identified as independent variables. Multiple regression analysis and factor analysis were adopted to establish the relationships between influencing independent variables and PP measurements. The results showed that out of 48 independent variable only nine variable influence the performance of the projects.

2. 8 Research Gap

Based on the literature review conducted on PMs and PP, the author acknowledge that there is a substantial research and studies carried out that address a number of different construction procurement issues. The focus of these studies and researches has tended to mainly concentrated on four areas of procurement, namely: the characteristics and features of existing PMs; the importance of using the right PM for project delivery; selecting such methods based on PMSC and the influence of this on PP. All these offered important and valuable information needed to address the objectives of this research.

However, little research has been considered regarding the influence that PMSC wields on PP, and which of PMSC has the most influence on PP criteria. The literature also indicated that, there is currently no systematic and no realistic approach applied or used to determine the influence that PMSC have on PP, although many studies have demonstrated the importance of using procurement method selection criteria to choose the most appropriate project delivery method (see Section 1.2). Such approach will be of invaluable benefit to clients, such as helping them to understand the aspects of PMSC they need to focus on in PM selection if they are to ensure improved PP. Considering this inadequacy, this study attempts to examine the influence of PMSC for DBB and DB methods on the PP in Libya. Therefore, this study seeks to develop an in-depth knowledge on which PMSC need to be given the most focus when deciding on the best PM that would yield project success, which is an important information that would highly benefit clients, stakeholder of public and private companies as well as the academic researchers in the field of construction procurement.

2. 9 Summary

This chapter identifies the concepts, principles, theories and practices first within the area of study (procurement methods), then brings across examples of different studies on PMs from different countries in order to give general view on this area. The chapter reviews the existing literatures on PMs and PP to confirm both the gap in literature and the need of this research study. The reviews were undertaken were limited to relevant issues such as the selection of PMs and their suitability criteria, comparing different PMs, the criteria for measuring and evaluating PP, and the influence of the different PMs on PP. The findings of the review offered important and valuable information about these procurement issues. The most popular and common PMs currently in use are DBB, DB and CM methods respectively. They differ from each other in terms of activities sequencing, procedures and processes which means that no single method of procurement can be suitable for every project.

The main types of contract strategy associated with these PMs are: unit price/bill of quantity, lump sum and cost-plus contract. The most significant criteria used for selecting the most appropriate PMs are quick project delivery, quality level, flexibility of changes, complexity of design, cost certainty, time certainty, price competition, responsibility, risk avoidance, working relationship, speed of commencement, functionality and controllable variation. However, the most common and preferable criteria for measuring and evaluating PP are the 'iron triangle' of time, cost and quality.

The findings of the literature review also highlight a number of studies relating to: the development of tools/models to aid clients in their selections of appropriate PMs; and the selection criteria relied on by these tools. However, such attempts contain very little on studies that have looked into how the perceived suitable PMs selected actually do impact on PP. As a result, investigating this relationship was considered to have the potential of making essential addition to the body of literature of the subject of construction procurement. Furthermore, the findings of such investigation would not only help to confirm (or otherwise) the long-held notion that suitably-selected PM leads to successful PP, but would also offer some decision-making aids (by way of modelling of this relationship) that would enable clients to know and rely on the most significant PMSC when selecting PM, if they are to ensure successful PP. In general, the findings from review of the literature did help to, firstly, discover the research gap existing in the area of construction procurement methods; secondly, they serve as the basis for developing, among others, a conceptual framework that underpins the theoretical basis for investigating the relationship between PMSC and PP. Thirdly, they formed the main basis of the subsequent primary data collection stage via field surveys.

The next chapter explains the steps followed in developing the conceptual framework that seeks to reinforce the theoretical relationship that exist between suitably-selected PM (based on PMSC) and PP outcomes of time, cost and quality.

CHAPTER 3: CONCEPTUAL FRAMEWORK OF PMSC INFLUENCE ON PP

3.1 Introduction

The key premise underlying this study is the notion, commonly espoused in literature, that an appropriate PM rightly chosen for a given project delivery leads to a successful project outcomes. Put differently, the level of performance expected of any project is influenced by the extent to which the PM used was suitable for the project in question (Eriksson and Westerberg, 2011; Mahon, 2011). With this in mind, clients are increasingly making use of rational decision-making approach to select PMs based on suitable selection criteria (Jin et al., 2015; Eyitope et al, 2012; Love et al., 2008; Rwelamila and Edries, 2007; Mohsini and Davidson, 1991). The suitability of a given PM for a particular project as determined by such approach (see for example, Jin et al., 2015; Alhazmi and McCaffer, 2000; Chan, 2007) are often established by the extent to which the selection criteria favour or best suit the characteristics and requirements of the project in question (Xia et al., 2012; Chan et al., 2001; Luu and Chan, 2005). In order words, using a particular PM that best satisfies all the criteria that ensure its optimum use for a given project will result in successful PP, and vice versa.

A relationship thus exists between the way a particular PM was selected and the performance outcomes of the project it was used for. Investigating this relationship in more detail would thus provide vital insights into PM selection such as having a better understanding of how selection criteria actually contribute to PP, and which of them make significant contribution and therefore deserve more attention during the selection process. As an initial step towards critically exploring this relationship, this chapter presents a conceptual framework that sheds light on the theoretical basis of the perceived link. The framework was developed based on extensive review of literature on both the criteria for selecting PMs and for measuring PP. The rest of the chapter is organised as follows. In the following section, a review of construction procurement selection and the criteria used for selecting of suitable PMs are presented, followed by the conceptual framework of the influence of PMSC on PP and a detailed review of this link. The final section is a summary of the chapter.

3.2 Construction PM Selection Process

As highlighted in section 2.3, the numerous PMs available, coupled with their individual unique features, have made clients' decisions to choose the appropriate method for any given project a complex task to grapple with. Such challenge has largely resulted in the need to conduct a selection process in a disciplined and systematic manner. Various factors have to be taken into consideration before any informed decision can be made on the right choice of PM. The factors can be classified into three groups (Luu and Chen, 2005; El-Hassia, 2005; Love et al., 1998), as presented in Figure 3.1 (Ratnasabapathy et al., 2006). The figure shows how the factors relate and interrelate with each other, which explain how the task involved in selecting the right PM can be extremely complex and difficult to unravel.

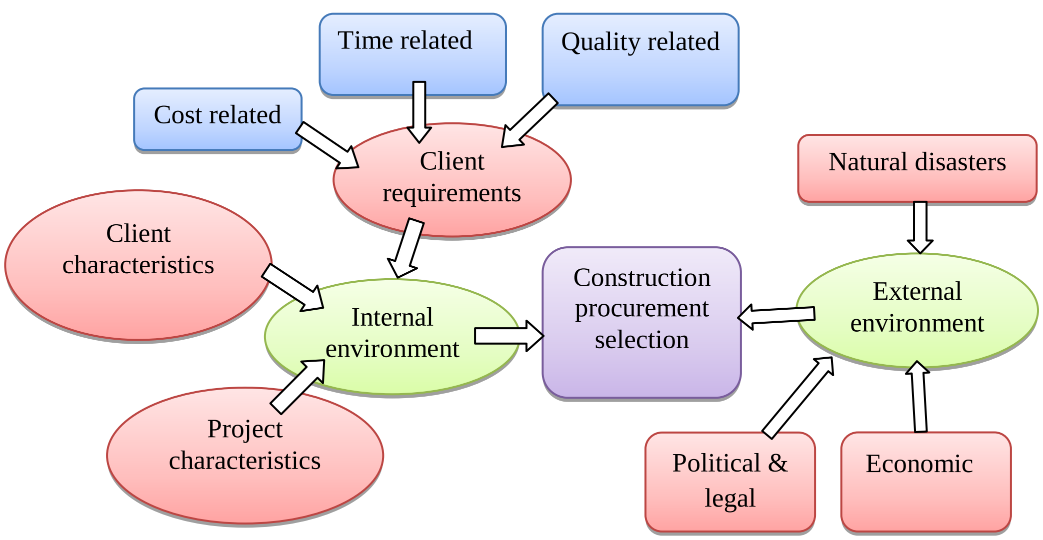

Figure 3.1: Factors affecting selection of PM

Source: Ratnasabapathy et al. (2006)

Choosing an appropriate PM entails first identifying the right selection criteria, which are informed by these factors, and then assessing their level of compatibility with the features or characteristics of the project to be delivered (Love et al., 1998; Rwelamila and Edries, 2007). According to Love et al. (2008), the selection process can be narrowed down into two main components: (i) analysing and establishing priorities for project objectives and client attitudes to risk; and (ii) considering possible options, evaluating them and finally selecting the most appropriate. The accuracy and clarity of the client's requirements and needs are crucial ingredients here (see section 2.3). Hence, selecting a PM involves a key set of decisions, which must not only be planned for, but should also require the participation of high-level decision makers. The nature of the selection process therefore calls for employment of sound systematic procedure by clients, which involves relying on a number existing PM selection techniques/models (Alkhalil, 2002; Chan, 2007; Chan et al., 2001) to arrive at the best PM that meets the needs for the particular project (Ali et al., 2011).

Since there are a wide range of factors that could count as criteria for selecting a PM, it was deemed appropriate for this study to identify the most common criteria commonly reported in the literature from past research studies, through an extensive literature review. A critical review of the literature suggests a total of 23 PMSC are commonly cited (see Table 3.1 and Table 3.2). The criteria have been classified into 2 groups: those which are suitable for selecting DBB method (Table 3.1); and those suitable for selecting DB method (Table 3.2). However, a few of the criteria were found suitable for both procurement methods, which are: “complexity of design” and “desiring efficient project planning”. Many of the past studies, including those listed in these tables, have highlighted the importance of relying on these criteria to rightly select the most appropriate PM, if increased satisfaction with PP is to be ensured.

Table 3.1: Criteria for selecting DBB procurement method

DBB procurement criteria / Authors	High Price competition	Clarity of scope definition	Complexity of design	High Quality level required	Clear definition of project parties' responsibility	Client involvement in the project	Controllable project variation	Cost certainty	Time certainty	Ease to organizing and reviewing project activities	Desiring efficient project planning	Project functionality
Ratnasabapathy et al., 2006	✓		✓		✓			✓			✓	✓
Hashim et al., 2006	✓		✓	✓	✓		✓	✓				
Seng & Yusof , 2006		✓										
Alkhalil, 2002			✓			✓	✓				✓	
Cheung et al., 2001	✓			✓		✓	✓	✓	✓			
Luu et al., 2005						✓			✓			
Love et al., 1998			✓	✓					✓			
Love, 2002								✓				
Love et al., 2008								✓	✓			
Masterman & Gameson, 2010												✓
Hibberd & Djebarni, 2010										✓		
Chan et al., 2001	✓		✓		✓			✓				
Alhazmi & McCaffer, 2000												
Chan, 2007	✓		✓	✓				✓	✓			
Abdul Rashid et al., 2006	✓			✓			✓	✓		✓		✓
Eriksson & Westerberg, 2012	✓											

DBB procurement criteria / Authors	High Price competition	Clarity of scope definition	Complexity of design	High Quality level required	Clear definition of project parties' responsibility	Client involvement in the project	Controllable project variation	Cost certainty	Time certainty	Ease to organizing and reviewing project activities	Desiring efficient project planning	Project functionality
Tooky et al., 2001	✓		✓					✓	✓			✓
Thomas et al., 2002	✓		✓									
Park, 2009	✓											
Natkin, 1994				✓								
Molenar & Songer, 1998		✓										
Lim & Ling, 2002						✓						
Songer & Molenar, 1997		✓								✓		
Morledge et al., 2006								✓				
ConstructionExcellence, 2004			✓					✓				✓
Gehrig, 2009	✓											
Mahi & Alreshaid, 2005										✓		
Asley, 1994											✓	
Pinto & Slevin, 1998											✓	
Total	**11**	**3**	**9**	**6**	**3**	**4**	**4**	**11**	**6**	**4**	**4**	**5**

Table 3.2: Criteria for selecting DB procurement method

DB procurement criteria / Authors	Quick delivery of construction process	Quick project commencement	Effective communication between project parties	Flexibility in design & construction changes	Single point of responsibility	Less conflicts amongst project parties	Complexity of design	Transfer of risks to the contractor	Desiring reduced project cost	Desiring reduced project time	Level of competence & experienced contractor	working relationship between project	Desiring efficient project plan
Hashimet al., 2006								✓	✓	✓			
Seng & Yusof, 2006	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Al Khalil, 2002					✓								
Cheung et al., 2001	✓				✓			✓					
Edmond et al., 2008													
Chan et al., 2001					✓		✓	✓			✓		
Alhazmi & McCaffer, 2000													
Abdul Rashid et al., 2006					✓								
Mohsini & Davidson, 1991			✓										
Pramen et al., 2012	✓	✓					✓				✓		
Adnan et al., 2012	✓				✓		✓				✓		
Natkin, 1994			✓			✓							
Park et al., 2009			✓			✓	✓						
Gould, 2005			✓										
Lee, 2006						✓	✓						
Mante et al., 2012						✓							
Ola et al., 2006								✓					
Koncher & Sanvido, 1998							✓						
Ndekkugri & Turner, 1994						✓							

DB procurement criteria / Authors	Quick delivery of construction process	Quick project commencem ent	Effective communicat ion between project parties	Flexibility in design & construction changes	Single point of responsibilit y	Less conflicts amongst project parties	Complexity of design	Transfer of risks to the contractor	Desiring reduced project cost	Desiring reduced project time	Level of competence & experienced contractor	working relationship between project	Desiring efficient project plan
Palaneeswaran & Kumaraswamy, 2000				✓	✓	✓			✓	✓			
Songer & Molenar, 1997							✓						
Kamal & Hindle, 2000							✓						
Turina et al., 2008			✓	✓					✓			✓	
Albert, 2000									✓	✓		✓	
Tooky et al., 2001					✓				✓				
Parkins, 2009				✓					✓	✓			
Darren et al. 2009													
Eriksson & Westerberg, 2011									✓				
Mahdi & Alreshaid, 2005													
Thomas et al., 2002	✓			✓									
Skimore & Marsden, 1988	✓				✓			✓					
Eriksson & Westerberg, 2012		✓							✓	✓			
Murdoch & Hugh, 2008		✓											
Shapiro, 2013		✓			✓				✓	✓			
Pinto & Slevin, 1998			✓								✓		
Songer & Molenaar, 2011									✓	✓			
Molenaar & Songer, 1998									✓				
Ness, 2012						✓							
Liv, 2011			✓							✓			

DB procurement criteria / Authors	Quick delivery of construction process	Quick project commencement	Effective communication between project parties	Flexibility in design & construction changes	Single point of responsibility	Less conflicts amongst project parties	Complexity of design	Transfer of risks to the contractor	Desiring reduced project cost	Desiring reduced project time	Level of competence & experienced contractor	working relationship between project	Desiring efficient project plan
Guld, 2005			✓										
Albert, 2000	✓				✓								
Gehrig, 2009					✓	✓				✓			
Terril, 1998					✓			✓					
Ola et al., 2006								✓					
ConstructionExcellence, 2004				✓				✓					
Gibson & Walewski, 2001		✓											
Total	**7**	**6**	**9**	**6**	**13**	**9**	**9**	**9**	**12**	**10**	**5**	**3**	**1**

3. 3 PMSC and their relationship with PP

Following the identification of the most commented upon PMSC in the literature, the next section focuses on a review of what each of these selection criteria (for both DBB and DB) entails in terms of their relationship with PP. The aim of this review is to support the conceptual framework that follows in Section 3.4 with the theoretical basis underpinning the posited relationship between PMSC and PP. This review also aims to identify the variables that were used to operatioinalise or conceptualise these criteria, for purposes of using them in the subsequent empirical investigations of this relationship base on how past DBB and DB projects were procured in the LCI, including the considerations given to the suitability of the procurement strategies.

3. 3.1 DBB selection criteria

- **High price competition**

This criterion relates to the extent to which a procurement method allows for a project to be procured under a competitive price that gives value for money to the client (Park et al., 2009; Tooky et al., 2001). The usual approach to ensuring this is often based on the contractor selection method used (i.e. the type of tendering process). Irrespective of the type of procurement, contractor selection may be based on open tendering, selective tendering or negotiation tendering process (Eriksson and Westerberg, 2011). The first two approaches are competitive in nature and appear to be the most popular due to reasons of public accountability and the high familiarity of the approach among clients (Thomas et al., 2002). For public sector clients, open bid invitation is the most popular, in which all contractors are welcome to submit bids (Eriksson and Westerberg, 2011). However, private sector clients tend to invite limited number of contractors or negotiate with a single selected contractor (Eriksson and Westerberg, 2011; Lam et al., 2001).

The main purpose of competitive tendering is to enhance price competition so as to increase the client's chance to attain lower project price, as price quotation tends to be the defining criterion used in selecting contractors (Brook, 2004, p.88). This option tends to be more popular with DBB procurement method, whereas negotiated types tend to be used for non-traditional methods such as DB (Abdul Rashid et al., 2006; Love, 2002). According to Tooky et al. (2001) and Thomas et al. (2001), the DBB method provides the most competitive price to clients, and thus enables them to select the best price for their projects, which contributes positively to cost performance outcome. In this procurement approach, clients with their consultants perform detailed design before contractors are procured, making it amenable to competitive bidding (Abdul Rashid et al., 2006; Eriksson and Westerberg 2012). This criterion therefore forms one of the important factors that clients often consider when contemplating the suitability of using DBB.

Therefore, we hypothesis that:
H1. High price competition has a positive effect on the performance of the project.

- **Clarity of scope definition**

A scope of work describes the work to be done or the services to be provided. It demonstrates and clarifies the project tasks, goals, materials, specification, methodologies to be used, costs and the duration of project construction (Cruzbuy, 2013). The scope of work may also define how the job is to be accomplished. Ambiguous scope of work can lead to unsatisfactory performance and overrun in terms of time and cost (Cruzbuy, 2013). For any project, the scope of work "must cover the following points: (i) what needs to be done (ii) Who will do what (iii) When it should be done (iv) Where it should be done (v) How contract performance will be judged" (Cruzbuy, 2013).

A well-defined scope contributes to project success (Molenaar and Songer, 1998). The most common measure of determining the extent of scope definition of any project is the amount or percent of design completed prior to the tendering phase (Songer and Molenaar, 1997). For the case of DBB method, clients are able to work closely together with theirs consultants to prepare contract documents such as drawing, bill of quantities, detailed design and specification before starting construction (Songer and Molenar, 1997; Seng and Yusof, 2006), which offer an opportunity for clients to review these documents and clearly define the scope of work properly before construction commences. Such documentation and clarity subsequently enable contractors to prepare a more accurate tender, which is an important factor that contributes to successful project performance. As projects with clearly-defined scope favours DBB method, this criterion remains an important factor that is considered in the selection of this method.

Therefore, we hypothesis that:
H2. Clarity of scope definition has a positive effect on the performance of the project

- **High quality level required**

To achieve high quality level in projects requires dealing appropriately with three main requirements: quality of materials, workmanship and design concept (Thomas et al., 2002). These requirements are often expressed in terms of technical specification, function, and appearance (Love et al., 1998; Thomas et al., 2002). Accurate attention should be given to these requirements during construction processes because they play important role in achieving high quality level of the project (Perkins, 2009). This criterion was thus operationalized in terms of quality of workmanship, suitability of the finished project to users and the clients' satisfaction with the final project quality. According to Abdul Rashid et al. (2006), DBB method is capable of rendering projects of high quality standard, making this criterion an essential factor in the selection of DBB. Not surprisingly, many studies (including for example, Francom et al., 2014; Love et al., 2012 and Perkins, 2009) have indicated that for projects procured by DBB method there is a significant relationship between this criterion (quality level required) and PP. This relationship is understandable if one examines one of the key settings under which DBB method operates. For instance, as a result of the segregation between design and construction works in DBB method, clients and consultants are able to spend adequate time to review and fully develop the design and specification of the project (Abdul Rashid et al., 2006). Such efforts have the high potential of allowing them to properly prepare contract documentations in terms of drawing, design, materials and specification to ensure these reflect adequately on the required level of project quality and appearance desired.

Therefore, we hypothesis that:
H4. High quality level required has a positive effect on the performance of the project.

- **Clear definition of project parties' responsibilities**

The responsibilities of project parties (client, contractor and consultants) are directly related to the degree of their involvement in the project delivery (Alkhalil, 2002). The accuracy and clarity of the parties' responsibilities positively contributes to project success (Chan et al., 2001). Important to ensuring this is that each party must be made aware of their clear roles and responsibilities, with no overlap in responsibilities between the parties, which is a recipe for confusing and may subsequently affect PP negatively. For DBB the dichotomy in the design and construction works facilitates clear delineation between the parties responsibilities, making this criterion one of the important factors considered in the

DBB selection (Thomas et al., 2002). For instance, the client usually engages different architects or engineers and other consultants to take responsibility of the design and supervision of works from the pre-tender stage until the completion stage, and will hold the contractor responsible for carrying out the construction work (Hashim, 2006).

Therefore, we hypothesis that:
H5. Clear definition of project parties' responsibilities has a positive effect on the performance of the project.

- **Client involvement in the project**

Client involvement benefits project delivery in many ways, notable of which is the fact that it creates the opportunity for clients to work in harmony with other project team members, which facilitates, among others, smooth communication flow between all members of the project teams (Kometa et al., 1995; Chinyio et al., 1998; Lim and Ling, 2002). This inhibits errors/omissions in documents, delays in information requests, poor coordination of various aspects of the work, rework etc and hence contributes to improved project performance (Josephson and Hammarlund, 1999). The project client's involvement could take different forms as determined by the contract terms and conditions, client experience and availability of the resources, and these in turn inform the appropriate procurement arrangement to use. For example, clients lacking experience and capability tend to prefer minimal involvement (Ameyaw, 2009; Cherns and Bryant, 1984; Lim and Ling, 2002). This selection criterion was operationalized based on the degree to which the client would have to be consulted or kept informed to facilitate smooth delivery of the project.

According to Al Khalil (2002), to ensure that DBB project meets requirements, a high level of client involvement is necessary. This criterion is thus an important factor in selecting DBB. Under this method, the client has much control over the project, which could benefit the project and potentially lead to enhanced performance. For instance, strategic decisions made during the early stages of projects by the client are helpful in addressing any risks early on time, rather than later in the course of the project where they are likely to be expensive and difficult to deal with (Cheng and Proverbs, 2004; Kometa et al., 1995).

Therefore, we hypothesis that:
H6. Client involvement in the project has a positive effect on the performance of the project.

- **Controllable project variations**

Variations are one of the major common features of construction contracts that affect negatively the performance of projects (Ibbs, 1997, 2003). According to Turner (1990), variation often occurs during construction stage and is caused by insufficient or incorrect contract information. Variations or (changes) in project scope or specifications lead to increase project cost and time (Hashim, 2006). From clients' point of view, variation can be classified on the basis of its foreseeability prior to commencing construction as controllable (e.g., design errors), and uncontrollable (e.g. differing site conditions, change requests from user groups) (Perkins, 2009).

Controllable variation can thus be defined as the extent to which changes to project, can be reduced and controlled at the preconstruction phase (Hashim, 2006 and Abdul Rashid et al., 2006). This selection criterion was operationalized as the extent to which changes experienced in the DBB projects were foreseeable at the preconstruction phase. This criterion is an important factor considered when selecting DBB strategy, since in this method, the project designs, drawings and specifications tend to be fully prepared before tendering processes. This gives an opportunity to the client and consultant to review all these documents properly and therefore more likely to control or kept variations to a minimum (Hashim, 2006).

Therefore, we hypothesis that:
H7. Controllable project variation has a positive effect on the performance of the project.

- **Cost certainty**

The desire for clients to know the final project cost in advance is a very important consideration (Thomas et al., 2001; Thomas et al., 2002; Skitmore and Marsden, 1988) as this allows them to anticipate and prepare for the cost expected to be incurred, and hence the right plan to put in place for any eventualities (Chan, 2007; Love et al., 1998).This criterion represents the extent to which clear and reasonable project costs were stipulated and agreed between the client and the contractor at the contract award stage. Most DBB projects are often procured on competitive tendering basis (Love, 2002), which allows this procurement method to offer price certainty to clients than DB or other methods are capable of. Also, under competitive bidding, the contractor tenders for the work on the basis of full project documentation (e.g. bill of quantities), thus ensuring certainty of price.

To a client with overriding concerns over price, such certainty would be a considerable feature, and therefore making this criterion a key driver in its DBB selection (Love, 2002; Thomas et al., 2002; Ratnasabapathy et al., 2006). In DBB method, the expected cost of projects tend to be known after bid competition and before the contractor commences work, enabling clients to have some certainty with the project cost.

Therefore, we hypothesis that:
H8. Cost certainty has a positive effect on the performance of the project.

- **Time certainty**

The certainty of knowing project duration in advance offers priceless information for the client, not least of which is relying on it for proper planning and prudent use of resources to avoid time and cost overruns (Xiao and Proverbs, 2003). This criterion represents the degree of certainty with which a project will be completed by its contractual completion date as agreed by the client and contractor (Construction Excellence, 2004; Love et al., 1998; Thomas et al., 2002; Tooky et al., 2001). Therefore, it was thus operationalized as the extent to which clear and reasonable project time duration were stipulated and agreed between the client and the contractor at the contract award stage. A well-known feature of DBB projects is that they are often delivered on competitive tendering on the basis of project information that are more or less complete (Love, 2002), which is useful in offering clients with some certainty about the project time duration. This criterion is thus often considered when selecting the DBB method of procurement (Chan, 2007; Cheung et al., 2001; Tooky et al., 2001).

Therefore, we hypothesis that:
H9. Time certainty has a positive effect on the performance of the project.

- **Ease of organising and reviewing project activities**

This criterion represents an important component of project management process, specifically as a key element of construction planning function (Gidado, 2004; Winch and Kelsey, 2005). This aspect of planning is supported or facilitated by existing procurement methods to different degrees in commensuration to the different project arrangement and settings they engender (Chan et al., 2001; Winch and Kelsey, 2005; Seng and Yusof, 2006). Such settings include, time available for planning, terms of contract, degree of uncertainty and complexity of project and availability of planning information (Faniran et al., 1994, Winch and Kelsey, 2005). This criterion can be defined as the ease with which the project works could be broken into manageable units of activities to help facilitate their adequate planning and effective monitoring/controlling of their execution (Mahdi and Alreshaid, 2005). According to Abdul Rashid et al. (2006), DBB method provides more accessibility for clients and consultants to review design and management of the project. Also, for DBB method, design, specifications and bill of quantities of the project are developed early on prior to construction work, enabling the client and contractor to discover and address any errors in the detailed design, planning, contract specifications and resources before construction work commences (Mahdi and Alreshaid, 2005). By virtue of these characteristics, this criterion constitutes an important factor considered in selecting DBB project delivery.

Therefore, we hypothesis that:
H10. Ease of organising and reviewing project activities has a positive effect on the performance of the project

- **Project functionality**

Functionality of project is one of the main criteria that clients tend to use for selecting DBB procurement method (Ratnasabapathy et al., 2006). According to Albert et al. (2002), functionality can be defined as "the degree of conformance of the completed project to all technical performance specifications". This criterion was thus operationalized as the extent to which the functional requirements of projects were clearly defined before construction commence. According to Abdul Rashid et al. (2006) and Tooky et al. (2001), the DBB method ensures high degree of project functionality. This is because the functionality of DBB projects tends to be well-defined before commencement of construction work. This criterion is therefore often considered when selecting DBB method.

Therefore, we hypothesis that:
H12. Project functionality has a positive effect on the performance of the project.

3.3.2 DB selection criteria

- **Quick delivery of construction process**

This refers to the need to complete a project faster than other projects of similar nature and circumstances. Delays usually contribute to huge risk impacts to all parties involved in the project execution. One of the most common project demands from clients is to fast-track the project delivery process through overlapping the design and construction processes in order to avoid any delays (Bogus et al., 2005). This criterion can thus be defined as the speeding-up of the construction process needed to enable completion of the project within client's desired planned project duration time or before (Albert, 2000; Chan, 2001; Seng and Yusof, 2006; Thomas et al., 2002). This criterion has been confirmed by many authors as being a significant factor for selecting DB method (Rowlinson and McDermott, 1999; Skitmore and Marsden, 1988). Holt et al. (1998) also concluded that DB procurement method is often used when there is pressure for early completion of the project. One of the main reasons is, of course, the fact that DB involves only one single procurement phase for carrying out design and construction work, which in itself creates substantial time savings for projects.

Therefore, we hypothesis that:
H13. Quick delivery of construction process has a positive effect on the performance of the project.

- **Quick project commencement**

In some circumstances, clients prefer projects to start early for obvious economic, business or political reasons. This can be achieved by relying on DB procurement method, as this approach allows for construction to start before the design is completed, which increases the possibility of achieving good performance in terms of time (Edmond et al., 2008; Love et al., 1998). Quick project commencement is thus one of the defining features of DB project delivery and it has always been a key reason for selecting DB method (Song and Yusof, 2006). This criterion therefore represents the extent to which the actual construction work can commence whilst the designs and specifications are still developing and incomplete (Eriksson and Westerberg, 2011; Gibson and Walewski, 2001; Molenaar and Songer, 1998; Seng and Yusof, 2006). It was thus operationalized based on the extent to which the client preferred early commencement of the project.

Therefore, we hypothesis that:
H14. Quick project commencement has a positive effect on the performance of the project.

- **Effective communication between project parties**

Effective cooperation and communication amongst project parties contribute positively to project success, and thus considered as one of the major criteria for selecting DB method (Mohsini and Davidson 1991; Seng and Yusof, 2006). It plays a crucial role in ensuring good PP (Love, 2008). This criterion was operationalized on the basis of the extent to which project parties (client, contractor and consultant) are able to communicate effectively during the design and construction stages of the project (Edmond et al., 2008; Mohsini and Davidson 1991; Seng and Yusof, 2006). Using DB procurement method to deliver projects enables the design and construction processes to overlap, which facilitates communication between client and contractor, through for example, direct and close interrelationships engendered by the project delivery settings of this PM (Gould, 2005; Pinto and Slevin, 1998). Conversely, the DBB method of procurement is well known to inhibit communication, coordination and integration among project parties by virtue of the separate design and construction roles.

Therefore, we hypothesis that:
H15. Effective communication between project parties has a positive effect on the performance of the project.

- **Flexibility in design and construction changes**

Flexibility in design and construction changes is particularly necessary for large and complex projects wherein their exact requirements are often difficult to establish before tendering (Thomas et al., 2002). This criterion represents the ability to accommodate changes during both design and construction stages. Changes (or variations) are amongst the main factors that negatively impact on PP (Hanna et al., 1999; Ratnasabapathy et al., 2006). The extent of the impact is a function of how flexible the changes could be effected or accommodated, which mainly depends on stage of the project, size and complexity of the project (Thomas et al., 2002). For instance, changes implemented during construction periods are often more costly than those executed during design stages (Perkins, 2009). As DB method integrates design and construction phases with no clear separation between them, it tends to offer more flexibility to changes than DBB (Thomas et al., 2002). Not surprisingly, studies (e.g. Perkins, 2009) have established that DB results in successful performance with relatively less impacts from changes compared to DBB.

Therefore, we hypothesis that:

H16. Flexibility in design and construction changes has a positive effect on the performance of the project.

- **Single point of responsibility**

This criterion has great effect on PP (Seng and Yousf, 2006), and is considered a significant determinant of DB selection (Adnan et al., 2012). It is also a characteristic feature of the DB method, as it allows the project to be carried out without any mediating consultants, leaving the main contractual relationship as being between the client and the contractor (Abdul Rashid et al., 2006; Chan et al., 2001; Cheung et al., 2001; Seng and Yusof, 2006). This criterion thus represents the extent to which a single organization is able to assume the required responsibility of both project design and construction duties. According to Gehrig (2009), an important driving force behind this criterion in DB selection lies in the fact that the overall project delivery responsibility rests with a single organisation, which avoids the inconveniences clients tend to suffer for being in contract with many organisations. By virtue of such arrangement, clients are able to not only draft contracts that guarantee performance from contractor, but to also resolve disputes relatively easier than would otherwise have been the case when many parties are involved (Ive and Chang, 2007). In particular, the method makes it relatively easy to determine the culpable party when things go wrong with the project. Furthermore, it provides incentive to the contractor to keep the client’s costs to a minimum in the event of unforeseen circumstances (Abdul Rashid et al., 2006; Seng and Yusof, 2006). All these contribute to ensuring smooth delivery of the project with improved performance outcomes compared to DBB.

Therefore, we hypothesis that:
H17. Single point of responsibility has a positive effect on the performance of the project.

- **Less conflict amongst project team**

Reducing the level of conflicts amongst project team is a key factor responsible for projects success (Mante et al., 2012; Natkin, 1994; Park et al., 2009; Seng and Yusof, 2006). Conflicts can be defined as a state of opposition between project participants’ interests and ideas (Ness, 2012). Construction projects are often undertaken by parties of different disciplines and organisations, with different project priorities. Each has their own expertise and interests, yet their inputs are interdependent, which therefore produces conflicting views between project participants (Ness, 2012). A significant feature of DB method is its ability to reduce the level of such conflicts (Mante et al., 2012; Ndekugri and Turner, 1994; Seng and Yusof, 2006). One of the main reasons for this is the fact that DB method integrates design and construction processes, whereby the different teams involved are able to work in the spirit of teamwork. This arrangement enhances effective communication, coordination and collaboration among project team members, which are all critical to reducing conflicts and disputes (Seng and Yusof, 2006).

Therefore, we hypothesis that:
H18. Less conflicts amongst project team has a positive effect on the performance of the project.

- **Transfer of risks to the contractor**

This criterion represents the degree to which the project risks transferred to the contractor were fairly allocated by the contract (Thomas et al., 2002). According to a number of studies (e.g., Seng and Yusof, 2006; Cheung et al., 2001; Ola et al., 2006), the DB method offers opportunities for clients to transfer most of project risks to the contractor than other construction procurement method. Therefore the ability to transfer risks to the contractor remains one of the significant reasons for clients' decision to choose DB method. As this method offers single point of responsibility, project risks (within both design and construction) are easily transferable to the contractor

Therefore, we hypothesis that:
H20. Transfer of risks to the contractor has a positive effect on the performance of the project

- **Desiring reduced project cost**

DB is often used because it provides better value for money (Eriksson and Westerberg, 2011; Molenaar and Songer, 1998), through reducing project cost by overlapping the design and construction processes (Seng and Yusof, 2006; Tooky et al., 2001; Turina et al., 2008). Under this arrangement, the design team typically works closely together with the construction team, which helps to increase the level of cooperation and communication, and therefore allow for errors, which otherwise could lead to rework with attendant increase in cost, to be spotted and dealt with. This explains one of the reasons why this criterion is often considered when selecting the DB procurement. In addition, Seng and Yusof (2006) noted that DB presents a better chance of completing a project at or within the stipulated budget, concluding that this method's popularity largely stems from its ability to minimize the total cost of projects. This criterion was thus operationalized as the extent to which clients were desirous of ensuring reduction in project cost.

Therefore, we hypothesis that:
H21. Desiring reduced project cost has a positive effect on the performance of the project

- **Desiring reduced project duration**

Reducing the duration of a project has a significant positive influence on PP (Gehrig, 2009; Tooky et al., 2001). Saving project time is one of the major client priorities and thus an often considered factor in PM selection. This criterion was operationalized on the basis of the extent to which a client desires to finish the project by an earlier completion date or in shorter project duration. According to Seng and Yusof (2006), DB approach is a project delivery strategy that is famous for reducing project duration. This desirable feature of DB method largely results from the integration of the design and construction process, which helps the contractor to manage, organise and accelerate construction work to finish the project early (Eriksson and Westerberg, 2011; Songer and Molenaar, 2011).

Therefore, we hypothesis that:
H22. Desiring reduced project duration has a positive effect on the performance of the project

- **Level of competence and experience of contractor**

Contractors' level of experience and skills determine how accurately they are able to properly interpret and implement designs during construction (Pinto and Slevin, 1998; Seng and Yusof, 2006). According to Pramen et al. (2012), such competence is a significant factor considered in the selection of DB method. This can be explained by the fact that DB procurement strategy often requires contractors who are highly experienced and efficient in managing the design and construction processes effectively. This criterion thus represents the level of skills and experience of contractors required to manage and control projects efficiently (Adnan et al., 2012; Pinto and Slevin, 1998; Seng and Yusof, 2006).

Therefore, we hypothesis that:
H23. The level of competence has a positive effect on the performance of the project

- **Collaborative working relationship between project team members**

Integration of the design and construction works through DB method helps to improve communication and collaboration among the project team members (Turina et al., 2008). This criterion represents the extent to which the team members are able to collaborate with each other on work execution (Seng and Yusof, 2006; Turina et al., 2008). According to Seng and Yusof (2006) and Albert (2000), good relationships among project team members are nurtured as a result of the arrangements of this procurement method, making this criterion therefore an important factor in the decision to use DB.

Therefore, we hypothesis that:
H24. Desiring reducing project cost has a positive effect on the performance of the project

3.3.3 DBB and DB selection criteria

- **Complexity of design**

Project design is often characterised by complex processes, creating uncertainties and therefore difficulties in achieving good project performance (Naoum and Mustapha, 1994; NEDO, 1988). A key feature of complexity is high interdependency between project activities, which require among others a central coordinating unit for dealing with the issues involved (Mohsini et al., 1995). This criterion thus represents the ability of the procurement method to facilitate complex design projects (Molenar and songer, 1998; Park et al., 2009; Thomas et al., 2002). It is often considered when selecting either DBB or DB. For instance, according to Love et al. (1998) and Ratnasabapathy (2006), projects with greater complexity may call for the use of DBB method as it allows sufficient time for the design to be fully developed before tendering. However, Konchar and Sanvido (1998) and Seng and Yusof (2006) concluded that the DB method is relatively appropriate for dealing with large and complex project in terms of design due to its ability to facilitate early collaboration between design and construction disciplines. This collaboration minimises design errors, which are a major source of change to the construction contract (Perkins, 2009) and hence a source of poor project performance.

Therefore, we hypothesis that:
H3 and H19: Complexity of design has a positive effect on the performance of the project

- **Desiring efficient project planning**

Various studies suggest that client' objectives in construction projects can be better achieved through improving the efficiency of the construction planning process (Faniran et al., 1994, Naoum et al., 2004; Gidado, 2004). (Faniran et al., 1994). Earlier studies have also established that construction planning efforts are influenced by organisational characteristics of construction firms (Kabasakal et al., 1989; Gidado, 2004). These organisational features are directly influenced by the procurement methods used, with DB likely to promote more efficient construction planning due to it having more collaborative arrangements in place for planning, design and construction works (Edmond et al., 2008; Eriksson and Westerberg, 2011). This criterion thus represents the extent to which the client is desirous of ensuring that effective planning is achieved (Asley, 1994; Pinto and Slevin 1998). Past studies on procurement showed that this criterion should be given important consideration when selecting either DBB or DB method of procurement. DB is likely to result in more efficient construction planning due to its collaborative working style, wherein the designer and the contractor can work closely together to meet construction plan (Edmond et al., 2008; Eriksson and Westerberg, 2011), while under DBB there are more or less complete contract documents available before construction commences, which avails client and the contractor the opportunity to review these documents and improve the construction planning processes (Edmond et al., 2008; Eriksson and Westerberg, 2011).

Therefore, we hypothesis that:
H11and H25: Desiring efficient project planning has a positive effect on the performance of the project

3. 4 PMSC influence on PP – a Conceptual Framework

A conceptual framework is defined by Miles and Huberman, (1994) as "*a written or visual presentation that explains either graphically, or in narrative form, the main things to be studied, the key factors, concepts or variables and the presumed relationship among them*". Such framework helps to set out the focus and content of the study as well as acting as the link between the literature, the methodology and the results (Smyth, 2004). Reichel and Ramey, (1987) earlier on noted that the conceptual framework of a research is something that is constructed, not found. Its construction requires borrowing ideas and principles from relevant fields of enquiry but the structure and the general coherence are built by the researcher and not something that is ready-made (Minichiello et al., 1999).

The main potential usefulness of a conceptual framework is that, it can be used "*to assist a researcher to give meanings of subsequent research findings. Such a framework should be intended as a starting point for reflection about the research and its context"* (Den Hertog et al., 2010). Smyth, (2004) highlighted another importance of such framework as that it serves as a research tool to help a researcher develop awareness and understanding of the situation under scrutiny and to communicate this.

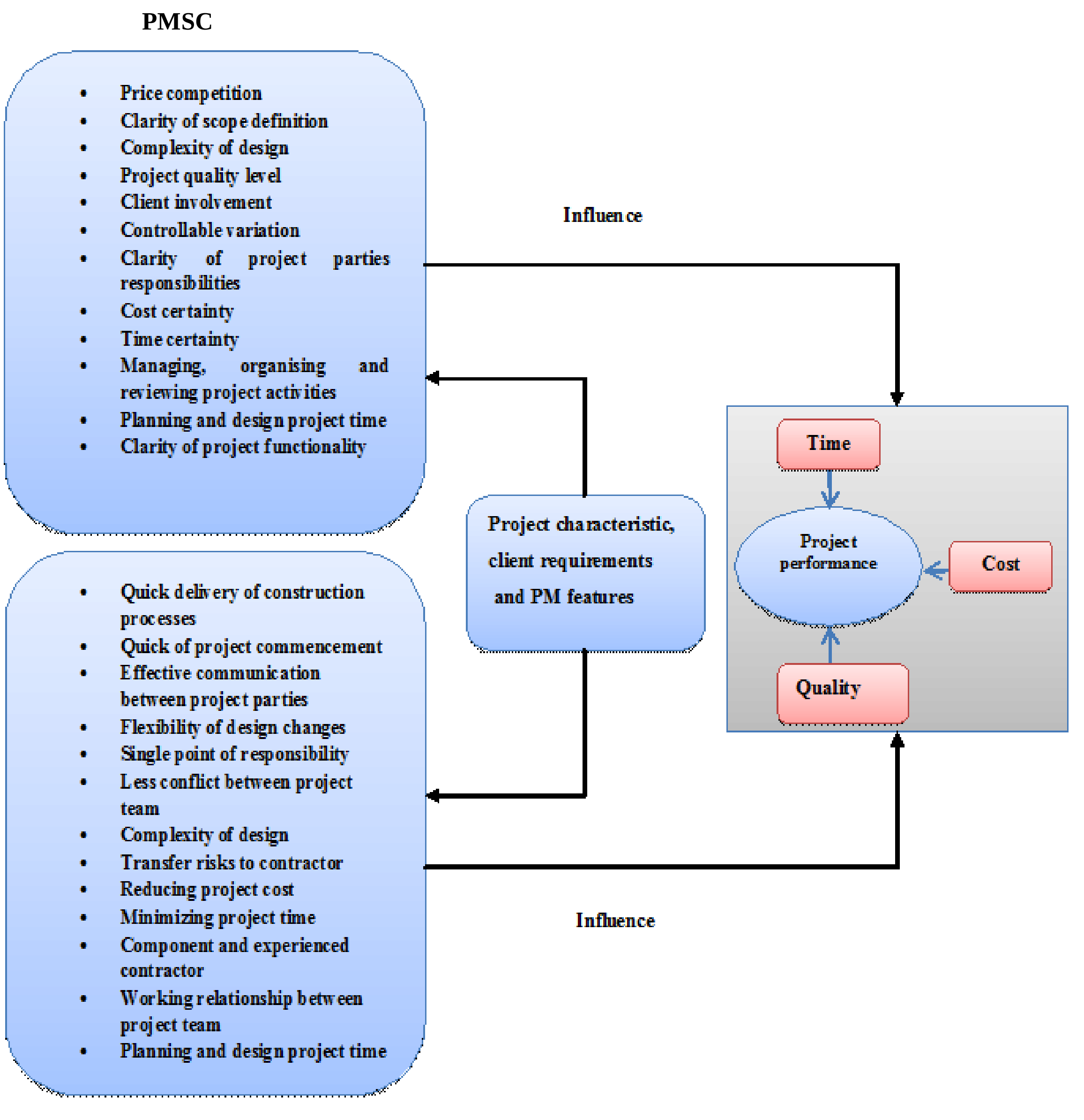

Figure 3.2: Conceptual framework of PMSC influence on PP

According to Kasperson et al. (1988), a conceptual framework can be developed either descriptively or graphically in order to examine the principal factors and construct variables as well as to assume links amongst them. Therefore in this study the conceptual framework is developed using descriptive and graphical techniques (see Figure 3.2), so that a clear picture about the research parameters can be demonstrated to facilitate readers' comprehension of the issues of investigation and the scope of study. This conceptual framework seeks to, among others, illustrate the theoretical basis of the influence that PMSC exert on PP outcome. A detailed review of this relationship has been presented for each of the selection criterion in the preceding section, Section 3.3.

As Figure 3.2 shows, the independent variables of the study are represented by PMSC, whilst PP outcomes (time, cost and quality) form the dependent variables. Using the PMSC (in the light of project and PM features) to rightly select a DBB or DB method for a project could impact differently on time, cost and quality performance depending on the extent in which each of the selection criterion meets the suitability requirements of the PMs. Therefore, the extent to which each PMSC meets the suitability requirements of DBB and DB methods can be measured using a rating scale that demonstrates how appropriate each PM is for the project and hence the level of PP outcomes (time, cost, and quality) expected.

It must be noted that out of the many PMs available, only these two were focussed on as they are considered the most commonly used strategies (Masurier et al., 2006; Molenaar et al., 2009). In addition, the results of an initial survey of this research also demonstrated that these PMs are the popular methods used to deliver construction projects in Libya.

As noted earlier on in the introduction section, a number of researchers have developed systematic approaches (in a form of model/tools) for selecting the right PM based on a set of selection criteria assessed in the light of the project characteristics, requirements of the client as well as the features of the PMs being considered. However, there are no such methods in the LCI to aid clients in the selection of PMs for their projects. According to HIB report in 2010, PMs used on most Libyan construction projects were selected intuitively based on just clients' past experience with projects. Due to this, there is a vital need to develop a systematic approach (framework or tools) to assist LCI's clients with deep knowledge and understanding on the influence that PMSC used to select PM have on PP. This will offer insights into which these criteria make significant contribution to PP, and therefore deserve more attention during PM selection and management of procurement to enhance PP.

3. 5 Summary

This chapter highlights the development of a conceptual framework as a means of clarifying and establishing the theoretical basis on how PMSC influence PP, towards offering a deeper understanding of this subject matter. The framework was developed based on intensive literature review, which was used to identify the key PMSC used for making a rational decision on the suitability of DBB and DB methods in enhancing PP. From the literature, 23 of such criteria were identified as the most commonly cited in the literature. The ways in which each of these criteria are relevant for deciding on the appropriateness of using DBB and DB have been explored as well their potential influence on PP.

Another key outcome of this chapter is the formulation of different hypotheses which will be tested in chapter Seven in order to check whether these hypotheses are supported or rejected.

CHAPTER 4: LIBYAN CONSTRUCTION INDUSTRY

4.1 Introduction

This chapter reviews the current state of the Libyan Construction Industry (LCI). The aim of this review is, among others, to develop a better understanding of construction procurement practice and the state of project performance in the LCI. It is organized into six main sections. Following the introduction section, the next section presents an overview of the LCI, covering: the development of the LCI during the period between 1950 and 2010, and Libya's public client and public sector projects. Section Three discusses a number of procurement-related issues, including: the PMs employed in the LCI; the institutional and legal framework governing construction procurement processes; public sector construction procurement processes and their timeline; the main types of contracts and tendering employed in the LCI. Section Four presents the common problems that affect construction project delivery in Libya. Section Five presents the justification of carrying out this research. The last section presents a summary of the key points of this chapter.

4.2 Review of the Construction Industry in Libya

The term "construction industry" (CI) describes a group of industries' operations and processes that are organized around a construction project (Omran et al., 2012). These operations and processes are integrated to transform construction resources such as land, capital, materials, labour and knowledge into the physical built environment in a specific geographical, political, social and economic environment. These processes are also influenced by the method in which construction business is organized, and the systems and rules by which construction activities are conducted (Bon et al., 2000; Turin, 1980; Wells, 1986). Omran et al. (2012) indicated that the *"CI is one of the main important economic activities that contribute towards the economic growth for any nation*"

Not surprisingly, Libya has witnessed enormous growth in the construction industry. This is mainly due to the discovery of oil in 1959, and the commencement of exportation in 1964 which aided the establishment of different industries and transformed the geographical and demographical distribution of the population, especially in the coastal areas (Krima, 2005).

The current shape of the LCI is a consequence of the interaction of geographical, historical, social, political, economic, institutional and technological factors. The industry operates in hard and difficult geographical, social and economic circumstances. The operations of the CI are focused on four main independent regions, influenced by social tribalism and nepotism, fluctuations in oil revenues and foreign workers. Political ideology has played a significant role in the formation of the current status, particularly the imposition of partnership principles (Grifa, 2006).

- ***Geography***

The country has four main geographical and planning regions: Tripoli, Benghazi, Fezzan and Al-khalij (Figure 4.1). The Tripoli region is the most important region in the country in terms of social and economic activities, as most of the country's political, economic and industrial activities are concentrated there. For a variety of reasons this region is considered the most important in the country in terms of the concentricity of the population and social and economic activities; in 2003, around 58% of the total population of Libya was settled in this region, followed by 27% in Benghazi.

According to 2010 Census, the population of Libya is around 6**,**742,000 million, with a population density of 3.2/km^2, growing by 3.5% annually. Libya's climate is a blend of the climates of the Mediterranean Sea and the Sahara desert.

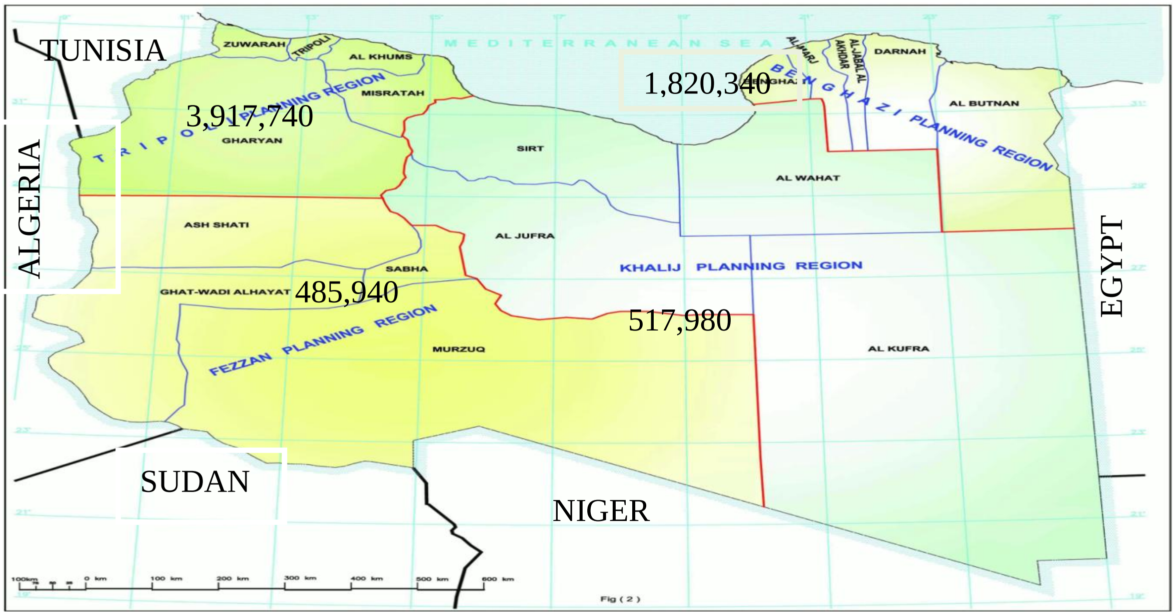

Figure 4.1: Map of Libya showing distribution of population in four main regions (2010)

Source: Bureau of Statistics and Census Libya (2010)

- ***Culture and Society***

The Libyan population originates from Bedouins in the east, Berbers in the mountains to the west, Turks in the main cites, sub-Saharan Africans and the nomadic Tauregs in the south. However, the population is regularly described as the most homogenous in the world, with an Arab-Islamic linguistic and cultural identity. The people's traditions and values are rooted in the fundamentals of the Islamic religion. The society is organized and structured around the tribalism, nepotism, clan and family.

- ***Economy***

The Libyan economy is categorized as an oil-based economy; it is highly dependent on oil revenue, which forms 80% of the country's GDP, with the remaining being 20% coming from non-oil construction sectors. The country is ranked as one of the poorest in water resources as a result of the arid desert conditions. Consequently, 75% of Libya's food is imported. The state has controlled the economy since the early 1970s, and the country started market-oriented economic liberalisation only recently (as part of the rapprochement with Western countries from 2003 onwards). The World Trade Organization (WTO, 2006) has identified reducing subsidies, privatization of social services and opening Libya's Stock Market (2006) as examples of this transformation (Ngab, 2011).

4.2.1 Developments of the LCI

The CI in Libya has faced serious challenges and difficulties due to fast developments and dependence on foreign experts (Omran et al., 2012). As in many developing countries, the LCI is affected by several factors, including the nature of work to be constructed, the selection of technology, and the country's social, political and economic circumstances, as well as tradition and attitudes towards construction business (Ngab, 2011; PPA, 2010). The LCI has played an important key role in socio-economic development processes since the early 1950s. It contributes about 5.2% of the Libyan GDP, and it employs around 3.2% of the total workforce (Ngab, 2011; Hassouna, 2008). The LCI has undergone three stages during the period between 1950 and 2010. The first stage was between 1950 and 1970. A limited budget and resources characterized that period. Construction was based on original local building materials and local workmanship. In 1958 cement production was only 60,000 tons, and cement was used in only 2% of buildings in 1964 (Ngab, 2011).

Between 1951 and 1962 Libya was classified as one of the world's poorest countries and its economy relied on a narrow range of primitive agriculture and international financial assistance (World Bank, 1962). However, between 1963 and 1969 the economy was transformed from a primitive economy into an oil-based economy. Since then it can be said that the Libyan society has moved from being a primitive agricultural society to a hydrocarbon society. In addition, the economy moved from capital deficits to capital surpluses (El-Mallakh, 1969, p.308; Davis, 1988, p.262).

The second stage was between 1970 and 2000. This stage was characterized by high spending on all sectors, including the construction industry, to meet the urgent needs of the population for houses, roads, schools and other infrastructure (Grifa, 2006; World Bank, 1960). In 1975 the government began to reorganize the CI to make it more efficient. At that time, there were about 2,000 contractors, many of them in small partnerships. The Minister of Housing was given the authority to merge contracting firms into a smaller number of larger firms capable of carrying out large construction projects. Firms with capital in excess of LD 30, 000 were converted into corporations, and the majority shares were sold to the public or the government (El-Hassia, 2005; Grifa, 2006).

Many changes occurred in construction processes and operations in this stage (1970 to 2000). During the oil boom of the 1970s, Libya witnessed a huge increase in the scale and volume of construction activities. As a result of that, at the end of the 1970s Libya was the world's leading per capita consumer of cement. The construction activities changed from domestic and indigenous activities based on local and dry construction materials to an industry structured around formal firms and projects that was guided and controlled by professionals, formal construction regulations, and standard materials (Abbas, 1997; Krima, 2005; Ngab, 2011).

During the period from 1970 to 1986 the government spent a lot of money and invested more than 10 billion dollars in housing and infrastructure, as a result of which 277, 500 housing units were built. Furthermore, more than 30, 000 km of road network across the country was constructed during that period. The project of the Great Man Made River, which is considered one of the world's largest civil engineering water projects, was planned, designed and constructed during that period (Ngab, 2011).

The ostracism of Libya by the US during the 1980s led to an economic slowdown. Between mid-1983 and mid-1988 the number of construction workers declined by more than 50%, mainly because of the departure of foreign workers (Hassouna, 2008). The budget allocations for housing and other infrastructures fell in keeping with a general decline in government spending on non-military sectors. Many housing contracts were suspended or cancelled as a result. The cutbacks in development spending and foreign worker departure led to a decline in overall construction (Hassouna, 2008; Grifa, 2006).

In 1985 the cement industry, which had expanded during the building boom, was capable of producing 6 million tons a year, but domestic demand had decreased to only 4.5 million tons. From 1986-2000 the Libyan economy witnessed enormous ordeal because of the dramatic slump in oil prices and international sanctions during the 1980s and early 1990s. As result of that the LCI slowed to a halt (El-Hassia, 2005; Fayad, 2000; Krima, 2005; Ngab, 2011).

During the third stage from 2000 to 2010 the price of the oil increased dramatically. Globally oil increased from $22.3 per barrel in 1986 to about $70 in early 2007, and the gradual lifting of sanctions on Libya during the 2000s allowed the country to benefit from this, precipitating a boom in public sector expenditure, and the development of massive investment programmes. By 2006 the government had resolved all the outstanding debts of contractors for previous construction projects. Several massive construction projects were launched in the oil and gas industry, power generation and water projects, airports, housing and transport. The highest proportion was invested in housing and public utilities (Omran et al. 2012; El-Gayed; Ngab, 2011).

The government recently proposed its future development plan for the CI until 2030 to meet the people needs and demands. This plan includes the implementation of projects in all the different infrastructure fields such as industry, housing, transport, supply and distribution of water (PPA, 2010). This proposal was actually instigated by a noticeable increase in the demand for public services, witnessed in the country over the last few decades, mainly as a result of increase in the population and the growth of the industrial and commercial domains (Hassona, 2008).

4.2.2 The Libyan Public Client

The Libyan public client represents the major employer of construction projects in the CI, taking up around 90% of total construction orders in the country (PPA, 2010). The public sector here can thus make a considerable difference to wide adoption of "good" construction procurement state-policy principles. Public clients in Libya come in the form of government (public) departments, secretariat or even a specifically formed body to implement a certain public project (Omran et al., 2012; El-Hassia, 2004).

The Organization of Developments and Administrative Buildings (ODAC), and the organization of Housing and Utilities Implementation Projects (HIP) are the most important public construction organisations that are responsible for the implementation of governmental projects in Libya (HIB, 2010; ODAC, 2010). HIP is responsible for residential and infrastructural projects, whereas ODAC oversees and maintains institutional and commercial projects. Both work under the umbrella agency the Public Project Authority (PPA), responsible for monitoring projects, which are implemented via foreign and local contractor companies.

4.2.3 Public Sector Projects

Public sector projects in Libya include building and civil engineering projects (ODAC, 2010). Building projects consist of residential and non-residential projects with the most common types being: individual private houses, apartment complexes, and single unit dwellings, public housing and villas. A report from ODAC in 2010 shows that the percentage of the residential projects constitutes about 30% of the total projects contracted in Libya during the period between 2006 and 2010. These types of projects constitute the simplest type of construction projects and are the most familiar to clients and contractors (PPA, 2010). Non-residential projects on the other hand, covers a great variety of project types and sizes such as hospitals and clinics, schools and universities, sports facilities and stadiums, large shopping, administrative buildings and hotels (ODAC, 2010). These projects constitute about 20% of the total projects contracted in Libya during the period between 2006 and 2010 (ODAC, 2010). It usually requires specialist firms with qualified design, skilled and experienced staff, operatives and workers (Grifa, 2006). The vast majority of building projects either, residential or non-residential projects, is procured by traditional method (PPA, 2010).

Civil engineering projects covers utilities and infrastructure projects such as; pipe lines, railway, roads, and water supply and sewage projects. These projects require heavy equipment, plant and machinery. Moreover, they require highly qualified designers, managers and skilled workers. These projects constitute around 20% of Libyan projects. The majority of these projects are procured by DBB method. However, some of them are procured by DB method (PPA, 2010; HIB, 2010).

Maintenance and repair projects in the LCI are undertaken for infrastructure facilities such as roads, public housing facilities, pipe lines, water and sewage networks, as well as residential and non-residential buildings. These projects are usually carried out by small and medium size firms, and constitute around 30% of Libyan projects (ODAC, 2010). DBB is the most common method used to deliver these projects (PPA, 2010).

4. 3 Construction Procurement Issues in the LCI

As with many developing countries, the use of inappropriate PM to deliver construction projects in Libya is a common issue and often seen as a major source of poor PP (Grifa, 2006). As indicated in Section 1.1, a number of studies and Government reports have highlighted this problem as one of the main reasons that contributes to the cost and time overruns of majority of Libyan construction projects. A report from PPA (PPA, 2010) demonstrates that, time and cost overruns are common with Libyan construction projects, and that clients' failure to select suitable project delivery methods is the cause. Also, Libya's Committee of Monitoring and following up (LCOMAF, 2009) surveyed construction projects that have suffered from cost and time overruns during the period between 2005 and 2009. The results of this survey indicated a number of factors as being responsible for this poor performance. These factors relate to the actions and inactions of clients, contractors and consultants, but the use of inappropriate PM showed up as the most significant factor.

El-Hassia (2005) studied the procurement policy in Libya and lamented about the state of the LCI as follow: "*some clients have been wasting vast amounts of money on projects, and yet continue to experience long delays, all because they are failing to educate themselves well on how to choose the right method of procurement*". He also stated that many project clients in Libya use only their experience as the main criterion when selecting PMs for their projects.

Furthermore, a recent study by Omran et al. (2012) on the critical success factors of Libyan construction projects using field surveys comprising of questionnaire and interviews with sample of construction professionals from public sector organisations. The survey covered all the key geographical areas in Libyan where the volume of construction projects is high. The results revealed that, the selection of the most appropriate PMs is one of the key factors affecting the success rate of Libya construction projects. The survey also revealed that, the main criteria that guide the selection of PMs in Libya are client experience, followed by project priority and requirements, and the project bidding method to be used.

The poor practice with PM selection results from the fact that, in the LCI, there is no approved technique or model/tools used to select the most appropriate PM to deliver projects (PPA, 2010; Hassouna, 2008). Although, procurement selection criteria and tools for employing them have been highlighted in the literature, Libyan clients still rely on their mere experience with past projects when deciding on the appropriate PM to use. They sometimes make use of some of the known selection criteria but tend to do so in an unstructured or non-uniform manner, which is bound to produce erroneous results in their decision-makings over PM selections (Omran et al., 2012; PPA, 2010; HIB 2010).

Hassouna (2008) studied the suitability of using modern methods of procurement such as project private partnership (PPP) to procure Libyan construction projects. In this regards, he indicated that due to the increasing difficulty and complexity of construction as well as the changes in Libyan government policy toward openness with foreign investment coupled with active engagement with private sector suggest that there is a need to embrace modern PMs to procure construction projects. He also confirms that selecting PMs based on PMSC has the potential of helping clients to achieve project objectives and ensure project success.

4. 3. 1 Types of construction PMs used in Libya

Krima (2007) argued that, there are limited approaches for delivering construction projects in the LCI. These approaches are DBB and DB methods, with the former being mostly in use that the latter. She also indicated that there are no specific criteria used for PMs selection in Libya, and attributed the dominance of DBB system in the LCI to the current contractual agreements (Decision No. 8 of 2004), which do not encourage other contractual methods such as DB or design, build, and operate/transfer.

Previous studies and reports on the construction industry in Libya (e.g. El-Hassia, 2005; Grifa, 2006; LPCOMF, 2009; HIP, 2010) have shown that DBB is the most commonly used method to deliver construction projects, and constitutes around 95% of projects, with the remaining 5% comprising DB procurement projects. The studies indicated that the main reason why clients choose DBB procurement method is that it is simple and familiar to use, suggesting that lack of knowledge and experience with modern form of procurement on the part of clients is the bane of the poor industry practice. The way in which the CI is understood in Libya is another important reason. For example, it has been observed that current architectural and engineering educational systems in Libya see construction as a set of separate processes (Grifa, 2006).

El-Hassia (2005) indicated further reasons for DBB's popularity, stating that:

> "*The DBB is the most common approach as it originated from the influence of the developed world and in the UK in particular due to the effect of the British administration era between 1943 and 1952. Even after the revolution in 1969 the lack of administrative and management experts had not changed the DBB approach to the specific the LCI reality* (El-Hassia, 2005).

In the light of the above it can be concluded that there is no systematic approach used for selecting PMs in Libya. The DBB method has remained the most common and preferable PM in Libya, even though alternative forms could better suit some projects there. It can also be concluded that most of obstacles affecting the operations of the CI in Libya can, in general, attributed to the wide use of DBB method regardless of whether would be suitable for the project or not.

4.3.2 Institutional and legal framework governing LCI's construction procurement

This section gives a brief overview about the current legal and institutional framework of the Libyan project delivery. The information obtained was based on regulations and laws which are relevant of management and organisation of the LCI. Generally the CI in Libya is regulated by Law No. 9 of 1985 and Law No. 9 of 1992, and their associated amendments as well as Decision No. 8 of 2004. Most of the conditions and procedures required to establish a firm in the CI, tendering and contracting are explained by these Laws. Law No. 9 of 1985 and Law No. 9 of 1992 explain the procedures and condition required to establishing contractors 'construction firms to carries out the projects. However, Decision No. 8 of 2004 explains the procedure and conditions of the construction procurement processes in terms of tendering, contracting and implementation the project. These three laws are supported by regulation on design codes and specification, condition of the tendering and contracting, standard of construction work and the condition of employing construction work and starting up construction firm.

The processes involved with delivering construction projects in Libya go through 2 main phases. Pre-construction phase and construction phase. Pre-construction phase of public construction projects in Libya, fall under the public consulting office's responsibilities in terms of design and specification as well as evaluating of tendering and contracting. There is a legal framework that regulates the consulting sector and makes decisions concerning engineering consulting best practice in Libya (Grifa, 2004; Ministry of Housing, 1985). The rules and regulations fall under the responsibilities of Libya's General Association for Engineers (GAE). One of the key requirements is that project consultants in Libya, either private or public, cannot run any sort of consulting services unless they have registered with the GAE.

With regard to the tendering and contracting arrangements, most construction projects in Libya are subjected to the "Administrative Contracts Regulation" (ACR) (General People's Committee GPC, 1999), which stipulates guidelines that determine the mechanisms of the contract and the obligations between parties of the contract. This regulation is meant to ensure the selection of the best project contractor, and also for the client to use its utmost care to ensure the implementation of the project within budget, on time and to the required quality.

Also, the ACR (General People's Committee, 1999) together with Decision no 8 stipulates and clarify the contractual arrangement between client, contractor and consultant. Moreover, they clarify the procedures to be followed in the tendering process. The ACR emphasizes that, all construction contracts should be carried out by public/open tender while the other types such as selective tender and direct order may not be used except in specific cases and under limited circumstances. For example, the ACR sets a list of situations which may require direct order tendering. These are: (i) meeting the requirements of national security and emergency; (ii) contract with institutions and national public bodies or foreign governments as required by international conventions; and (iii) when no contractor is interested to tender (General People's Committee, 1999). The ACR also identified a set of key criteria that prospective contractors must satisfy, if success of the project is to be guaranteed. The criteria include the need for them to:

- possess right technical and financial competence, good reputation and previous experience of similar projects.
- be registered and hold permission of work from the competent authority in accordance with the legislation in force.

The ACR also contain provisions for setting price estimates which must be followed by the contractors when submitting their bids. The contractors should estimate the project price as far as accurate as possible, taking into account current market prices as well as prices from similar previous projects. The price should be set in Libyan currency for either the lump sum total of the contract as a whole or based on the unit price. Additional guidance for awarding project contracts in the ACR as following:

- Awarding contracts is the responsibility of the Tender Committee, and is mainly based on the lowest price tendered by the contractor.
- The Tender Committee may sometimes select the contractor who tenders a suitable offer whose price is not necessarily the lowest, but for reasons of public interest.
- The selected contractor should pay the final insurance for the project once he signed the contract.
- In case the selected contractor rescinds its decision to accept the contact, the tender committee will have to select the next suitable contractor that follows in order of merit.

With regards to the construction phase the major rules that are emphasized by The ACR are that: the construction works should be implemented according to the contract documents in terms of design and specification; and, any delays with construction works will incur payment fines against the contractor. The monitoring, supervisions and following up of the construction works fall under the PPA organisation.

4. 3. 3 Public sector construction procurement processes and timeline in the LCI

As mentioned in Section 4.3.1, DBB method is the most dominant method for procuring construction projects in Libya. The procurement processes followed in the LCI thus largely follows this method’s generic and standardised set of processes to deliver construction projects in Libya. The processes involves going through three main phases. Firstly, pre-construction phase: in this phase all the preparatory work and feasibility studies are made and contract documents are prepared (PPA, 2010; Krima, 2005). The client appoints a designer or a consulting firm to transfer its needs and expectations into complete project documents (drawing, designs, bill of quantity and specifications). Then, the client invites contractors to tender for construction project. The second stage, called "construction stage", is the phase in which contractors carry out the construction work in accordance with the project documents and the contractual agreement. The third stage is handover of the project to the client and this includes initial and final handover (Omran et al., 2012). EL-hassia (2005) stated that "*hand over stage also covers a specified time period after practical completion, known as "the defect liability period", where any defects are remedied".*

With regards to project delivery timeline in Libya, there is no standard methods available to measure the period of any project as it varies from project to project depending on the type and size of the project as well as its difficulty and complexity (PPA, 2010; El-Hassia, 2005). Determination of project delivery timeline is considered very difficult due to the large changes in the project specification and designs as in for example, client's requesting additional works and design changes during construction processes (ODAC, 2010).

According to (PPA, 2010) and HIB (2010) additional works is common with most construction projects in Libya, with more than 75% of the country's projects experiencing extended durations as result of additional works. Project clients are often unable to accurately determine their requirements and needs of projects in the pre-construction stage. As results of that, there are usually some deficiencies with the pre-construction stage design and specification tasks which in turn reflect negatively on the execution the work and project progress. El-Gayed (2013) and Krima et al. (2007) indicated that lack of adequate experience from the consultants and design team in preparing accurate designs and specifications are the key causes of additional works. Most engineers working in the consultants' offices do not have enough experience to handle complex, difficult and large size projects. The Libyan government, as the client, therefore often contract the services of international consultants particularly for major strategic projects.

Delays suffered by Libyan construction projects usually occur during the construction stage, which explains why it is difficult to estimate and assign an accurate timeline for the key project delivery processes (HIP, 2010 and ODAC, 2010), as depicted in Figure 4.2.

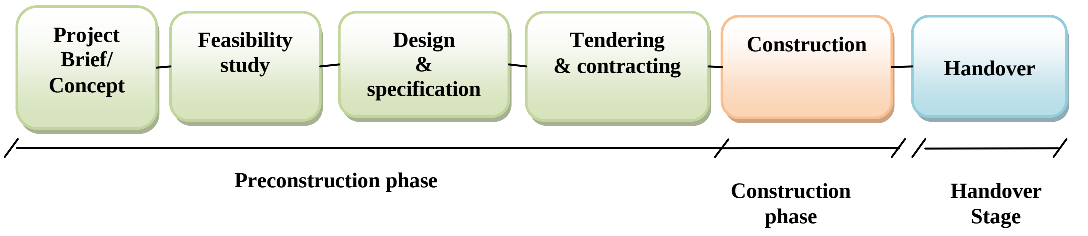

Figure 4.2: Key phases of LCI's construction procurement processes

4. 3.3.1 Pre-construction phase:

As indicated in Figure 4.2, the Pre-construction stage embodies the following activities: Project brief/Concept, Feasibility Study, Design (preliminary design and detailed design), and Tendering and contracting. The main critical project decisions are made in this phase (PPA, 2010; General People Committee, 1999).

a) Project brief/concept: Grifa (2006) argued that "*project briefing involves gathering and analyzing information needed in the building process in order to make right decisions on project planning implementation*". Project brief involves understanding the client's needs and then expressing them in a way that ensures compatibility among the client's vision of the project and the resulting product (Kelly 2004, p. 47). Krima (2005) indicated that at project conception stage, the project basic ideas and concepts are examined by following the principles:

- Determine the project purposes and objectives;
- Studying the environmental, social, technical and economic aspects of the project by owner and consultant;
- Laying out a strategic plan and forecasting the project difficulties and the possible solution for them;
- Establish alternative plan in order to achieve the project goals and objectives; and
- Identify all project events and determining project cost, its planned start and completion dates.

The project brief/concept is usually conducted for large size projects wherein the client presents and explains to the consultant the ideas and purposes behind the project as well as the advantages and benefits to be accrued after its construction. The role of the consultant in this step includes advising the clients of whether or not this project will achieve its intended benefits.

b) Feasibility study: the feasibility study is the next development stage undertaken after determining the purpose and benefits for pursuing the project. This usually consists of (i) a study, where an initial project definition is developed in outline, (ii) evaluation of a proposed project in order to determine if the project is: technically feasible, within the predicted cost, and will be profitable (iii) identifying how the project should be structured in order to deliver the benefits expected of it. Although feasibility study is considered significant in delivering projects, it is rarely employed for construction projects in Libya, except for large-size projects executed by international contracting firms (PPA, 2010). The lack of feasibility studies for projects outside this category has had a negative impact on LCI projects such as failure to achieve the desired benefits expected to be gained from the projects.

c) Design, Bill of Quantity and Specification: project design is considered a significant project delivery stage. This stage includes preliminary and detailed design. In the design stage, the client sometimes hires consultant to prepare the preliminary and detailed design. However, some public sectors in Libya have in-house design departments staffed with engineers of different construction expertise. These engineers work as consultants for the client and are responsible for preparing the preliminary and detailed design.

In the preliminary design the consultant prepares some sketches and brief design of the projects and then discusses them with the client (PPA, 2010). If the client accepts the preliminary design the next step then is the detailed design. The consultant together with the design team prepares the detailed design of the project and this includes: architecture designs and drawing, structure designs and drawing, civil work and infrastructure drawing and others. The next step is preparing the bill of quantity and specifications. In this step, the quantities and the general specifications of the project will be prepared based on the detailed design provided.

d)Tendering and Contracting: As with most developing countries, submitting tender for construction projects in Libya is considered the most important and risky duty of the contractor (Krima et al., 2007; PPA, 2010). The quality of the submission usually has direct effects on the contractor's success. As result of that contractors must estimate the cost of the project properly. For instance, the contractor needs to comprehensively and deeply study the project documents (designs, conditions and specifications and bills of quantities) as well visiting the project site to identify the sources of water, electricity and any obstacles that may affect the execution of the project (PPA, 2010).

Tendering and contracting stage comes after completion of the project documents (designs, drawings, bill of quantity and specification). The client then invites contractors for tender competition by one of two ways: (i) open tender: advertises the notice of tender within a period of time in newspapers, public media or website to invite suitable contractors for tender competition or (ii) selective tender: invites the contractors who are only prequalified in particular work and registered in the client's organisation list. The contractor who intends to bid for the tender will purchase the tender documents, provide the appropriate tender information required, and then submits the completed tender before the deadline. The submitted tenders' will be assessed by a tender evaluation committee of client in order to select the best eligible contractor. The best contractor selected will then enter into a contract with the client to implement the project according to contract documents. Figure 4.3, adopted from Grifa (2006), summaries the general tendering processes followed in the LCI, reflecting the key operations from the perspectives of the client, consultant and the contractor, as largely fashioned by the DBB approach.

The main weakness of this stage (tendering and contracting) is that the ultimate basis for selecting the wining contractor is the lowest price criterion with little emphasis on other relevant criteria such as work experience, technical staff and equipment availability. This issue creates problems with Libyan construction projects' delivering, as a number of them continuously fail to achieve success (Tumi, 2009; PPA, 2010).

In some special circumstances or for specialist or emergency projects that needs to be finished quickly as highlighted in section 4.3.2, the client go directly by the direct order tender in which only one contractor will be invited for tender (Tumi, 2009; Ngab, 2011).

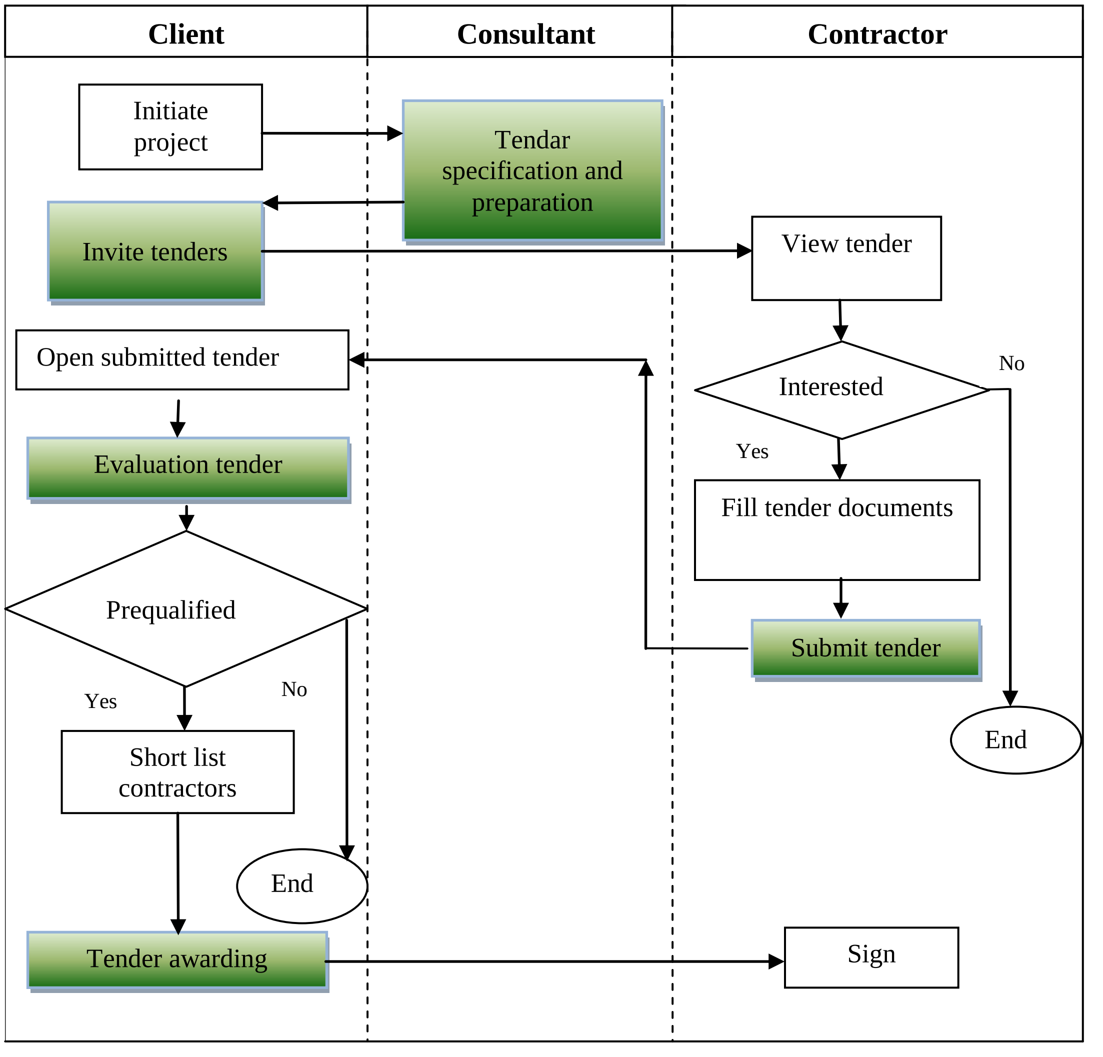

Figure 4.3: The general tendering processes in the LCI

Source: Grifa (2006)

The tendering process of selecting contractors for DB projects in the LCI is almost the same as that for DBB projects, with the exception that in the former, the contractor is responsible for preparing the design, drawing and specifications of the project and submits these documents to the client for evaluation.

4.3.3.2 Construction phase:

This phase is falls under the contractor's responsibility where contractors, with their staff carry out the construction projects according to contract documents (drawings, designs, bill of quantity and specification). Krima (2005) indicated the construction phase for Libyan project delivery includes such activities as:

- implementation project by selected contractor;

- construction supervision and quality control to ensure contractor performance;
- managing, organising and following up construction work; and
- comparison of the actual construction with the outline project execution plan.

For small and medium size projects, the monitoring and supervision of projects are usually carried out by engineers who already work as employees in the client organization or from existing design consultants. However, in large-sized construction projects the monitoring and supervision of projects are run by consultants of PPA construction organisation.

Construction phase is always associated with conflicts and disputes between contractor and supervisors with regards to following the technical specification and designs by contractor during the implementation of the project. This is exacerbated by deficiencies and errors with project designs as well as the client's failure in determine the objectives and requirements of the project accurately.

4. 3.3.3 Handover phase

This phase comes after the construction phase. It includes initial and final acceptance of handover proceedings of the project. The initial handover starts right after all construction works are completed, where the contractor will inform the client officially. The client will then select a committee usually from the engineers who works in his organisation or the project design consultant to take responsibility of handover of the project from the contractor. In the initial handover the client's committee checks and tests whether or not the project has been implemented in accordance with the contract documents in terms of designs and specifications. If the committee is satisfied with the works done then they will hand over the project from the contractor. Otherwise, they will have to prepare a list of works that have not been executed properly and asked the contractor to re implement them. The client's committee usually gives one year to the contractor to finish the list of defective works. In this situation the client's committee can accept an initial handover from the contactor, and then accept the final handover later on, after one year from the initial handover date (PPA, 2010).

4.3. 4 Types of construction contract strategies used in Libya

The term ‘construction contract’ can be defined as an agreement between two or more parties for the construction of a specific project (Kate, 2010; Abd-Elshakour, 2011; Hosie, 2007). This agreement explains and demonstrates the rights and obligation of each party to the other during the life cycle of the project construction (Hosie, 2007; Grifa, 2006). In the LCI there are limited types of contracts in use for construction projects. The authors' review of a random sample of projects contracted by the HIP and ODAC during the period of 2006 to 2010 in Libya showed that the majority of these projects were based on bill of quantities contracts followed by lump sum contracts (60% and 35% respectively). However, few projects were based on cost plus contract (5%), which may be due to the contract parties (client, contractor, and consultant) having little experience of this kind of contract. This result confirms that the bill of quantity contract is the most popular in the LCI recently.

PPA, (2010) and Grifa (2006) concluded that the reasons why the aforementioned contract types, particularly bill of quantity contracts, have dominated the LCI are because of the government's disinterest in introducing new project delivery systems, mainly caused by its lack of knowledge and experience regarding the advantages and disadvantages of modern contracting methods, possibly resulting from dearth of relevant studies (Grifa, 2006; ODAC, 2010).

As DBB approach is commonly used in Libya, the client usually enters into three-way contracts between (Krima, 2005):

- *Client and Contractor*: The contractor is responsible to implement the project.
- *Client and Consultant*: The consultant is responsible to carry out the engineering and design work.
- *Client and Supervisor*: The supervisor is responsible for monitors the contractor's performance during construction stage. The supervision contract may be made with the existing design consultant or an independent body, or, in some cases supervision is carried out by a team of engineers who are working as employees in the client organization.

4.3. 5 Types of tendering used in the LCI

Brook (2004) indicated that tendering can be defined as an offer which incorporates the sum of money, time and other conditions required to carry out the contract obligations in order to complete a project or a part of it consisting of specified works. Halaris et al. (2003) defined tendering as the list of processes required to produce and manage tender documents by client or consultant. Tender documents must be clear, well defined, consistent and adequate. It should contain the requirements of the client for what he or she wants to build (Bentley, 1987, p.10; Laryea, 2011; Smith, 1986, p.34).

It has been highlighted in Section (4.4.2) that, in LCI the ACR confirmed that construction contracts should be managed by public/open tender except in some specific case. A review of a random sample of projects contracted by ODAC and HIB during the period of 2004 to 2010 in Libya shows that the types of construction tendering in use are: public/open tender, selective tender and direct order. The review also indicates that, 45% of projects went through selective tendering, 40% through direct order and 15% by public tender. It is quite surprising to see that public tendering recorded the lowest percentage, although the ACR has emphasized its use as the first position. This is probably because at the time of tendering these projects, the government was willing to complete these projects very fast (HIP, 2010; ODAC, 2010; PPA, 2010). The procedure followed in public tendering to select contractor is relatively long and therefore the government is now compelled to resort to the use of other tendering approaches that can help reduce the time of contracting projects (PPA, 2010).

4. 4 Common problems that negatively affect project delivery in Libya

Time and cost overruns are the most serious problems associated with public construction projects in Libya (PPA, 2010). This is because they lead to conflict and lawsuits between project parties, reduced productivity and revenue, and contract termination (Tumi, 2009). These aspects normally reflect negatively on the performance of the project. Several studies and government reports including for example (Krima et al., 2007; Tumi, et al., 2009; LPCOMF, 2009) have been conducted for the purpose of identifying the major factors causing project delays and cost overruns in Libya. These studies argued that time and cost overruns are common in the LCI as with most developing countries. They are considered the most common and costly problems in today’s national and international construction industry, not least because they impact negatively on society and the economy in general, as well as resulting in expensive disputes and claims of tremendous consequences. The studies also indicate that most of the factors responsible for the time and cost overruns of Libyan construction projects are caused by PMs selected for projects that do not adequately suit them.

Tumi et al. (2009) surveyed the causes of time and cost overruns for construction projects procured by DBB method in Benghazi city in Libya from perspective of clients, contractors and consultants. The results indicated that the major factors causing time and cost overruns in construction projects are (in descending order of importance): “improper planning”, “lack of effective communication”, “shortage of supply i.e. steel, concrete, etc.”, “design errors”, “slow decision-making”, “financial issues”, “shortage of material” and “acts of God” (Tumi et al., 2009).

Abubaker et al. (2008) studied the problems associated with project planning generally, with specific reference to DBB constructed projects in Libya, using field surveys comprising of questionnaire and interview survey with a sample of 60 construction engineers in Libyan public sector. The study results identified a set of six factors responsible for delays and cost overruns associated with construction projects in Libya. These are delays in payment for the project, lack of appropriate technology and information, shortages of labour, client changes represented, site conditions, and inappropriate skills of subcontractor.

Kriam et al (2007) studied the effectiveness of project supervisors (architects/engineers) in dealing with construction delays. They found that the most frequent causes of delays in Libyan construction projects are: client payments to the contractor, long administrative routines, unstable material prices, frequent adjustments and additional work ordered by owner, delay in administrative processes carried by owner’s supervisor, design errors, unavailability of spare parts in the local market, supervisor delays in decision-making and taking action on time, lack of or bad application of modern planning techniques by the contractor, communication between the supervisor and the owner to obtain required approval or permission and unclear drawings and specifications prepared by the consultant.

According to reports issued by the Libyan Public Committee of Monitoring and Follow-up (LPCOMF, 2009) regarding time and cost overruns of Libyan projects executed in the western and eastern regions between 2005 and 2009, 12 major factors were identified as being responsible for this problem:

- Delay in approving the project plans and designs from the urban planning organization.
- Design errors.
- Client delays in payment of dues to the contractor.

- The difficulty of obtaining the building permits from the relevant authorities.
- Slow decision-making by project client.
- There are no specific criteria to classify consulting offices.
- Poor performance of contractors and subcontractors,
- Poor planning and project management.
- Lack of coordination between clients and contractors.

Of these, LPCOMF (2009) concluded that, the three most significant factors responsible for time and cost overruns and strongly related to the projects procured by DBB are “client delays in payment of dues to the contractor”, “poor skills and experience of the project client supervisors” and “design errors”.

Thus, it can be concluded that delays to construction projects are a common in the LCI, as most developing countries. These delays cumulatively damage the reputation and image of the LCI, and thus cause negative impacts to society and the national economy. There are clearly many issues within the LCI in terms of procurement practice and employing modern types of PMs, which call for close and urgent attention, if project performance in this industry has any chance of getting better.

4. 5 Justification of carrying out this research

A number of studies and Government reports in Libya (see section 4.3) highlighted that, there is no systematic approach or tools can be used to aid project clients in selection the most appropriate PMs for their projects as well as there is no studies that looked at the influence of PMs on the performance of the projects. These studies indicated that PMs in Libya are selected based on the client experience with the past projects rather than using an acceptable rational criteria to make the right choice. As result of that, a large number of construction projects have suffered from severe cost and time overruns. These studies also confirmed that DBB is the most commonly used method in Libya. Using DBB procurement method as the only option for delivering most of projects has contributed significantly to the frequent poor PP (PPA, 2010; ODAC, 2010). The reasons are that: (i) DBB is not justifiably selected based on set of procurement criteria (ii) there are deficiencies in the DBB procurement processes particularly in the pre-construction stage (feasibility study, design and specification as well as evaluation and assessment of contractors’ tenders), which reflect negatively on projects outcomes in terms of time, cost and quality.

To need to address the afore-mentioned problem have instigated, *inter alia*, the dire necessity to investigate PMs selection process and its influence on the performance of projects in Libya. This investigation can offer a much deeper understanding of which PM selection criteria makes significant contribution to PP and hence, how best the selection process in the LCI could accordingly be advised so as to ensure successful delivery of project.

4. 6 Summary

The chapter reviews the existing literature on LCI and particularly those that related to the PMs and PP. Although, the previous studies conducted in the area of procurement in Libya did not show how PM affects PP, they have given an indication of the most common PMs used to deliver projects, and other associated procurement issues that have received very little attention, particularly regarding making decisions on PMs selection without paying due consideration on its suitability for the project to be delivered. The chapter also reviewed the institutional and legal context within which the PMs take places in Libya, construction procurement processes, types of contracts and tendering associated with the most common PM, and factors besides procurement that influence the performance of construction Projects in Libya. The findings of the reviews offered important information that demonstrates the needs of conducting such research. The summary of the findings indicates that: DBB method is the most common method of procurement for delivering construction project in Libya wherein around 95% of country projects were procured by DBB.

The construction procurement processes for delivering construction projects in Libya usually go through three phases: preconstruction phase, construction phase and hand over. The timeline for these phases is difficult to determine, not least because of clients' habit of frequent change/additional work requests during construction. The inability of clients to fully determine their requirements and needs accurately in the pre-construction phase remains the main reason for additional/change work requests. Due to this, delay usually occurs in construction phase.

Bill of quantity and lump sum contracts are the main types of contracts the used to manage construction projects in Libya. However, the most popular form of tender in Libya is selective tender, followed by direct order tender. Submitting tender of construction projects is considered the most dangerous duty of the contractor, because the results of the submission usually have a direct effect on the continuation of the contractor and his success. Time and cost overruns are the most common problems associated with construction projects in Libya wherein the vast majority of country projects have suffered from these problems.

The findings of reviewing literature also confirmed that, in LCI there is no approved technique or systematic approach that can help clients to select the most appropriate PMs or the PMSC. As result, using of inappropriate PM is common in Libya and it has been investigated as the main reasons of the frequent time and cost overruns in recent years which demonstrate how the field of constructions is suffer as result of using the inappropriate PMs. The wrong selection of PMs mainly because, the Libyan clients did not consider the procurement criteria when they decide which the method of procurement should be used for delivering projects. They usually use this criteria intuitively based on their experience of past projects which adversely effects their PM selection. The lack of project clients' knowledge with the modern types of PMs such as construction management, management contracting and build owner operate and transfer (Boot) is another reason for the wrong PM selection.

The importance and the value of the information obtained from reviewing the literature about PMs in Libya form the underlying theory of the research. As this research looking at investigating the influence of PMSC have on PP in the context of Libya, it is very important in the first stage for this study to know which the type of PMs are used in Libya and their selection criteria, and their processes and timeline, as well as why they are commonly used and the main reasons behind wrong PM selection practice. This information can support the second stage of this research in order to develop a model to assess project clients in Libya to know how the PMs identified influence the performance of the projects and which of PMSC that have the most influence on PP.

The next chapter covers the research methodology adopted in order to address the research aim and objectives. It will provide an explanation of the different approaches and methods for conducting the research, and how data was collected and analysed.

CHAPTER 5: METHODOLOGY

5.1 Introduction

Research methodology refers to the overall approach used for the research process. This includes the theoretical position that underpins a research design and methods used in the research strategy to answer the questions. On the other hand, methods refer to actions and techniques that are used for data analysis (Saunders et al, 2009). This chapter aims to describe and justify the methodology employed to collect and analyse the data needed to address the research aims and objectives. The chapter is organized in 11 main sections. The section that follows the introduction covers research paradigms, and this includes positivism versus interpretivism. The third section covers research approaches such as deduction and induction. The fourth section reviews research strategies, followed by reviews research methods such as quantitative, qualitative and mixed method in the fifth section. The sixth section covers cross-sectional and longitudinal research. The seventh section describes the various methods used for this research study, whereas the eighth section focuses on the justifications for using them. The ninth section explains the research design followed, which covers the scope of the literature review undertaken, the design of the survey instruments (questionnaires and interviews), and the methods used for collecting survey data and their analyses. Section ten reviews the methods followed in developing and validating the model. The last section summaries key points of this chapter.

5. 2 Research Paradigms/Philosophy

The term ‘research paradigm’ has been defined by Collies and Hussey (2009) as a philosophical framework that shapes or guides how to carry out or conduct research based on people’s assumptions of the world (ontology) and the nature of knowledge (epistemology). Epistemology deals with the nature, possibility, and the general scope of knowledge (Saunders et al., 2003). Positivism and Interpretivism are the two research philosophies related to epistemology. Saunders et al. (2003) indicated that objectivism, subjectivism and pragmatism are the three research philosophies related to ontology, while Sexton (2003) relates ontology with realism and idealism. Realism has elements of both positivism and constructivism (Bryman and Bell, 2007). Saunders et al. (2003) indicate that the essence of realism lies in *“what the senses show us is reality, is the truth: that objects have an existence independent of human mind”*. The main difference between realism and positivism is that realism is concerned with multiple perceptions of reality, whilst positivism is only concerned with single reality (Saunders et al 2009; Bryman and Bell, 2007).

Hussey and Hussey (1997) earlier on described research paradigm as, *"an interpretative framework, which is guided by a set of beliefs and feelings about the world and how it should be understood and studied"*. In this regard, a research paradigm offers a basic structure and patterns underlying a system that consists of accepted set of ways, methods and theories for defining and regulating research (Taylor et al., 2007; Glenn, 2009). In more specific terms, the functions of research paradigms, as stated by Dill and Romiszowski (1997), are:

- Define how the world works, how knowledge is extracted from this world, and how one is to think, write, and talk about this knowledge;
- Define the types of questions to be asked and the methodologies to be used in answering them; and
- Structure the world of the academic worker.

According to Easterby-Smith et al. (1997), the three main reasons of understanding research philosophical paradigms are:

"(i) it can help the researcher to refine and specify the research methods to be used in a study, as well as the overall research strategy to be used (ii) knowledge of research philosophy will enable and assist the researcher to evaluate different methodologies and methods and avoid inappropriate use and unnecessary work (iii) it may help the researcher to be creative and innovative in either selection or adaptation of methods that were previously outside his or her experience" Easterby-Smith et al. (1997).

A number of studies on research approaches and paradigms (including, Fitzgerald and Howcroft (1998); Robert and Timothy (2011), and Saunders et al.(2009)) have indicated that the paradigms commonly used in research include positivist and interpretive. The positivist paradigm is largely used in quantitative research and it is based on the philosophy of logical positivism. It usually involves the use of measurements and rigid rules. However, interpretive paradigm is largely used in qualitative research and it is based on the philosophy of logical interpretivism.

5.2.1 Positivism versus Interpretivism

Positivism is a research philosophy adopted from natural science and is mainly related to examining of the essential patterns or associations in social life in order to determine their nature or condition (Blaikie, 2000). Myers and Klein (1999) argued that:

> *"Positivists believe that reality is stable and can be observed and described from an objective viewpoint i.e. without interfering with the phenomena being studied. They contend that phenomena should be isolated and that observations should be repeatable. Positivism is usually associated with structured quantitative methods such as questionnaire survey"* (Myers and Klein, 1999).

Positivism approach is associated with confirmatory research that attempts to confirm relationship between variables, and it is associated with structured approaches, involving the use of questionnaires, surveys and experiments.

However, the interpretivism approach is based on establishing the meanings assigned by people to their different actions. Such meanings are then used for discovering patterns and thoughts, as reflected by samples' experience and beliefs, to provide knowledge on phenomenon reality (Myers and Klein, 1999). This approach is associated with exploratory researches that are often pursued in a less organized manner, such as by unstructured qualitative methods, participants' observation studies and in-depth-interviews (Blaikie, 2000).

Table 5.1 summarises the basic differences between the main two paradigms as adopted from Collis and Hussey (2009).

Table 5.1: Different research paradigms

	Positivism	**Interpretivism**
1	Concerned with hypothesis testing	Concerned with generating theories
2	Associated with quantitative approach	Associated qualitative approach
3	Reality is objective	Reality is subjective
4	Knowledge is based on observable facts outside of the human mind	Knowledge is determined by people rather than by objectives external factors
5	Scientific	Humanist
6	Uses large samples	Uses small samples
7	Data is highly specific and precise	Data is rich
8	Deductive approach	Inductive approach

Source: Collis and Hussey (2009, p.58) and Hussey and Hussey (1997, p. 54)

The research philosophy adopted in this study is a combination of positivism and interpretivism. According to Saunders et al. (2007), research problems can be addressed by merging of these two research philosophies. Positivism philosophy is found suitable for the first aspect of the research data collection process due to the existence of variables that are to be subjected to quantitative measurement. This philosophy is particularly appropriate when it comes to determining the relationship between research variables, which in this is the influence that PMSC have on PP. Meanwhile, interpretivism philosophy was chosen for the second stage of the main primary data collection stage as it was found particularly suitable for helping to understand how this influence might play out.

5.3 Research Approach

Research approaches can be classified based on how a logical move is made from general ideas/theories to specific particular situation or vice versa (Bryman and Bell, 2011). There are two research approaches: deductive approach and inductive approach. According to Collis and Hussey (2009), research can be described as deductive if '*the research, starts out with a general statement, or hypothesis, and examines the possibilities to reach a specific, logical conclusion. The scientific method uses deduction to test hypotheses and theories. Sometimes this is informally called a "top-down" approach*'. Conversely, a research can be classified as inductive if the study involves developing a theory based on observations of empirical reality. So, it involves moving from specific observations to broader generalizations and theories. Informally, this is sometimes called a "bottom up" approach' (Collis and Hussey, 2009). Saunders et al. (2003) stated that in the deductive approach, theory and its hypotheses are developed in the first stage, followed by the design of a research strategy to test the hypotheses. However, in the inductive approach theory is developed from the results of data analyses carried out. Table 5.2 summarize the major differences between deductive and inductive approaches as adopted by Saunders et al. (2003).

Table 5.2: Differences between deductive and inductive approach

	Deduction	Induction
1	Scientific principles	Gaining an understanding of the meanings humans attach to events
	Usually begins with a hypothesis	Usually use research question to narrow dawn the scope of the study
2	Moving from theory to data	In-depth knowledge of the topic
3	Liked with quantitative data	Liked with qualitative data

4	Highly structured approach	More flexible structure

Source: Saunders et al. (2003)

In addition to these two approaches, Lawrence (1997) suggested that research approach can be classified as exploratory, descriptive and explanatory. Exploratory research can be used when the researcher has an idea or has observed something and seeks to understand more about it. It is also used to acquire evidence to answer ‘what’ type of research questions. Descriptive research is used when researchers seeks to provide an accurate description of observations of phenomena. It is appropriate for obtaining data to explain ‘how’ the phenomenon occurs. Explanatory research looks at how things come together and interact. This research does not occur until there is enough understanding to begin to predict what will come next with some accuracy.

The research approach to use is thus usually influenced by the type of research data and questions to be addressed (Saunders et al., 2009). Based on the characteristics of the data, the research approach can be classified as quantitative, qualitative, or mixed method. In this regard, Creswell (2003) stated that:

> “*many researchers prefer to classify the research approaches as qualitative, quantitative, or mixed approach rather than inductive and deductive, and mention induction and deduction while focusing on the role of theories in research methods or link these concepts with the research philosophy. This classification usually made based on the research method adopted*” (Creswell, 2003).

5.4 Research Strategy

As suggested by Bell and Bryman (2003) and Yin (2003), research strategy can be selected based on characteristics of the research problem and the questions needed to be answered. The strategies in use are generally categorised into explanatory, descriptive and exploratory research. Some of these strategies belong to the deductive approach and the others belong to the inductive approach (Saunders et al., 2003).

According to Robson (1997), “*no research strategy is inherently superior to any other. The research strategy used must be suitable for the questions that the researchers want to answer and objectives to meet*”. Yin (2003) indicated that there are three conditions can be used to define research strategy. These are: types of research questions, control of the investigator, and the focus on contemporary events. Table 5.3 presents the most common research strategies used for these conditions, as adopted by Yin (2003).

Table 5.3 Criteria for determining research strategies to use

Strategy	Form of research question (1)	Requires control over behavioral events? (2)	Focuses on contemporary events? (3)
Experiment	how, why	Yes	No
Survey	Who, what, where, how, how much and how many	No	Yes
Case study	how, why	No	Yes
Archival analysis	who, what, where, how many, how much	No	Yes/No

Source: Yin (2003)

Based on the research questions' type 'What' and 'How', the possible research strategies according to condition (1) could be experiment, survey, case study and archival analysis. A condition (2) indicates possible research strategies are survey, case study and archival analysis. This because the research did not involve designing the environment in which collaborative technologies takes place or test the group of people in different types of collaborative technologies implementation therefore, the experiment strategy is unsuitable. Condition (3) indicates possible research strategies are survey and case study because the study is focused on contemporary events. According to Yin (2003), a research study could use more than one strategy and that each strategy must be suitable in specific conditions.

This study used "Survey" as the appropriate research strategy to answer the research questions, and meet the objectives by gaining reliable and valid information. The research strategies applied in this study address each research question as follows:

- **Question 1** was answered by conducting an extensive literature review supported by telephone interview survey which is related to the PMs and PP. This can help the researcher to understand and knows the types of PMs currently in use and the criteria of selection as well as the criteria of measuring PP.
- **Question 2** was answered by conducting correlation and multiple regression to find out the PMSC with significant contribution to PP this based on collecting and analysis data via questionnaire and interviews.

5.5 Research Methods (Quantitative, Qualitative and Mixed methods)

According to Hussey and Hussey (1997), research methods are the methods used for data collection in a research. The aims of research methods are to find solutions to research problems or answers to research questions (Creswell, 2009). The research methods can be classified as quantitative, qualitative or mixed method (Hussey and Hussey, 1997; Sapsford and Jupp, 2006; Creswell, 2009). The main different between qualitative and quantitative research is that the former is based on perspectives and actions of subjects while the latter focuses on the testing preconceived theoretical hypotheses (Zikmund et al., 2012). Creswell (2009) also indicated that each method differs from the other based on the type of research data collected. In addition, each uses various techniques and procedures to answer different or specific research problems, objectives and questions. Usually there is no single best way of collecting data as the right method depends on the nature of the research questions and the specific questions you want to ask respondents. The aim of all methods, is to obtain valid and reliable data through the responses from respondents (Sapsford and Jupp, 2006, p.98).

5.5.1 Quantitative Method

According to Creswell (2003), "*quantitative research method is associated with the use of deduction approach as it is useful for testing theory"*. It emphasizes on the quantification of data, and relies heavily on numerical and statistical data (Creswell, 2003).The main strength of quantitative research method is the control of data (Bell and Bryman, 2003).

Quantitative method also focuses more on numbers and frequencies rather than on meaning and experience. It focus more on counting and classifying features and constructing statistical models and figures to explain what is observed. It is useful for addressing questions related to what, whom, where, how many, and how much, and can be used to measure the incidence and prevalence of a phenomena (Bell and Bryman, 2003 and El-Hassia, 2005).

Babbie (2005) stated that, the quantitative method is "*The numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect"*. He also stated that, quantitative method provides information that is amenable to analyse statistically. It is associated with the scientific and experimental approach and are criticised for not providing an in depth description.

Quantitative method is most appropriately used to "*test hypotheses with the goal of predicting or explaining situation*" (Tripp-Reimer, 1985, p.180). Bell and Bryman, (2003) confirmed that, the best technique of collecting quantitative data is questionnaire survey. Brief explanation of questionnaire survey as follow:

a) Questionnaire Survey

According to Saunders et al. (2009) questionnaire survey is one of the data collection methods used widely in different fields of science for a long time and it has been explained as a prearranged list of queries which is generally self-completed by participants. Saunders et al. (2009) emphasized that questionnaire is a good way to obtain information from a large number of people and/or people who may not have the time to attend an interview or take part in experiments. They enable people to take their time, think about it and come back to the questionnaire later. Participants can state their views or feelings privately without worrying about the possible reaction of the researcher (Saunders et al., 2009). Questionnaire tends to be used for descriptive or explanatory research. It is not particularly good for exploratory or other research that requires large number of open question. Questionnaire work best with standardised questions that you can be interpreted the same way by all respondents (Sunders et al., 2009, pp. 362).

Questionnaires can be categorized into self-administered questionnaire and interview-administered questionnaire. Self-administered questionnaire can be divided into internet and intranet-mediated questionnaire, postal or mail questionnaire and personally delivered and collected questionnaires. Interview administration can be undertaken by telephone questionnaire and structured interview (Saunders et al., 2009, p.362).

Zikmund et al. (2012) stated questionnaires normally come in the form of closed-ended questions or open-ended questions format. For instance, the style of close ended questionnaire is restricted to answering the options which are given and participants need to select from them (e.g. multiple choice, often using Likert scales) whereas open-ended questionnaire enables participants to give greater voice to their own thoughts and opinions (Zikmund et al, 2012; Oppenheim., 1992).

The main advantage of questionnaire is that it is relatively inexpensive and not time-consuming as compared to other methods of data collection, especially if administered in person or by e-mail. Participants are free to express their views privately without any stress as well as giving more accurate, clear and honest responses as a result of anonymity

(Stanton et al, 2005). On the other hand, the main common problems associated with using questionnaire is that of low response rate, if not administered face-to-face, and also the participants sometimes miss some questions or give inappropriate responses that can cause questionnaires to be discarded (Saunders et al, 2009).

5.5.2. Qualitative Method

A qualitative method is defined by Creswell (2009) as *"a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem. The process of research involves emerging questions and procedures. Data analysis inductively builds from particular to general themes"*. Qualitative method is linked with the use of deduction approach and it is useful for generating new theory. A qualitative method is more subjective; therefore, it produces results from oral data (words) and describes meanings rather than numbers, measurements and/or drawing statistical inferences (Creswell, 2003).

The primary aim of a qualitative research method is to provide a complete, detailed analysis of the research topic in order to generate theory through making new concepts in observing social practise and events in depth (Bryman, 2006). Qualitative method is ideal for earlier phases of research projects (Creswell, 2009). There are many techniques of collecting qualitative data. For instance, interviews, case study and focus groups. Each technique is particularly suited for obtaining a specific type of data. The interviews survey is considered to be the most common technique to gather qualitative data (Bryman, 2006). Brief explanations of these techniques as follows:

a) Interviews

Interview is the key data collection technique in qualitative research (Nachmias and Nachmias, 1996). It is one of the most commonly techniques that used for collecting primary data directly from the resource. This data can be assessed to examine the facts and expose new evidences and aspects of concerns depending on individual experience (Blumberg and Cooper, 2011).

Patton (1992) and Collins et al (2003) held that, an interview is mainly appropriate for a research aimed at discovering opinions, views and credibility of groups of people with regards to a specific condition or matter. Rowley (2012) stated that an interview gives a very flexible technique for gathering huge quantities of probable data concerning a broad range of topics. There are many contact channels for carrying out interviews, such as in person by telephone or via internet (Smith, 2005), and by group interviews and discussions (Frey and Fontana, 2005). Hiebl (2014) stated that although there are various methods for administering interviews, the most prevalent one in qualitative studies is face-face interviews, which allow observations to be made, and which enable the researcher to interact within the natural settings (Creswell, 2003). According to Patton (1990) and Bogdan and Biklen (1992) the format of the questions asked in interviews can be classified into three ways:

- **Totally structured:** the interviewees are asked the same question in order without any interruption.
- **Structured questions with open responses (semi-structured):** a semi-structured approach is the type of interview that enables the interviewees to speak relatively freely but which simultaneously allows the researcher to ensure that certain issues are covered.
- **Totally unstructured:** the interviewees are allowed to talk regarding specific issues without constraint from the interviewer.

The primary purpose of conducting interviews is to allow the researcher to gather data from respondents and to make direct observations as well. In addition, the physical interaction between the interviewer and interviewees and time spent to discuss the phenomenon under study can be revealing (Blumberg and Cooper, 2011 and Sultan, 2013). It is important when conducting the interview, for the researcher to have a check list or a form to record answers. This might even take the form of a questionnaire. Taking notes can interfere with the flow of the conversation, particularly in less structured interviews. Also, it is difficult to pay attention to the non-verbal aspects of communication and to remember everything that was said and the way it was said (Sultan, 2013). Interviews are optimal for collecting data on individuals' personal histories, perspectives, and experiences, particularly when sensitive topics are being explored (Rdonlyres, 2012).

b) Case Study

Case study method is used for exploratory research and it is preferred from answering "how" and "why" questions (Rdonlyres, 2012). It is considered the empirical inquiry that aims to find out a phenomenon in the real life. Case study approach involves the use of a variety of research methods for capturing research, (Yin, 1994) to provide reliable and solid results. Although, case study approach provides in-depth information and explanation of the topic, it is hard for this approach to produce pure results because observable effect is present.

c) Focus groups

Focus group interviews are used to gather information relating to the feelings and opinions of participants in a non-threatening environment (Love et al., 2008). For this method the researcher brings together a small number of subjects to discuss the topic of interest. The group size is kept deliberately small, so that its members do not feel intimidated but can express opinions freely (Collis & Hussey, 2009). A topic guide to aid the discussion is usually prepared beforehand/earlier and the researcher usually ‘chairs/heads’ the group, to ensure that a range of aspects of the topic are explored. The discussion is frequently tape-recorded, then transcribed and analysed (Rdsu, 2012). Focus groups are effective in eliciting data on the cultural norms of a group and in generating broad overviews of issues of concern to the groups (Rdonlyres, 2012).

5.5.3. Comparing Quantitative and Qualitative Research Methods

Many studies have presented the main different between quantitative and qualitative methods. For instance, Bernard (1995) and Irani (2006) conclude that quantitative and qualitative research methods differ primarily in: their analytical objectives, the types of questions they pose, the types of data collection, instruments they use, the forms of data they produce and the degree of flexibility built into study design. Table 5.4 below briefly outline the major differences.

Table 5.4: Comparison of quantitative and qualitative research approaches

	Quantitative method	**Qualitative method**
General framework	Seek to confirm hypotheses about phenomena Instruments use more rigid style of eliciting and categorizing responses to questions Use highly structured methods such as questionnaires, surveys, and structured observation	Seek to explore phenomena Instruments use more flexible, iterative style of eliciting and categorizing responses to questions Use semi-structured methods such as in-depth interviews, focus groups, and participant observation
Analytical objectives	To quantify variation	To describe variation

	To predict causal relationships To describe characteristics of a population	To describe and explain relationships To describe individual experiences To describe group norms (criteria)
Question format	Closed question	Open-ended question
Data format	Numerical (obtained by assigning numerical values to responses)	Textual (obtained from audiotapes, videotapes, and field notes)
Flexibility in study design	Study design is stable from beginning to end Participant responses do not influence or determine how and which questions researchers ask next Study design is subject to statistical assumptions and conditions	Some aspects of the study are flexible (for example, the addition, exclusion, or wording of particular interview questions) Participant responses affect how and which questions researchers ask next Study design is iterative, that is, data collection and research questions are adjusted according to what is learned

Source: Bernard (1995)

Quantitative and qualitative research methods also differ in terms of their stand on research paradigm/philosophy. Spratt et al. (2004) and Bryman and Bell (2011) compared them in this context, based on: the role of theory, theory of knowledge and view of social reality (see Table 5.5).

Table 5. 5: Basic differences between quantitative and qualitative research approaches

	Quantitative method	Qualitative method
Role of theory	Deductive approach, testing of theory	Inductive approach, generation of theory.
Theory of knowledge (epistemology)	Follows a natural science model, Particularly positivism.	Interpretative.
View of social reality	Social reality as something objective and measurable.	Social reality as something constructed by people.

Source: Bryman and Bell (2011), Spratt et al. (2004)

5.5.4 Mixed *M*ethod

The mixed method is a combination of qualitative and quantitative, which allow statistically reliable information, obtained from numerical measurement to be backed up by information about the research participants' explanations (Bryman and Bell, 2007). Creswell (2009) indicated that *"mixed method involves philosophical assumptions, the use of qualitative and quantitative approaches and the mixing of both approaches in a study"*. The use of a combination of qualitative and quantitative provides two main benefits. The first benefit is the increase in potential of the research, while the second benefit is the increase in certainty and validity of the research (Creswell, 2007). The data obtained from this method can be collected by, for example, questionnaire and interview surveys (Brannen, 2005; Bryman and Bell, 2007).

5.6 Cross-Sectional Versus Longitudinal Research

The research design can be classified according to the time dimension into cross-sectional and longitudinal studies (Blumberg et al., 2008). Hussey (2009) described cross-sectional studies as getting research data on relevant variables at the same time or within a relatively short space of time. They are conducted when there are time restrictions or limited resources. Longitudinal studies on the other hand, involve collecting data over long periods of time by taking measurements of the variables over two or more distinct periods (Blumberg et al., 2008). In cross-sectional research the focus is on drawing inferences from differences between people while, in longitudinal research the focus is on repeated observations. The main difference between cross-sectional and longitudinal research is that, the cross-sectional involves observations at one time whereas longitudinal involves multiple observations over extended time period (Blumberg et al, 2008). The time horizon of this research was chosen as cross sectional since it was not possible to access all of the organizations for a longitudinal study. Add to this, there was limited time of the PhD study.

5. 7 Determining the Appropriate Method

Bryman and Bell, (2011) argued that determining the most appropriate method for conducting research is critical issue. Construction management is a significant area of the research where different methods are used. Brad, (2012) indicated that the there is no single best way of collecting data. Determining which method to use is widely based on the purpose and the aims of the study. If the study aims to discover answers to an inquiry through numerical evidence to test a theory, then the quantitative method is considered the most appropriate. However, if the study wishes to explain further why a particular event happened or why a particular phenomenon is the case to generate a theory, then qualitative method is preferable (Brad, 2012; Bryman and Bell, 2011; Spratt et al., 2004). The methods of selection data also based on the types of research methods used for the similar past studies (Spratt et al., 2004).

Richard and Anita (2008), indicated that quantitative, qualitative and mixed method are the three most commonly research methods in the field of construction management and these methods include experiments, case study and survey. Panas and Pantouvakis (2010) reviewed eighty-nine papers published in both construction and general management journals. The results showed that the three common methods adopted by the researches of these papers are qualitative, quantitative and mixed-methods. Quantitative method dominates (60.7%), followed by mixed-method (29.2%), and qualitative method (10.1%).

Loosemore, et al (1996) conducted a survey of publications in the refereed journal Construction Management and Economics between 1983 and 1993. The results revealed a domination of quantitative data collection in construction management research wherein 65% of the articles published used a quantitative methodological approach. 15% were based on qualitative research and 20 % used, a mixed method

Carterl and Fortune (2011) reviewed the paper in ARCOM proceedings and postgraduate construction management research at Heriot-Watt University during the period between 2000 and 2003. The results presented in Table 5.6 show that, there is an increase in using quantitative research compared with qualitative and mixed method. This suggests that the use of quantitative research approaches remains predominant within construction management research and this reinforces the idea that the majority of research is still using a rationalist or scientific approach.

Table 5.6: Research Approaches in CME, ARCOM Proceedings and HWU Postgraduate Research 2000-2003

	Arcom 2000	Arcom 2001	HWU 2001-2003
Quantitative	44	41	45
qualitative	21	32	21
Mixed	35	27	34
Total	100	100	100

In the light of the above we can conclude that different studies in construction management have used different research methods based on the aim and the purpose of the study. Although all the acceptable research methods (quantitative, qualitative and mixed) were used, quantitative method was found to be the most dominant method in construction management research.

5. 8 Study Method and Rationale

Chen and Hirschheim (2004) argued that, the selection of a suitable method is a concern to any researcher, as there are a variety of research approaches and methodologies developed and implemented in the field of construction management, such as survey methods (e.g questionnaire and interviews) and case studies. Each method has its characteristics and requirements which is totally different than the others. Hall and Howard (2008) indicated that researchers need to be motivated to recognize the different types of paradigm, and to be accurate when choosing the methods that give the maximum opportunity in the study design. Braimah (2008) stated that '*The nature of a research topic, its aims and objectives and the resources available largely determine its design. These criteria largely informed the research methodology developed for carrying out this research*'.

In this study, the basic questions that need to be addressed were identified as results of analysis the objectives. The objectives posed a number of questions including:

- What are the most common PMs used for delivering construction projects in Libya?
- What are the criteria that inform the most appropriate PMs?
- What are the appropriate criteria for measuring PP out come in general and in context of Libya?
- Which of the DBB and DB procurement criteria that have the most influence on PP?
- How PMSC influence PP?

As a result of the multiplicity of the research questions and diversity in the types and sources of data required for answering these questions, it became apparent very early in the study that the data would be both qualitative and quantitative in nature. The quantitative method deals more with numbers and it is used to generate numerical data, which can then be analysed statistically to determine the whole idea of the problem by estimate and test parameters from enormous number of samples. This is applied in the form of a questionnaire survey to collect a large data pool (Babbie, 2005; Tanur, 1982). Meanwhile, the qualitative method is used to give deep and rich data by interviewing specific samples of populations to gain significant insights about the problems and factors underlying a phenomenon. The qualitative method is often applied in the form of interviews (Creswell, 2009; Babbie, 2005; Tanur, 1982).

Irani (2006) identified three key distinctions that should be considered between quantitative and qualitative research. These are "*explanation and understanding*", "*knowledge discovered and knowledge constructed*" and "*personal and impersonal role for the researcher*". Creswell (2009) stated that, applying quantitative and qualitative methods in one study named "*triangulation*", in which the strength of each method will overcome the other's weaknesses. "*One of the benefits of mixed methods is the ability to validate quantitative analysis results by adding additional information from the qualitative analysis findings or vice versa*" (Irani, 2006).

A quantitative research method involving the use of survey was adopted for first stage to identify the current methods of procurement in use to deliver construction projects in Libya. This was followed by mixed approach as main survey, involving: a large scale quantitative questionnaire survey, to answer the 'what' questions to find out the criteria of PMs with significant contribution and relationship with PP; and an in-depth qualitative investigation of issue informed by interview survey to answering most of 'how' questions to explore on how the PMSC influence PP.

The rationale for using quantitative method based on a questionnaire survey to collect data is that, this method is considered the most appropriate method for addressing the aims of the research (Bryman and Bell, 2011). As explained in section 5.7, this study seeks to test an existing theory, not to generate a new one. The survey questionnaire method allows researchers to develop background and learn from other studies conducted on the topic. The survey questionnaire method is also useful in finding answers of research questions as well as it helps in achieving clarity and accuracy in research.

Many studies have highlighted the importance of using questionnaire survey to collect quantitative data. For instance, Rea and Parker (1997) argued that "*there is no better method of research than a questionnaire survey for collecting information about large populations. Surveys are also viewed as the most appropriate method of studying participants' behaviour and job perceptions".*

Carterl and Fortune (2011) reviewed 29 of recent construction management and economics publications. The results revealed that, the most common selection data tool is questionnaire survey where in 16 out of 29 papers used a survey to collect data for the research. Rubin and Rubin (2011) emphasized that questionnaires are very broadly employed in large scale analysis to gain opinions and inclinations of certain group of people. Bowen et al. (1999) conducted an empirical study to investigate the effectiveness of the project briefing process, and the selection of procurement methods in the attainment of client objectives. Questionnaire survey was conducted to collect data. A total of 4933 questionnaires were distributed to 495 clients, 1499 architects, 607 quantity surveyors, 340 engineers, 489 project managers and 1501 general contractor.

Chua et al. (1999) studied the critical success factors in different project objectives. A questionnaire survey was developed to facilitate systematic data collection in this study. A total of 60 experts with an overall average of 20 years of experience in the construction industry were invited to participate in the survey. Frimpong et al. (2003) evaluated and analysed the cause of delay and cost overruns in construction underground water projects in developing countries. 125 questionnaires were directed towards three groups (clients, consultants and contractors) in both public and private organisation, in order to gathering data. Takim (2008) conducted research on the analysis of measures of successes in terms of effectiveness performance in the construction projects in Malaysia. The research data was obtained using field survey comprising questionnaire and interview among the four project stakeholders: the government, private clients, consultants and contractors.

Adnan et al. (2011) conducted a study to determine factors affecting the performance of construction projects in Gaza strip. Data of the study was collected using questionnaire survey covers 120 respondents. Gudien et al. (2013) conducted research on the evaluating the critical success factors for construction projects in Lithuania. A total of 45 questionnaires were used to collect data. The questionnaires were distributed via e-mail and personal delivery.

As highlighted in section 5.5.1 using questionnaire surveys to gather quantitative data provides many advantages. Various studies have been conducted to demonstrate advantages of using questionnaire survey to collect data. For instance, Sapsford and Jupp, (2006) confirmed that "*questionnaire survey is the cheapest and quickest method of data collection methods obtaining data from a large survey population and is therefore the most common choice to researchers under time and financial constraints"*. El Wardani (2004) and Irani et al. (2006) indicated that, using questionnaire survey to gather quantitative data offers great possibility to get different opinions from different groups of respondents with regard to their views on the research problems. They also stated that, several questions can be asked regarding the topic of the study simultaneously, which adds flexibility to the analysis.

Sultan, (2013) indicated that, questionnaire survey is relative speed for date collection, easy to administer and manage. Different ways can be used to administer questionnaire, such as e-mail, web (internet based), telephone and postal. He also, stated that, statistical tests possible (depended on nature date collected). Milne, (2011) indicated that, questionnaire can be carried out by researchers or by any number of people with limited effect to its validity and reliability.

On the other hand, the qualitative methods based on interviews was used to answers ‘how’ questions that were not included in the questionnaire. The answers of the interview survey gave explanation on how the PMSC influence PP. The justification of using qualitative method based on interviews survey is that to gain deep and rich data about the problems underlying a phenomenon. Furthermore it allows the researchers to collect more detailed information from relevant people based on their experience and opinion (Creswell, 2009).

Yin (2002) stated that “*the physical interaction, in face-to-face interviews, between the interviewee and interviewer, and spending more time on the essential questions to discuss complex phenomena can be revealing”* he also indicated that the interviews can help the researcher to reduce the data aligns problematic in qualitative research of this nature, and increase the reliability and conformability of the research findings

5. 9 Research design

According to Hussey and Hussey (1997), selecting of the right research processes within research design is the main step for the research success. Figure 5.1 below illustrates the steps adopted for the research design.

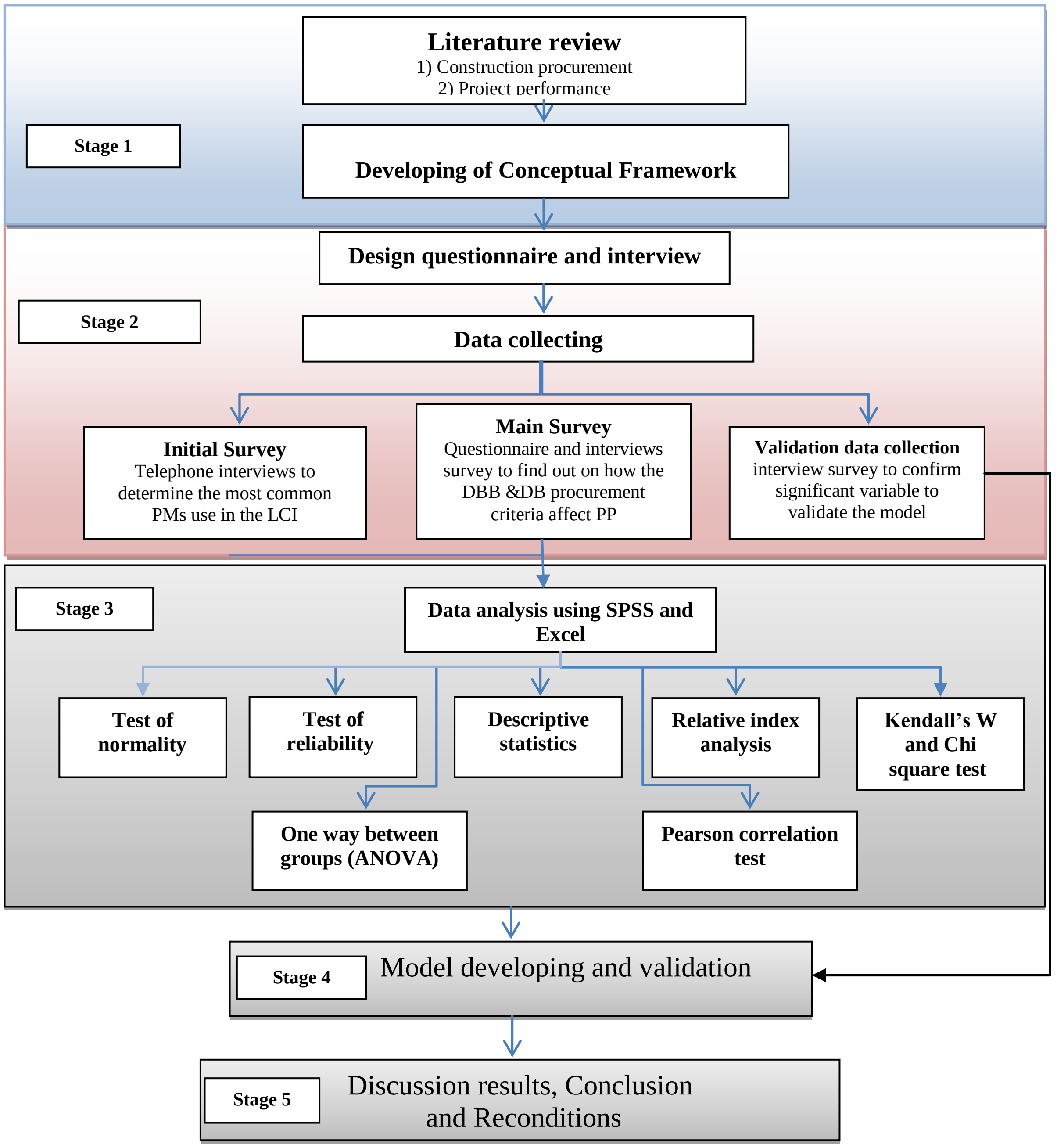

Figure 5.1: Study research design stages flowchart

5. 9. 1 Literature review

The processes start with a comprehensive review of literature relating to the PMs and PP. The objective of the review was to provide the background and context upon which the research was to be established. The findings of the literature review formed the basis of developing the conceptual framework and the subsequent field surveys. This framework was developed as a means of establishing the theoretical basis of the study. The framework was first presented at The (CIB) International Conference of Construction Management research to practice 2012 at Montreal, Canada to solicit feedback from knowledgeable academics who are active researchers in the area of construction management. It has also been published in the *NICMAR* journal of construction management in 2015.

5.9.2 Design questionnaire

Following developing the conceptual framework, the research questionnaires were designed. The questionnaire was developed by extracting the questions from previous literature in the field of construction procurement and project performance. The design of a questionnaire is influenced by how it will be administered and, in particular, the amount and nature of contact with respondents. The internal validity and reliability of data collected and response rate achieved depend, to the large extent, on the design of the questionnaire. A valid questionnaire will enable an accurate data to be collected, and one that is reliable will mean that these data are collected consistently (Saunders et al., 2009, p.371).

The questionnaire survey was designed carefully to ensure that it elicits useful responses to the various questions and also to overcome the limitations of questionnaire surveys. This was achieved by following recommended best practice supported in the literature, such as Moser and Kaltron (1986) and Oppenheim (1992). Such practice includes making sure the questionnaire is clear and accurate, easy to read and understand, as short as possible and able to complete within a matter of minutes, and prepared to flow smoothly without any hidden bias. Also, the wording of the questions was carefully considered to prevent as far as possible any misperception or vagueness. The survey was conducted over two steps: an initial questionnaire and main questionnaire survey.

In view of the nature of feedbacks being solicited, the initial questionnaire survey was designed to contain closed-ended questions. It consisted largely of multiple-choice questions that required ticking-box responses. The questionnaire was divided into two different sections. The first section was on general information including questions about profile of participation in terms of position, experience, qualification and types of project involvements. The second section consist of six closed questions which mainly focuses on the expert's opinion and overview on the most common types of Libyan construction project delivery and their popularity, the level of understanding of these, and the problems associated with their use. A copy of the initial questionnaire survey is indicated in Appendix A.

The main questionnaire was designed following an extensive review of literature. The questions consisted largely of multiple-choice questions that required ticking-box responses on a five-point Likert scale. Given that the survey respondents were dispersed throughout the whole country, the best way to send out the questionnaires was determined as postal mail and personal handing out distribution as internet facilities were found not reliable enough to be used to administer the survey, either via email or on-line surveys. The questionnaire was first subjected to intense review by the researcher before finalising it, to ensure there are no misunderstandings or ambiguities with regard to its wording.

The questionnaire was structured in two main sections. The first section contained general questions, which sought to collect general information about the personal experience and background of the respondents. It consists of four multiple-choice questions requiring ticked-box responses. The second section was related to the proposed model. It sought to collect data to establish any relationship between construction PM and PP. This section consists of fifteen closed-ended questions using a five-point Likert scale. Baker (2003) indicated that, the main reason of using five point Likert scale type question because it recognised as the most appropriate tool for obtaining information about respondents' attitudes and perceptions or analysing particular attributes, compared to asking a long list of individual questions (Baker, 2003).

The questions of the questionnaire include factors responsible for poor PP, the reasons behind selection of improper procurement type, the role of project parties' involvement in achieving good PP, the types of contracts and tendering commonly used for different construction procurement types, the level of respondent's agreement with PMSC and the extent to which completed projects meet performance standards. The data obtained from initial survey and main survey is analysed in detail in Chapters 6.

5.9.2.1 Translation

As part of the review questionnaire design process, the main questionnaire was translated from English into Arabic. The questionnaire was designed in English language by the researcher and then checked and examined by the supervisor and two academic senior lecturers in construction management in Libya in order to ensure that the questions are easy and understandable. Sultan (2013) reported that *"translating the questionnaire into the same language as that of the respondents will ensure valuable outcomes by answering the same survey variables from different respondent categories"*.

However, the questionnaire survey going to be conducted in Libya and the sample population are mostly Arabic Language speaker. Therefore questionnaire was translated into the Arabic language, the mother-tongue of the targeted respondents, in order to ensure the full understanding of the questions. The translation into the Arabic language has been done by the researcher with help of two PhD students in businesses school and one lecturer in computer science department. The translated English and Arabic versions were sent to a professional to validate both versions in terms of accuracy, meaning, fluency and words. In addition, the questionnaire was back translated from Arabic to English by other two different PhD students in order to highlight any differences.

5.9.2.2 Cover letter

Most self-administered questionnaires are often accompanied by a cover letter, which explains the purpose of the survey. Similarly, the questionnaire for this survey was enclosed with a cover letter on its first page. This formed the first part of the questionnaire. The massages/information provided in a cover letter affect response rates (Saunders et al., 2009, p.389). The letter also explained clearly and concisely why respondents are expected to complete the survey. The last paragraph of the letter explained clearly what the respondents are to do with completed questionnaire, thanked respondents for completing it and provided the researcher’s contact name, telephone number and email address for any enquires they may have. Details of the date by which questionnaires were to be returned, and when and where they should be returned, were also indicated. A sample of the cover letter is indicated in Appendix A.

5.9.2.3 Pilot survey

As a means of testing the suitability and comprehensibility of the questionnaire and the appropriateness of its structure, a pilot survey was carried out with 20 respondents who were construction professionals from the public sector in Libya. The main purpose of the pilot survey was to get useful feedback on the questionnaire with regard to its clarity and practicality of its completion by respondents. In addition, respondents were required to add any information that would enhance questionnaire. All the comments received from the pilot survey were largely positive, with the result that only slight modifications were required for the questionnaire. The responses and comments received were reviewed and a number of revisions involving deleting, adding or rewriting of questions made in the final version of the questionnaire. A copy of this version of the questionnaire is indicated in Appendix A.

5.9.3 Design of Interviews

The nature and scope of the issues to be investigated by the interviews for this study suggested that, a mixture of closed-ended questions (‘yes or no’ questions) and structured questions with open responses (semi-structured) as the most appropriate options for designing the interview questionnaire. Such interviews allow better scope for discussion and extract deeper knowledge of the problems, future predictions, opinions and views of the respondents (Sultan, 2013). The interviewees were required to provide information on specific questions related to how the PMSC affects PP; factors responsible for poor PP; and general information with regard to the construction projects in Libya.

The interview questionnaire was designed following recommended approaches highlighted by authors such as Bogdan and Biklen (1992), Rossman and Rallis (1998) and Creswell (2007), to ensure that the questions are appropriate and well presented. The questionnaire was divided into three sections. The first section sought to gather general information about the personal experience and background of the respondents. The second section sought to collect data on how the PMSC affect PP. The third section then contained general information with regards to the Libyan construction projects for example, the most important factors responsible for poor project performance, and the reasons of why Libyan public clients is unable to comply with administrative contracts regulation (*ACR*). The data obtained was later transcribed and analysed. A copy of the questionnaire is shown in Appendix B.

5. 9. 4 Sampling

Due to lack of specific sampling frame for construction organisations with relevant experience in procurement matters, non-probability sampling techniques (Barnet, 1991; Burns, 2000) were used to determine the study sample. The process involved first selecting a total of 200 professionals of the LCI who work with client, contracting and consulting organisations, using a combination of quota and purposive sampling as typically described by Patton (1990) and Barnet (1991), from a database developed by the Public Project Authority (PPA, 2010), the main governmental body responsible for monitoring construction operations in Libya. This database, entitled “Housing and Infrastructure

Project Annual Report", contains details of client, contracting and consulting organisations with significant involvement in all projects executed in the country between 2006 and 2010. The sample selection was based on two main criteria: the need to ensure that the selected professionals have the relevant experience on construction procurement practice and also the need for the survey outcomes to be generalizable over the study population.

Kish (1965) indicated that sample size is very important factor in sample design. He also indicated that statistical calculation is used to ensure the chosen sample fully represents the population. Hogg and Tanis (2009) suggested that the representative sample of the population (target respondents) can be calculated using the formulas shown in the Eqs. below:

$$n = \frac{m}{1+\left(\frac{m-1}{N}\right)} \text{ .... (1)}$$

$$m = \frac{z^2 \times p \times (1-p)}{e^2} \text{ .... (2)}$$

Where:

- ***n** is the sample size of the population (the targeted sample size of the respondants)*
- ***m** is the* unlimited sample size of population
- ***Z** is the statistical value for confidence level used, i.e., 2.575, 1.96, and 1.645 for 99%, 95% and 90% confidence levels, respectively*
- ***P** is the value of population proportion which is being estimated*
- ***e** is the sampling errors of the point estimate*
- ***N** is the available population (the total number of construction professionals involved with past projects in the country)*

Since the value of population proportion (*P*) is unknown, Sincich et al. (2002) suggested a conservative value of (50%) to be used. Using a 95% confidence level, the sampling error (e) will be 5% (Richard and Anita, 2008). The unlimited sample size of population (*m*) is approximated as follows:

$$m = \frac{(1.96)^2 \times 0.50 \times (1-0.5)}{0.05^{\,2}} = 385$$

According to database developed by the Public Project Authority (PPA, 2010), the number of construction professionals involved with past projects in the country during the period between 2006 and 2010 were 600. As result, the target respondents required in this study can be calculated as follows:

$$n = \frac{385}{1 + \left(\frac{385 \;\; - \;1}{600}\right)} = 234$$

The above analysis suggested that 234 respondents would represent the right sample size that is representative of the study population. However, the attainment of this size was constrained by the need to select only respondents that satisfy the 2 main sampling criteria noted earlier on. This explains why the sample size that was actually used was 200, which is slightly less than the expected 234 that could not be obtained due to the characteristics of the study population from which the sample was drawn from.

5. 9. 5 Data collection

Following the designing of the questionnaire and determine the sample size, research data was collected. Data collection is one of the most important stages in conducting a research. It is considered a crucial requirement necessary for achieving the objectives of the study (Bell and Bryman, 2003). Bryman (2007) indicated that collecting data is a very difficult job which needs comprehensive planning, hard work, patience, perseverance and more to be able to complete the task successfully. Saunders et al (2009) stated that "*You can have the best research design in the world but if you cannot collect the required data you will be not be able to complete your project*"

Different methods of data are required for this study, necessitating different methods of data collection. According to Bryman (2007) "*choosing several different procedures, such as documentation, archival records, reports, case studies, survey questionnaire and interviews for data collection will support the outcomes of the research being investigated, as the validity and reliability is increased*". The data in this study was collected through two different sources, primary sources and secondary sources. These sources are described as follows:

- **Secondary data**: The main propose of the secondary data is to produce significant background and information for the framework implementation. Different sources were used for collecting secondary data in this study. These include several PMs books, conference proceedings, journal article, and online databases, such as Science direct, Scope and reports. These resources were used (i) to identify the different types of procurement methods currently in use, and (ii) to determine the criteria of selecting PMs and PP to be tested and investigated in survey questionnaire and interviews in the primary data collection stage. Twenty-three criteria for DBB and DB procurement method and three criteria of PP were identified and listed as a guideline to develop the questionnaires for this study.

- **Primary data:** this data of the research was collected from questionnaire survey and interviews (see section 5.9.5.1 and 5.9.5.2). Based on these, the most common methods of construction procurement used to deliver projects in Libya and the impacts of their selection on PP were identified.

5. 9.5.1 Initial survey data collection

The main objective of the initial survey data collection was to gather relevant information about construction PMs used in Libya, including determining which of the methods are the most common and preferable to clients. The initial survey data was collected through questionnaire and telephone interviews covers 25 experts with no less than 11 years of working in the Libyan construction sectors. Detailed information of why, how, when, who and where the initial survey data was collected presented in the next chapter data collection and analysis (see section 6.2). The findings from initial survey of the data collection were then used to devise the questions for a major questionnaire survey (quantitative) for the second stage (main survey) that followed.

5. 9.5.2 Main Survey data collection

Collecting data of the main survey (quantitative and qualitative) involves both self-administrated questionnaire and interviews survey.

- *Collecting data via self-administrated questionnaire (quantitative data)*

The main objective of the main questionnaire survey was to examine the correlation and the effect of the DBB and DB procurement criteria on PP in Libya. Self-administrated questionnaire survey with 200 experts from client, contractor and consultant organisations was conducted. The respondent of each organisation were represented different work experiences and positions. Detailed clarification of why, how, when, who and where the data of the main questionnaire collected was presented in the next chapter data collection and analysis (see section 6.4).

- *Collecting data via interview survey (qualitative data)*

The main objective of the interviews was to answer the ‘how’ questions of the research, which were not included in the questionnaire as they could not be addressed satisfactory through the main questionnaire surveys. Data was collected through semi structured interview involved 17 respondents who had long years of experience in construction and project management. Detailed description of qualitative data collection including responses relating to “why” and “how” questions were collected and are presented in the next chapter (Chapter 6).

5. 9. 6 Data analysis

The initial and main survey data were largely nominal and ordinal in nature, as most of the responses were based on ratings measured on the Likert scale. For most parts of the questionnaires respondents were asked to rate a number of variables in respect of construction PMs using a five-point Likert scale. In the main questionnaire, the respondents were mainly required to complete questions relating to PMSC and PP based on their experience with recently completed DBB & DB projects that they are most familiar with. The results obtained were analysed using parametric statistics involving descriptive statistics analysis (e.g. frequencies), relative index analysis, Kendall’s *W* and Chi-square test, one-way between group (ANOVA) test, Pearson correlation test and multiple regressions. The analyses of all these were aided by Statistical Package for the Social Sciences (SPSS) and Microsoft Excel for Windows application software packages. Prior to subjecting the data to analyses, test of normality were first conducted to ascertain whether the distribution of the date is normal or otherwise. The reliability of the data collection instrument used was also assessed. Table 5.7 describes the types of tests used to analyse the quantitative data, which are explained in detail in Chapter 6.

Qualitative date collection was analysed using Microsoft Excel for Windows application software packages this is for closed ended questions however, the structured open questions were analysed manually.

Table 5.7: Data analysis Techniques and Descriptions Applied in this study

Required analysis	Purpose	Analysis technique	Tools	references
Initial Data Analysis	To check the data set for errors before starting analysis	Frequency and Range (min and max)	SPSS	Pallant, (2010); Field, (2005)
Test of normality	To ensure that the distribution of data is normal and linear	Test of , Skewness and kurtosis; P-P plot	SPSS	Pallant, (2010); Field, (2005)
Multicollinearity	To ensure that correlation matrix of three of more independent variables should be weakly related to each (<0.70)	VIF and Tolerance	SPSS	Pallant, (2010); Field, (2005)
Outliear	To identify a case of an extreme value	Mahalanobis and Scatter plot	SPSS	Pallant, (2010); Field, (2005) Tabachnick and Fidell (2010)
Reliability	To measure the consistency of the questionnaire	Cronbach's α	SPSS	Pallant, (2010); Field, (2005)
Descriptive statistics	Describing the characteristics of the sample (respondents)	frequencies, percentages, means, medians and standard deviation	SPSS	Pallant, (2010); Field, (2005)
Relative index	To rate each factor based on the weight given by the respondents	Mean and frequency	SPSS	Moore et al. (2003). Holt (1998)
Kendall's W and Chi square	To determine the degree of agreement among the respondents in their rankings and to insure that this agreement is not by chance	Kendall's (*W*) and Chi Square (χ^2)	SPSS	Frimpong et al. (2003); Moore et al. (2003); Field, (2005)
One way between group ANOVA	To compare the means or variance between three different groups or more	Levene's , ANOVA and Post- hoc,	SPSS	Field, (2005); Pallant, (2010)
Correlation test	To determine the strength of the relationship between variables	Pearson correlation	SPSS	Field, (2005); Pallant, (2010); Tabachnick and Fidell (2010)
Multiple Linear Regression (MLR)	To assess the contribution to the outcome factors within three predictor variables	R^2, P and T values of the items contributed to the model	SPSS	Field, (2005); Pallant, (2010); Hair et al. (2010);

5. 10 Model Developing and its validation

5.10.1 Developing the Model

The steps next analysis data collection is developing and validation of the model. MRA has been employed in order to determine the most contributed PMSC for developing the model. MRA technique can be considered as an excellent method to find out the relationships between one dependant variable and set of independent variables.

Additionally, it shows which independent variables can make significant contributions with dependent variable. The construction of the model was mainly based on 23 independent criteria (PMSC) and three PP dependent criteria. These PMSC and PP criteria were identified as relevant from the literature review. A detailed description of the model is reported in chapter 7. Figure 5.2 presents block diagram describes the influence of PMSC on PP.

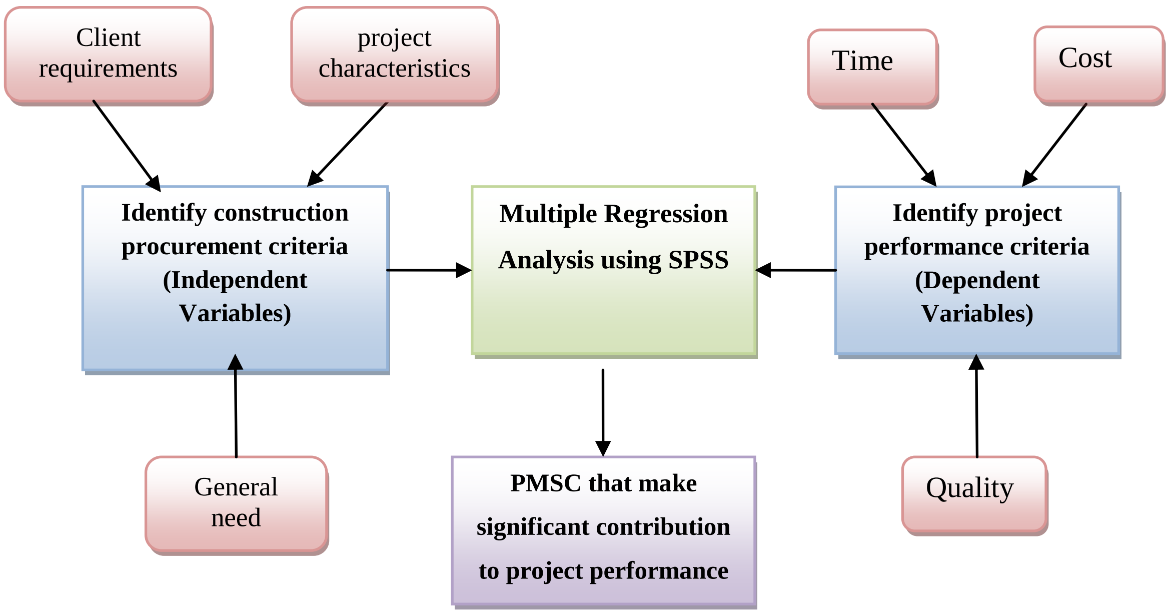

Figure 5. 2: Block diagram describes the influence of PMSC on PP

5. 10.2 Model validation

Validation is an essential part of the model development process if models are to be accepted and used to support decision-making (Macal, 2005, Braimah, 2008). In order to validate the model, and to also deeply investigate some aspects of the main survey responses, a case-study based on past projects executed in Libya was conducted. This involved conducting face-to-face semi-structured interviews with key construction experts who participated in those past projects. The interview questionnaire was meant to collect data needed to validate the model developed in Chapter 7 regarding the influence that PMSC have on PP. The interview questionnaire comprised of a combination of closed questions requiring tick-box responses on a five-point Likert scale and structured questions with open responses (semi-structured). This is because the nature and scope of the data to be collected were more amenable to these formats. The interview questionnaire was divided into three different sections. The first section covered general information about the project including questions such as the project type, planned and actual cost, planned and actual duration. In vthe second section, the interviewees have been asked to provide information on the extent to which the DBB and DB procurement criteria used in developing the model influence the performance of projects they have been involved with. Section three sought to explore whether any other PMSC affect PP. A copy of this questionnaire is indicated in Appendix F.

5. 11 Summary

This chapter has presented an outline of the research methodology adopted for carrying out this research. The focus of this chapter was on classifying the different research paradigms, approaches and methods such as positivism and interpretivism, deductive and inductive, qualitative, and quantitative. These methods are considered as the cornerstone in aiding the researcher to identify the appropriate method that need to be used in the research. The steps of the methodology followed in undertaking this research involved, firstly, an intensive literature review on construction PMs and their criteria, and the PP criteria. This was then followed by developing a conceptual frame work that demonstrates the theoretical base of the relationship between PMSC and PP. The third stage was data collection. Field survey comprising questionnaire and interview with objective of finding out how the most common PMSC affect project performance was conducted. The data collected were analysed, with the aid of SPSS and Excel, using a variety of statistical methods including test of normality, test of reliability, descriptive statistics relative index analysis, Kendall's *W* and Chi-square, one way between groups (Anova), Pearson correlation test. The model was developed using MRA and then validated via project case study based on some projects undertaken in Libya. The information gathered from literature review, data analysis and model developed will be used to draw conclusions in respect of the research objectives and recommendations for future studies.

The next chapter will present the data collection and analysis of the initial and main survey (quantitative and qualitative).

CHAPTER 6: DATA COLLECTION AND ANALYSIS

6.1 Introduction

The purpose of the chapter is to provide detailed analysis of the results of the initial and main surveys conducted with clients, contracting and consulting organisations across Libya. The findings/ results from the analysis will be used to draw up the conclusion and recommendation as well as developing the model of the forthcoming research. Detailed information on the design of the initial and main questionnaire as well as the design of the interview was presented in Chapter 5.

This chapter firstly, presents the data collection and analysis of the initial survey carried out through questionnaire and telephone interviews with 25 selected experienced practitioners in the Libyan construction sectors in order to obtain relevant information about construction PMs in Libya including which one of them consider the most common in use. This includes: (a) characteristics of the respondents; (b) the common types of construction PM that used to deliver projects in Libya; (c) the level of understanding of the most common procurement types; (d) the main problems associated with using the common procurement types; and (e) the level of project performance criteria have a source project dissatisfaction. The finding obtained was used as base to devise the questionnaire for the main survey.

Secondly, this chapter also presents the data collection and analysis of the main survey responses carried out through questionnaire with 200 selected experts in Libyan construction sectors followed by semi structured interviews involved 17 experts in Libyan construction and project management sectors to explore which criteria of DBB and DB methods have significant correlation/relationship with PP outcome and how these criteria influence PP. The main survey covers: (a) the initial survey data (screening and cleaning), which are then tested for normality and reliability, (b) the characteristics of the respondents and their organisations, followed by (c) factors identified as responsible for poor PP, (d) the reasons behind selection the improper method of procurement by project clients, (e) the role of project parties in achieving high levels of performance, (f) data concerning the types of contracts and tendering commonly used, (g) the influence of selection criteria on the choice of DBB and DB methods, (h) the consideration of the extent to which completed projects meet performance standards, (i) the correlation/relationship between selection procurement criteria and project performance, (j) demonstrates how DBB and DB procurement criteria influence upon PP, (k) the factors besides procurement that cause poor P, (l) explains the reasons that make public client in Libya unable to comply with the Administrative Contracts Regulation (ACR).

6.2 Initial survey data collection

The main focus of this section is to describe the selected sample and the purpose of the survey. As highlighted in section 5.9.5.1, the main purpose of the initial survey is to collect relevant information about construction PMs in Libya, to help confirm and establish the focus of the issues of this research investigation, including the rationale clients follow to decide on the appropriate PM to use for any given project. Data was collected through self-administered questionnaires and telephone interviews conducted in October 2011. Thirty questionnaires were emailed to experts who have experience of no less than 11 years of working in the Libyan construction sectors. The respondents were given 20 days to answer the questionnaires. Semi-structured telephone interviews technique was also conducted with respondents who experienced difficulties in understanding some questions. Each interview lasted between 20 to 25 minutes. A debriefing memo was written after each interview. The selected respondents worked in clients and contractors organizations. Registered contact persons in those organizations were the first approached by email or telephone in order to ask them if they or other more suitable persons in their organizations were willing to participate in the study. Hence, it was up to the contact person to choose the most suitable respondents given. The selected respondents were project managers, quantity surveyors, project coordinators, design engineers, construction engineers and general supervisors. Only 25 questionnaires were received within the time allocated. 13 questionnaires were received from clients' organisations while the rest were received from contractors' organisations. Detailed description of the questionnaire design has been presented in section 5.9.2.

6.3 Initial Survey Data Analysis

Data was analysed statically using SPSS and Microsoft Excel for Windows application software package. The results are presented below.

6.3.1 Section I: Respondents profile

The purpose of this section is to describe the respondents' designations, experience, type of projects involved with and their education.

6.3.1.1 Respondent categories/designation

Table 6.1 presents the respondents' professional distribution and the percentage of their involvement in the survey from each category/designation.

Table 6.1: Respondents' professional distribution

	Respondent's profession	No. of respondents	Percentage of respondents %
Client construction organizations	Project manager	5	38.46
	Quantity surveyor	2	15.38
	Project coordinator	4	30.78
	Designer engineer	2	15.38
Contractor Firms	Project manager	5	41.66
	Project coordinator	3	25.00
	General supervisors	2	16.67
	Site engineer	2	16.67
Total		25	100

The results reveal that, the majority of the respondents were project managers in both client construction organisations and contractor firms. They are recorded the highest participation rate in this survey forming 38.46% in clients' organisations and 41.66% in contractors firms. This is probably because project managers usually occupy crucial and active positions that offer them quick access to vast project information unlike the other participants. Project managers tend to generally be in close association with all phases of projects, which thus make their responses particularly useful.

6.3.1.2. Respondent experience in the LCI

The respondents were originally categorised into four experience groups. These were; Group 1 (11-15), Group 2 (16-20), Group 3 (21-25), Group 4 (>25). The results presented in Table 6.2 show that the respondents with experience between 21-25 years having the highest proportion forming 40% while those with 11-15 years having the lowest proportion forming 8%.

Table 6.2: Distribution of respondents' years of experience

Years of experience	Frequency	Percent (%)
11-15	2	8.0
16-20	9	36.0
21-25	10	40.0
>25	4	16.0
Total	25	100.0

It can be concluded from these results that, (i) most of the respondents had been working in construction sector for 11 years and above, which means they are experienced and therefore in a position to respond to the questionnaire (ii) to help achieve more global results, participants will be categorised into Group 3 (21-25).

6.3.1.3 Types of construction projects respondents are involved with

The respondents were asked to indicate the types of projects that they are involved with. The results show that the respondents were involved with only three types of projects: buildings, roads and other infrastructure projects (e.g. water supply and sewage networks), with 52%, 32% and 16% respectively.

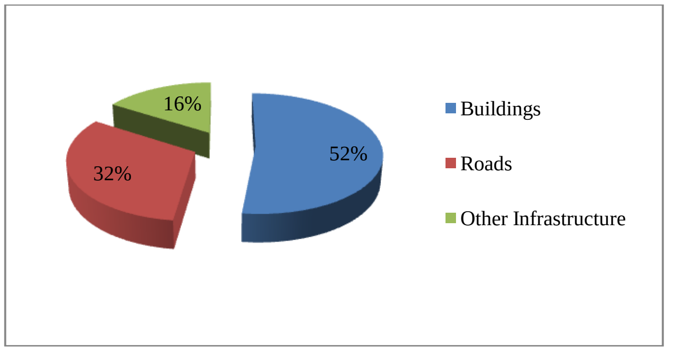

Figure 6.1: Types of projects respondents involved with

6.3.1.4 Respondent academic qualifications

Based on their academic qualifications, respondents were categorized into 3 main groups. The analysis of frequencies presented in Figure 6.2 shows that, the highest proportion of participants fall in the group which were MSc degree holders forming 56%, while the lowest fall in the PhD degree holders forming 4%.

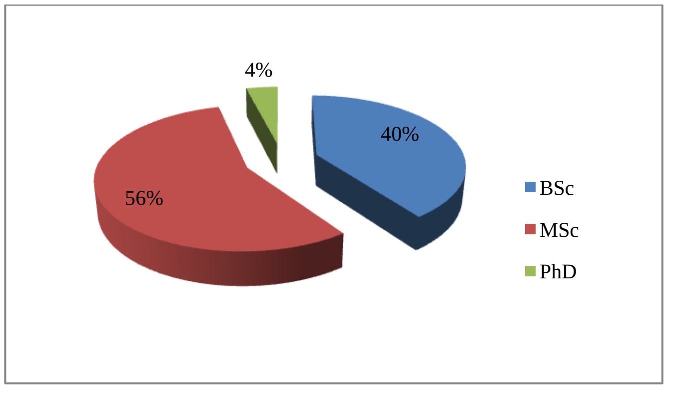

Figure 6.2: Respondents' academic qualification

This result can explain that the construction companies in Libya are in favour of postgraduate employees (MSc) staying on in work. This is probably as a result of their ability to properly direct the employees to their professional goal of achieving high level of qualification in the company furthermore, their scientific and practical ability to properly monitoring, organising, managing and supervising construction projects.

In summary, it is interesting to see that, the sample selected to participate in the initial survey brings a balanced response although their position is different. Project managers in the client organizations and contractor firms recorded the highest participation rate. All the participations with up to 11 years of experience in construction field and the majority of them are MSc degree holder.

6.3.2 Section II: Construction PMs currently in use and PP measures

The purpose of this section is to presents the experts' view and perception on the following: the most common types of Libyan construction project delivery, their extent of use, the criteria for measuring the performance, the level of understanding of the most common PMs. the main problems associated with PMs, the level of project performance in LCI and the performance criteria causing project dissatisfaction.

6.3.2.1 Construction Procurement Methods in Use

Figure 6.3 indicates that, of the different types of construction PMs used to deliver projects, only DBB and DB methods are in use in LCI. The results revealed that 92% of Libyan projects are procured by DBB method, whilst only 8% are procured by DB method.

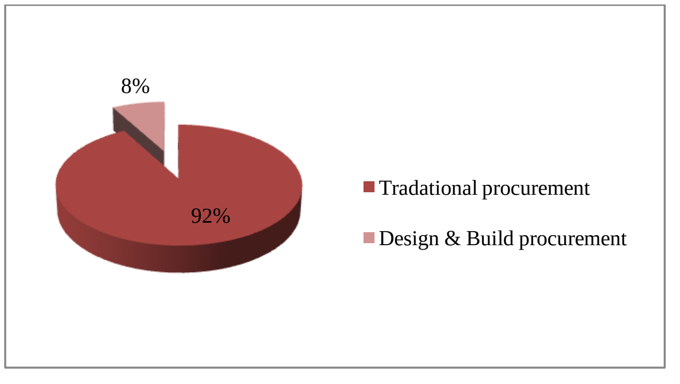

Figure 6.3: Types of construction procurements

These results demonstrate that DBB method is the most common and preferable in use, this is may be as a result of the lack of experience and knowledge of project clients with the modern types of procurement such as construction management (CM), management contract (MC) and build own operate transfer (boot) and others.

6.3.2.2 Criteria for measuring Project Performance

The respondents were asked to indicate the criteria by which the most common PMs have ensured successful project delivery. Figure 6.4 shows the analysis of the results. It can be concluded from these results that time, cost and quality are the main criteria of project success as confirmed by the vast majority of respondents.

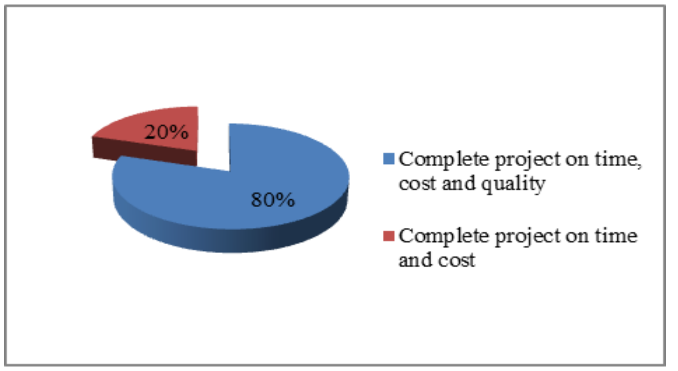

Figure 6.4: Criteria of successful procurement method

6.3.2.3 Level of Understanding of DBB

The respondents were asked to indicate on a scale of 1 to 5 their level of understanding to the most common procurement type, where 1 represented 'low level' and 5 represented 'high level'. The results shown in Table 6.3 indicate that, the majority of respondents forming 72% had a very high understanding of the most common procurement type.

Table 6.3 The level of understanding DBB

		Frequency	Valid Percent
	Neutral	2	8.0%
	High	5	20.0%
	Very high	18	72.0%
Total		25	100.0

6.3.2.4 The Main Problems Associated with DBB

The respondents were asked to state the problems that are often associated with using the most common procurement type. The frequency distribution in Figure 6.5 shows that, time overruns is considered to be the main problem associated with using the most common procurement type as it has been given the highest proportion by overall respondents forming 60%. This is followed by cost overrun and poor quality level.

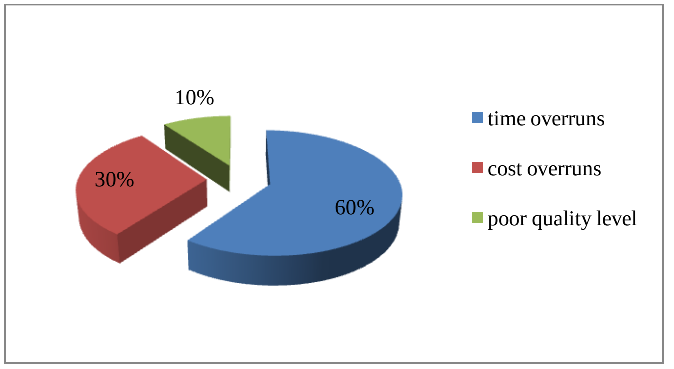

Figure 13: Problems associated with procurement method

6.3.2.5 Level of Project Performance in the LCI

In order to find out the level of performance in the LCI, respondents were asked to indicate on a scale of 1 to 5 the project performance level of the LCI, with 1 representing ‘very poor performance’ and 5 representing ‘excellence performance’.

Table 6.4: The level of performance of the LCI

Level of PP	Frequency	Valid Percent	Average respondents score
Poor	15	60.0%	2 of 5
Neutral	6	24.0%	
Good	4	16.0%	
Total	25	100.0%	

The results presented in Table 6.4 above demonstrated that, in average the performance of the LCI can be classified as poor, according to the average respondents’ score of 2 of 5.

6.3.2.6 Performance Criteria Causing Project Dissatisfaction

With regard to PP, the respondents were asked to indicate on a scale of 1 to 5 (1 representing ‘very low frequency’ and 5 representing very high frequency’) how often each the following performance criteria (time, cost, quality, health and safety and environment and social) have been a major source of project dissatisfaction.

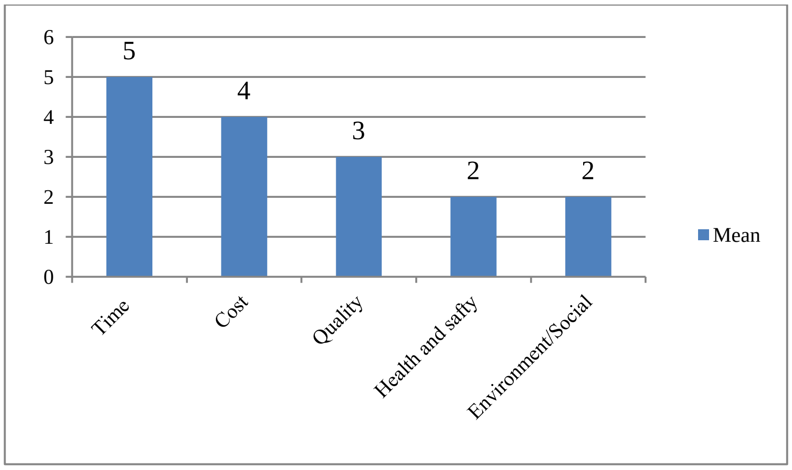

Figure 6.6: The mean frequencies of performance criteria

The analysis of the results presented in Figure 6.6 above demonstrates that on average, time performance has been the highest source of project dissatisfaction, as represented by an average score of 5. This is followed by cost performance with 'Health and Safety' and 'Environment and Social' performance criteria, in decreasing order of being sources of dissatisfaction.

In summary, the findings of Section II confirm that DBB and DB are the only two project delivery methods used in Libya with the majority of projects being procured by the DBB method. The performance of the projects were measured based on the criteria of time, cost and quality of projects' completions. The main problems associated with using DBB method are time overruns, cost overruns and poor quality respectively.

The findings from initial survey were thus used as the basis to devise the questions for the main questionnaire survey that followed. The results of the first stage, as highlighted in the above section, led to the design of the main questionnaire survey that captures experts' perceptions on projects procured by only these two methods (DBB and DB) in terms of the extent to which their selection criteria were compatible or amenable for their use on those project, as well as their views on how the projects fared with regards to the three main PP criteria (time, cost and quality).

Main Survey Data Collection and Analysis (quantitative and qualitative)

As explained in Section 5.9.5.2, mixed method (quantitative and qualitative) involving questionnaire and semi-structured interviews were used to collect the main survey data.

6.4 Quantitative Data Collection

The main focus of this section is to describe the selected sample and the purpose of the questionnaire. A survey instrument was carried out with the main objective of examining the relationship and the effect of the DBB and DB procurement criteria on PP in Libya. Self-administered questionnaire survey data collection was conducted between December 2011 and January 2012. A total of 200 questionnaires were distributed to the managing directors of the main construction organizations (consisting of clients, contractors and consulting firms) identified from a database of firms registered under the Public Project Authority, which is the main body in Libya responsible for monitoring the operations of construction organizations. The questionnaires were accompanied with cover letter, explaining the purpose of the survey and asking that senior staff members with major involvement procurement selection be encouraged to complete it (see section 5.9.2.2).

Almost half of the respondents 45% were from client organisations, 35% were from contractor organisations and 20% were from consultant organisations. The represented of each organisation were represented different work experiences and positions, which included project managers, design engineers, architecture engineers, quantity surveyor, and general supervisors. The departments from which the respondent participated were construction and engineering management, design and planning and civil work. These departments have been chosen due to their direct relation and involvement in monitoring, evaluating and following up construction projects.

Respondents were given 45 days to respond to the survey. To increase the survey response rate, reminders were sent out after a month of distribution. In the final analysis, 136 questionnaires were returned out of which 126 were assessed to have been completed properly and were useful for analysis. This represents a response rate of 68%, which is quite high compared to the norm of 20-40% for surveys of construction organizations (Furtrell, 1994).

6.5 Quantitative Data Analysis

The quantitative data was analysed statically using SPSS. The following tests were carried out to analyse quantitative date including; initial analysis of data, test of normality, test of reliability, descriptive statistics analysis (e.g. frequencies and mean), relative index analysis, Kendall's *W* and Chi-square test, one-way between group (ANOVA) and test of correlation. Before starting the processes of the data analysis, the data should be tasted in terms of screening and cleaning, normality and reliability as following:

a. Initial Analysis of Data (screening and cleaning)

The main objective of conducting the initial data analysis is to check the data set for errors before starting analysis. Mistakes in data entry can produce errors that severely compromise subsequent analysis (Pallant, 2010). The meaning of checking errors is looking for the values that fall outside the range of possible values for a variable. For instance, if the range of the variable score is between 1 and 5, a score of 0 would be invalid. This section describes the procedure of screening and cleaning the data to ensure that the input of the data is correct and is ready, to prevent any errors, before starting the process of the main analysis. The test of screening and cleaning was conducted by re-running the frequency tables and descriptive statistics (e.g., mean, standard deviation, minimum, maximum and range) in order to check the errors, missing data and identify for any unacceptable or null and out of range data (Pallant, 2010; see Appendix C). In exploring the suitable technique for this type of data, it must be checked in terms of normality, in order to gain good results (Hair, 1995).

b. Test of normality

Prior to subjecting the data to the statistical analysis, normality testing was first conducted. The purpose of this test is to ascertain whether the distribution of data is normal or not. This is particularly important in research having a sample size over a hundred, as the data may not keep to a normal distribution (Field, 2005. p.93). Although the normality of the variables is not usually necessary for analysis, results are usually better if the variables are normal distributed (Tabachnick and Fidell, 2006). For small sample size, the Kolmogrorov-Smirnov (KS) test is used to check the normality of the distribution (Pallant, 2010). If the test is non-significant ($p > 0.05$), the distribution of the sample is not significantly different from a normal distribution (i.e. it is probably normal). If, however, the test is significant ($p < 0.05$) then the distribution is significantly different from a normal distribution (i.e. it is non-normal), and there is a deviation from normality (Field, 2005. p.93).

For large sample size, the normality should be checked in terms of skewness and kurtosis as they are the major components of the normality (Pallant, 2010; Tabachnick and Fidell, 2006). Skewness refers to the distribution of the variables when the mean of the distribution is not at the centre, while kurtosis refers to the peak of the distribution (whether the distribution of the variables is too peaked or too flat). In order to ensure the data distribution is normal, it should be checked for skewness and kurtosis to confirm (or otherwise) as to whether the data lie within acceptable values of ± 1.0 (Hair et al., 2006). If the values of skewness and kurtosis are zero, then the distribution of the variables is normal. As result, all the quantitative data were tested and were found to have acceptable values of skewness and kurtosis, as presented in Appendix C.

c. Test of Reliability

To add validity and accuracy to the interpretation of the data, Cronbach's alpha (the most widely used index for objectively measuring the reliability of an instrument) was employed. The main objectives of this test is to measure the internal consistency of a questionnaire instrument, i.e. the extent to which all the items in a test or scale measure the same concept or construct, and hence its connection to the inter-relatedness of the items within the test (Bland and Altman, 1997). The acceptable values of alpha for consistency range from 0.70 to 0.95, as defined by many previous studies (e.g. De Vellis, 2003; Field, 2005; Pallant, 2010; Tavakol and Dennick, 2011). The reliability of scale can vary depending on the sample. It is necessary to check that each scale is reliable with the particular sample. If the scale contains some of items that are negative, then it needs to be reversed before checking reliability (Field, 2005; Pallant, 2010, p.97).

Table 6.5 shows the alpha values for each procurement selection criteria, each of which is greater than 0.7, and overall average values of 0.770 for DBB method and 0.761 for DB method. The results thus suggest that, all the selection criteria are of high reliability, implying that there is high interrelatedness between them, and each is capable of measuring the same latent traits on the same scale. This tells us that all PMSC are positively contributing to the overall reliability, which indicates good reliability. The results of the reliability tests of the other questions (factors responsible for poor pp, reasons of selecting the improper PM, extent of project parties' involvement in project delivery, types of contracts and tendering used) have been shown in the appendix C. the results show the overall average value of Cronbach's alpha as being > 0.70 for all items, which means the reliability is good.

Table 6.5: Test of reliability for selection DBB & DB procurement criteria

DBB procurement method		**DB procurement method**	
Selection criteria	**Cronbach's alpha**	**Selection criteria**	**Cronbach's alpha**
High price competition	0.776	Quick delivery of construction processes	0.721
Clarity of scope definition	0.750	Quick project commencement	0.759
Complexity of design	0.775	Effective communication between project parties	0.721
High quality level required	0.754	Flexibility in design & construction changes	0.741
Clear definition of project parties responsibilities	0.730	single point of responsibility	0.749
Client involvement in the project	0.769	Less conflict amongst project team	0.735
Controllable project variations	0.766	Complexity of design	0.759
Cost certainty	0.749	Transfer of risks to the contractor	0.760
Time certainty	0.734	Desiring reduced project cost	0.744
Ease of organizing and reviewing project activities	0.732	Desiring reduced project time	0.740
Desiring efficient project planning	0.736	Level of competent and experienced contractor	0.755
Project functionality	0.743	Collaborative working relationship between project team	0.724
		Desiring efficient project planning	0.735
Overall Cronbach's α	**0.770**	**Overall Cronbach's α**	**0.761**

d. Descriptive Analysis

Descriptive statistics aim to analysis and describe the basic features of data in a study in manageable form and make it more easily understandable and clear. Tables, pie charts, bar charts and graphs are used to describe the data (Field, 2005; Pallant, 2010, p.97). This includes mean, mode, median, range, standard deviation, skewness and kurtosis (Tabachnick and Fidell, 2006). According to the Pallant (2010, p.53) descriptive statistics have a number of uses, including:

- Describing the characteristics of the sample.
- Checking variables for any violation of the assumptions underlying the statistical techniques used to address the research questions.
- Providing simple summaries about the sample and the measures in a sensible way.

e. Relative index analysis

The relative importance index is a technique, which has been used widely in different types of questionnaire to rate factors based on the weight given by the study respondents (Moore et al., 2003). Holt (1998) indicated that relative index is used to further analyse responses related to ranking of the research variables. The technique has been used extensively in similar types of surveys and is recognised as a good approach for aggregating the scores of the variables rated on an ordinal scale by respondents (Holt, 1998). The valid percentage rating or the frequency of the variable rated can be determined using SPSS. The variables' respective rank indices (RIs) can be calculated using Eq. 1:

$$\mathrm{RI} = \frac{\Sigma\, W}{\Sigma\, A \times N} \qquad \text{Eq. 1}$$

Where:

W= the weight given to each factor by the respondents and ranges from 1 to 5;

A = the highest weight = 5;

N = the total number of respondents

The ranking index takes different labels depending upon the context, e.g. "involvement index", "importance index", "satisfaction index" and "frequency index".

f. Kendall's W and Chi square test

To determine the degree of agreement among the respondents in their rankings, Kendall's *W* was used. Kendall's *W* (coefficient of concordance) indicates the degree of agreement on a zero to one scale with '0' indicating no agreement and '1' indicating perfect agreement. Kendall's *W* can be computed using the formula below (Frimpong et al., 2003; Moore et al., 2003):

$$W = \frac{12 \sum R_i^2 - 3\, k^2\, N(N+1)^2}{k^2\; N(N^2\, - 1) - k \sum T_j} \qquad \text{Eq. 2}$$

Where:

$\sum R_i^2$ is the sum of the squared sums of ranks for each of the *N* objects being ranked; k is the number of sets of rankings, i.e. the number of respondents and T_j is the correction factor required for the *j*th set of ranks for tied observations, given by:

$$T_j = \sum_{i=1}^{g_i} (t_i^3 - \, t_i) \qquad \text{Eq. 3}$$

Where:

t_i is the number of tied ranks in the *i*th grouping of ties, and g_j is the number of groups of ties in the *j*th set of ranks.

Field (2005) stated that in order to know whether there is degree of disagreement or agreement among respondent groups with respect to their ranking of the factors and to verify that the degree of agreement did not occur by chance the significance of *W* was tested, a test of hypothesis is needed.

- *Null hypothesis: H_0: Disagreement in rankings among the three groups.*
- *Alternative Hypothesis: H_1: Agreement in rankings among the three groups.*

Chi-square approximation of the sampling distribution of *W* is computed with Eq. 4.

$$\chi\, 2 = k\, (n\text{-}1)\, W \qquad \text{Eq. 4}$$

g. One-way between groups (ANOVA)

The test aims to compare the means between the groups and determines whether any of those means are significantly different from each other specifically. It is usually used for compare means for three groups or more (Field, 2005; Pallant, 2010).

h. Pearson correlation test

The main objective of this test is to determine the correlation/relationship between PMSC and PP. The test determined the association between PMSC and PP within a survey on a scale of 0 to ±1, where +1 indicates perfect positive correlation, -1 indicates perfect negative correlation and 0 indicates no correlation (Field, 2005 and Pallant, 2010).

6.5.1 Section I - Characteristics of Respondents and their Organisations

The purpose of this section is to describe the respondents who participated and completed the survey using the following demographic variables: work experience, organisation activities, job position, and organisation turnover. Descriptive analysis was used to analyse these data.

6.5.1.1 Respondents' Experience

The respondents were asked to indicate their years of experience in working in the Libyan construction and civil engineering field. The results for this, as shown in Figure 6.7, indicate that the highest proportion of the participants are in the category of "21-25 years", forming 30% of the total respondents, while the lowest proportion are in the category of "< 5 years", representing 2% of the total respondents.

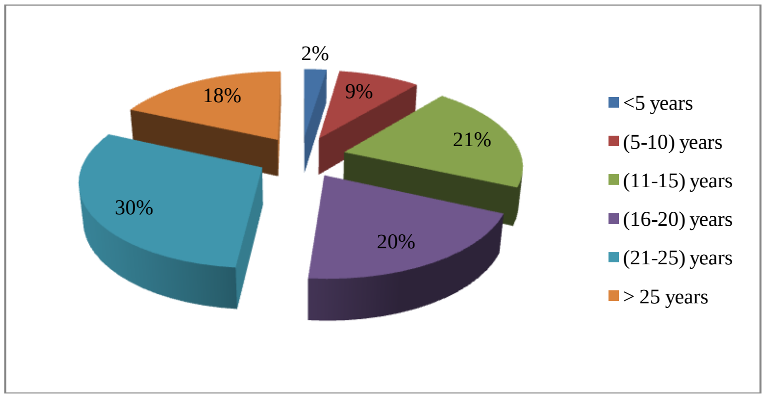

Figure 6.7: years of experience

It can be concluded from these results that, the vast majority of the respondents representing 90% have more than 11 years of experience in working in construction and civil engineering field, indicating a high level of experience.

6.5.1.2 Project types that respondents are involved with

The respondents were asked to describe the nature of construction activities that they worked in. The results presented in Figure 6.8 clearly show that, the largest group of respondents work in building and civil work organizations.

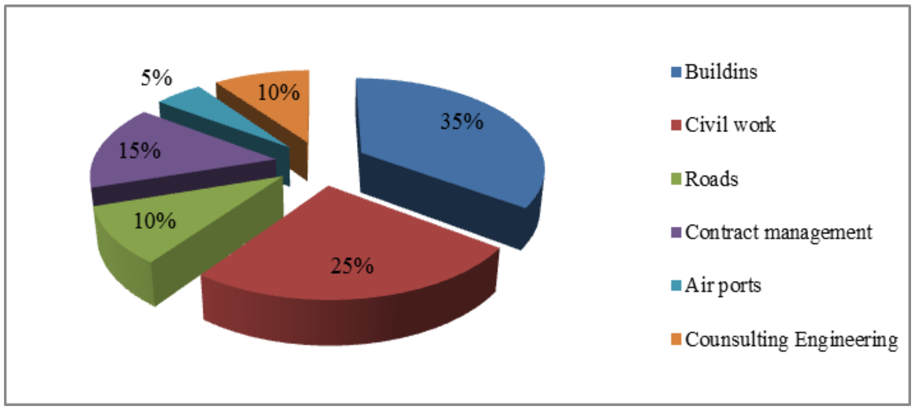

Figure 6.8: Types of organization activities

6.5.1.3 Respondents job positions/designations

The following Figures (6.9, 6.10 and 6.11) present the distribution of the respondents involved in the survey from each category/designation. As can be seen the majority of the respondents in client and contractor groups were project managers forming 53%, and 56%. However, with consultant group the majority of respondents were design engineers forming (54%).

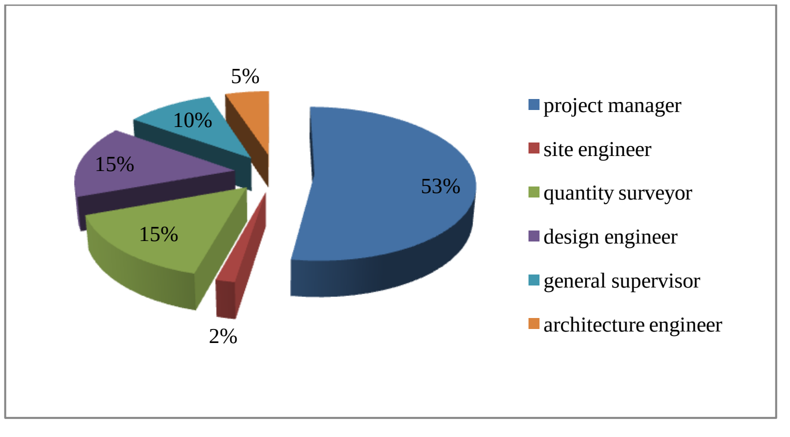

Figure 6.9 Respondents' designations for clients group

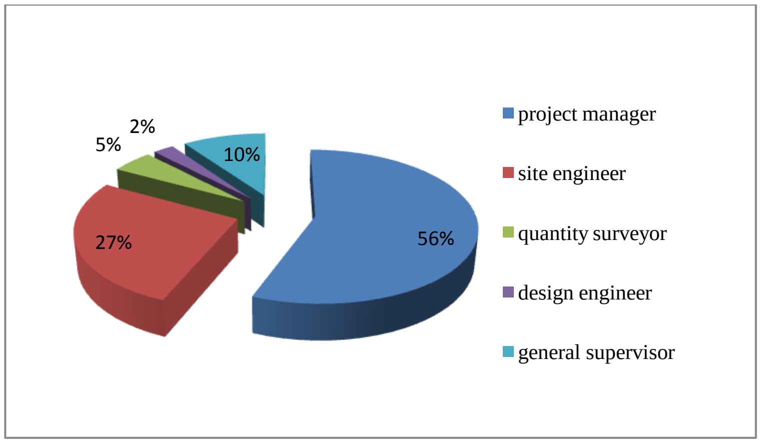

Figure 6.10: Respondents' designations for contractors group

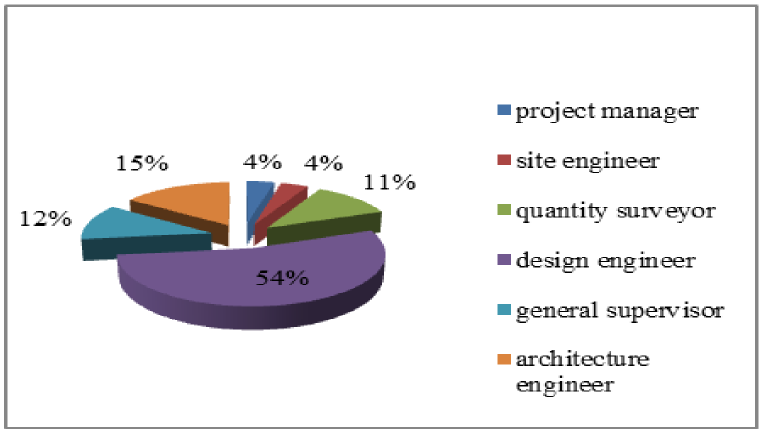

Figure 11: Respondents' category for consultants' group

6.5.1.4 Respondents Organizations' turnover

The respondents were asked to indicate the size of the annual turnover of the organizations that are worked in. Table 6.6 shows the analysis of the frequency. It can be seen that the highest proportion of respondents representing 45.2% are working in the organizations with turnover more than £40 million

Table 6.6: Organizations annual turnover (£m)

Organisation annual Turnover	Frequency	Percent (%)
< 3m	15	11.9
3m - 10m	12	9.5
11m - 20m	23	18.3
21m - 30m	6	4.8
31m - 40m	13	10.3
> 40	57	45.2
Total	126	100%

In summary, the sample selected to participate in the main questionnaire survey were in different position and organisations named as client, contractor and consultant. The majority of them were project managers and design engineers with experience of not less than 11 years in working in construction and civil engineering field in Libya. Most of the participants were working in buildings and civil engineering organisations with turnover of more than £40 million.

6.5.2 Section II - Project performance and procurement methods

This section considers the second section of the main questionnaire survey. It involves the analysis of questions related to PMs and PP. Descriptive analysis, relative index, Kendall's *W* and Chi-square test, one-way between group (ANOVA) and test of correlation were employed to analyse these data. Detailed description of the analysis and the purpose of each questions are explained as following

6.5.2.1. Factors responsible for Poor Project Performance

This section presents the analysis of the main factors responsible for the poor PP including the ranking of these factors based on their importance in procuring projects by DBB or DB methods. Therefore, the purpose of this section then is to introduce the main factors that have the most influence on DBB and DB projects.

In order to find out the common factors that affect construction projects delivery, ***the respondents were asked to indicate on a scale of 1 to 5 the frequency by which each of the factors commonly cited in the literature has been the reason for poor performance in projects procured by DBB method and DB. On the scale, 1 represents "very low frequency" and 5 represents "very high frequency".*** The results are depicted graphically in Figure 6.12 and Figure 6.13 for DBB and DB, respectively. They show that the frequency of all factors in each group is more than 3, which indicates high frequency.

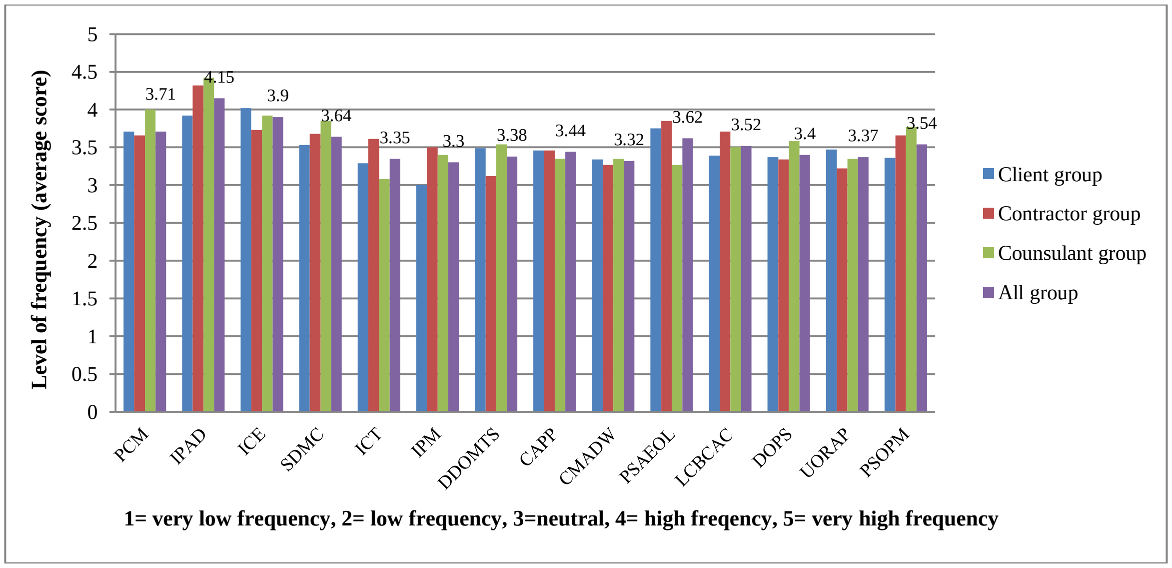

Figure 6.12: Factors responsible for poor performance for DBB procurement method

Poor contract management (PCM), improper planning and design (IPAD), inadequate contractor experience (ICE), slow decision-making by client (SDMC), inappropriate contract type (ICT), inappropriate payment method (IPM), delay in delivery of materials to the site (DDOMTS), conflict among project parties (CAPP), construction mistakes and defective work (CMADW), poor skills and experience of labour (PSAEOL), lack of coordination between clients and contractor (LCBCAC), difficulty of project site (DOPS), unavailability of resources as planned through the project duration (UORAP), poor leadership skills for project manager (PSOPM).

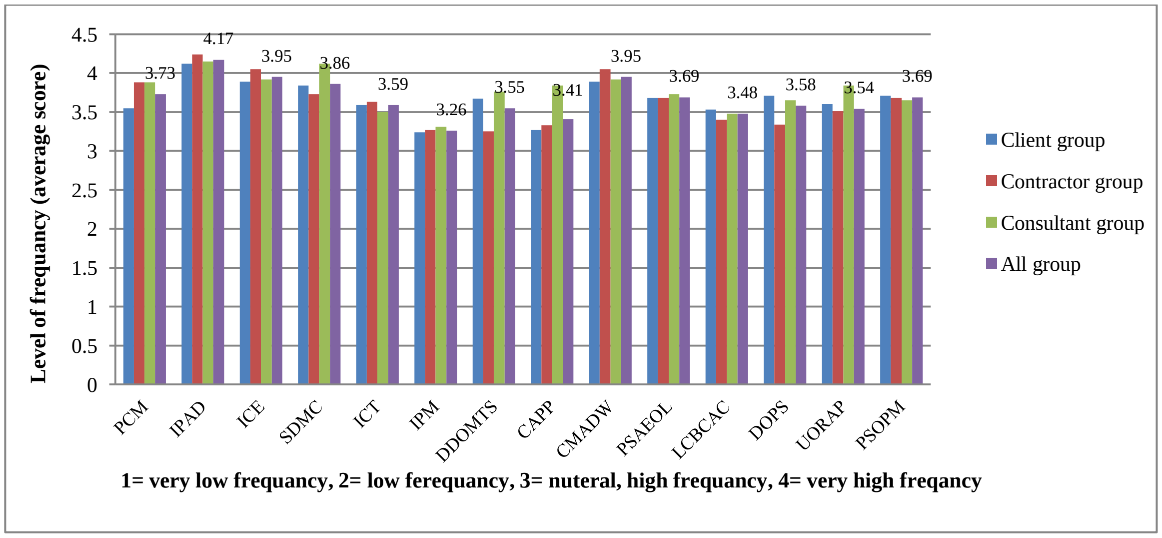

Figure 6.13: Factors responsible for poor performance for DB procurement method

a. Ranking of factors responsible for poor performance in DBB projects delivery

Table 6.7 presents the rankings of the factors responsible for poor performance in projects procured by DBB method. In this regard, relative importance index (RII) was used to determine clients, contractors and consultants' perceptions of the relative importance of the factors responsible for poor PP.

Table 6.7: Ranking factors responsible for poor PP in DBB

Factors	Clients		Contractors		Consultants		Overall	
	RII	rank	RII	rank	RII	rank	RII	rank
Poor contract management	0.745	3	0.770	2	0.850	2	0.776	3
Improper planning and design	0.783	2	0.863	1	0.884	1	0.830	1
Inadequate contractor experience	0.803	1	0.746	3	0.800	3	0.780	2
Slow decision-making by client	0.722	4	0.731	6	0.748	4	0.741	4
Inappropriate contract type	0.657	13	0.721	8	0.615	12	0.669	12
Inappropriate payment method	0.549	14	0.658	11	0.63	11	0.601	14
Delay in delivery of materials to site	0.689	6	0.624	14	0.707	8	0.676	10
Conflict among project participants	0.691	8	0.692	9	0.669	10	0.687	8
Construction mistakes and defective work	0.667	12	0.653	12	0.669	10	0.663	13
Poor skills and experience of labourers	0.705	5	0.736	5	0.769	5	0.728	5
Lack of coordination between clients and contractors	0.667	9	0.741	4	0.700	9	0.703	7
Difficulty of project site	0.674	10	0.668	10	0.715	7	0.680	9
Unavailability of resources as planned through the project duration	0.694	7	0.644	13	0.669	10	0.673	11
Poor skills of the project manager	0.671	11	0.731	7	0.753	6	0.708	6

The results reveal that, the three most factors identified by participants as being responsible for poor PP are "improper planning and design", with RII value of 0.830 followed by "inadequate contractor experience" and "poor contract management" respectively.

Kendall's *W* and Chi Square tests were conducted to determine the degree of agreement among respondants in their rankings for these factors. Table 6.8 depicts the value of Kendall's *W* and Chi Square.

Table 6.8: Kendall's W for agreement on rankings

N of cases	126
Kendall's Coefficient, (*W*)	0.68
Chi-square χ *2 sample*	470.5
Chi-square χ *2 critical* (= 0.05)	22.362
df = (N - 1)	13
Asymp. Sig. (P value)	.000

The results show that, there was a significant degree of agreement among the groups in their rankings of these factors; the Kendall's *W* obtained is 0.68, significant at 0.05.

This agreement between target groups is considered to be strong evidence that the aforementioned three factors as the most important factors responsible for the poor performance of Libyan construction projects.

b. Ranking of factors responsible for poor performance in DB projects delivery

For DB procurement method, the results presented in Table 6.9 show that, the four most important factors responsible for poor PP as ranked by all the groups (overall) are: “improper planning and design”, in the 1st position with RII value of 0.833 followed by “inadequate contractor experience”, “construction mistakes and defective work” and “slow decision-making by client” respectively.

Table 6.9: Ranking factors responsible for poor PP in DB

Factors	Clients		Contractors		Consultants		Overall	
	RII	rank	RII	rank	RII	rank	RII	rank
Poor contract management	0.712	9	0.775	3	0.776	3	0.722	4
Improper planning and design	0.823	1	0.848	1	0.830	1	0.833	1
Inadequate contractor experience	0.778	3	0.810	2	0.784	2	0.790	2
Slow decision-making by client	0.768	4	0.746	4	0. 768	4	0.746	3
Inappropriate contract type	0.718	8	0.726	7	0.700	10	0.717	6
Inappropriate payment method	0.654	11	0.667	12	0.502	12	0.681	12
Delay in delivery of materials to site	0.734	6	0.650	13	0.752	6	0.710	8
Conflict among project participants	0.6	12	0.695	9	0.712	9	0.691	11
Construction mistakes and defective work	0.814	2	0.648	14	0.776	3	0.790	2
Poor skills and experience of labourers	0.734	6	0.735	6	0.746	7	0.720	5
Lack of coordination between clients and contractors	0.705	10	0.680	10	0.696	11	0.695	10
Difficulty of project site	0.742	5	0.668	11	0.730	8	0.715	7
Unavailability of resources as planned through the project duration	0.719	7	0.702	8	0.696	11	0.708	9
Poor skills of the project manager	0.742	5	0.736	5	0.760	5	0.720	5

Table 6.10 shows that there is signficant agreement among respondants in their rankings of these factors (as given by Kendall’s $W = 0.66$ at 0.05).

Table 6.10: Kendall's W for poor PP in DB

N of cases	126
Kendall's Coefficient, (*W*)	0.66
Chi-square χ *2 sample*	456.7
Chi-square χ *2 critical* (= 0.05)	22.362
df = (N - 1)	13
Asymp. Sig. (P value)	.000

6.5.2.2 The effect of the factors on poor performance

The purpose of this section is to find out the effect of the factors mentioned in the previous sections on project performance outcomes (in terms of time, cost and quality) for projects delivered by DBB or DB method.

The respondents were asked to indicate the extent to which each the factor mentioned in the previous section influences PP in terms of time, cost and quality for DBB and DB projects using a scale of 1 to 5 (1 representing "very low effect" and 5 representing "very high effect"). The results reveal that, in terms of time and cost the average score of each factor were more than 3, indicating that most of the factors significantly affect PP in terms of time and cost, irrespective of the PM used DBB or DB. However, in terms of quality it was found that, the average score of each factor was more than 3 except for "slow decision-making", "inappropriate contract type", "inappropriate payment method", "delay in delivery of material to the site" and "conflict among project parties", irrespective of the PM used, be it DBB or DB method. These factors scored less than 3, which mean their effect on PP is low, as illustrated in the following figures.

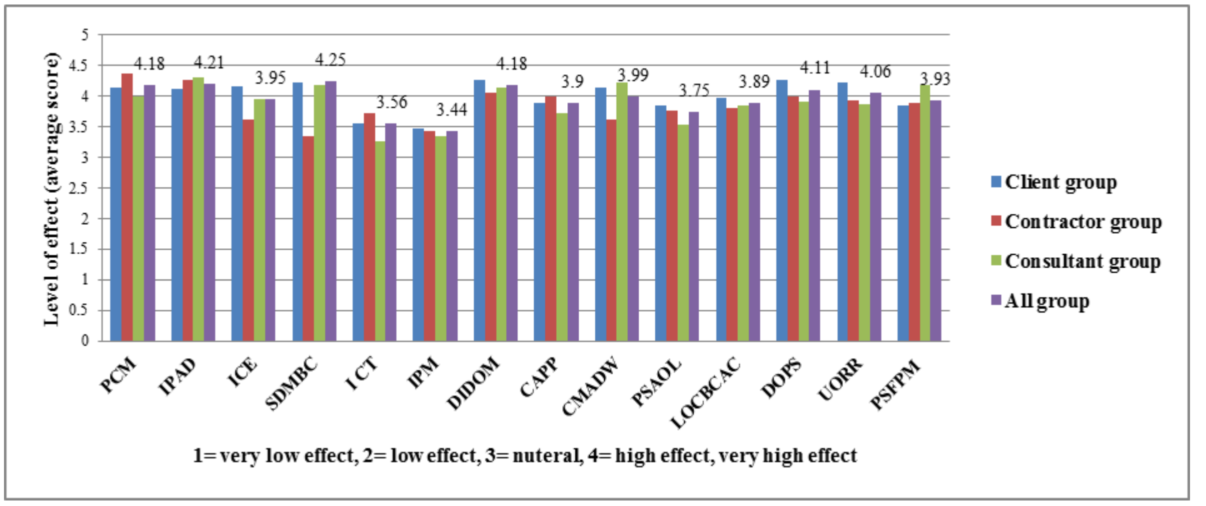

Figure 6.14: The effect of the factors on poor time performance for DBB projects

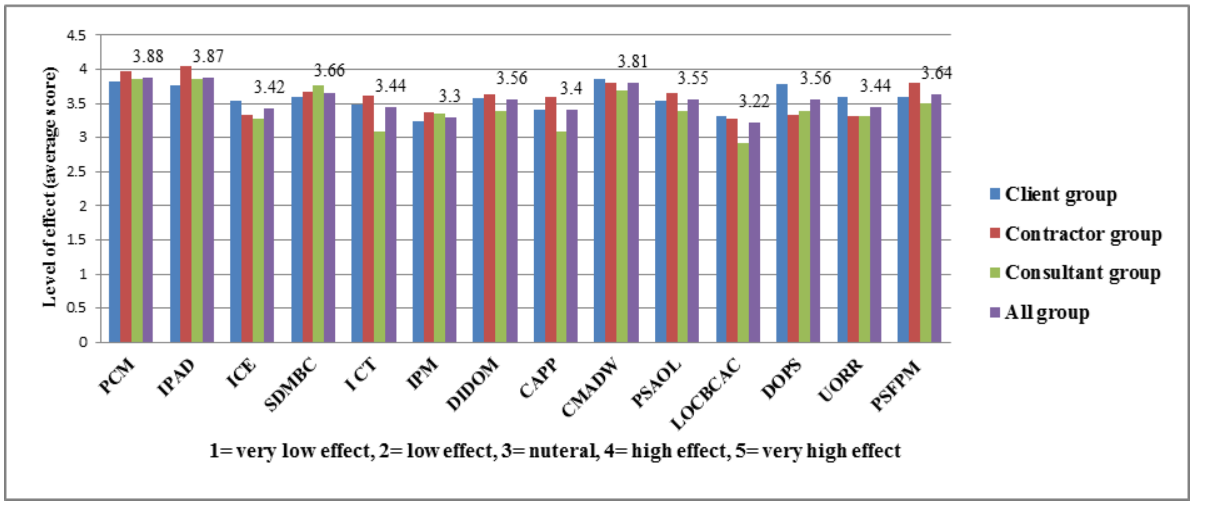

Figure 6.15: The effect of the factors on poor cost performance for DBB projects

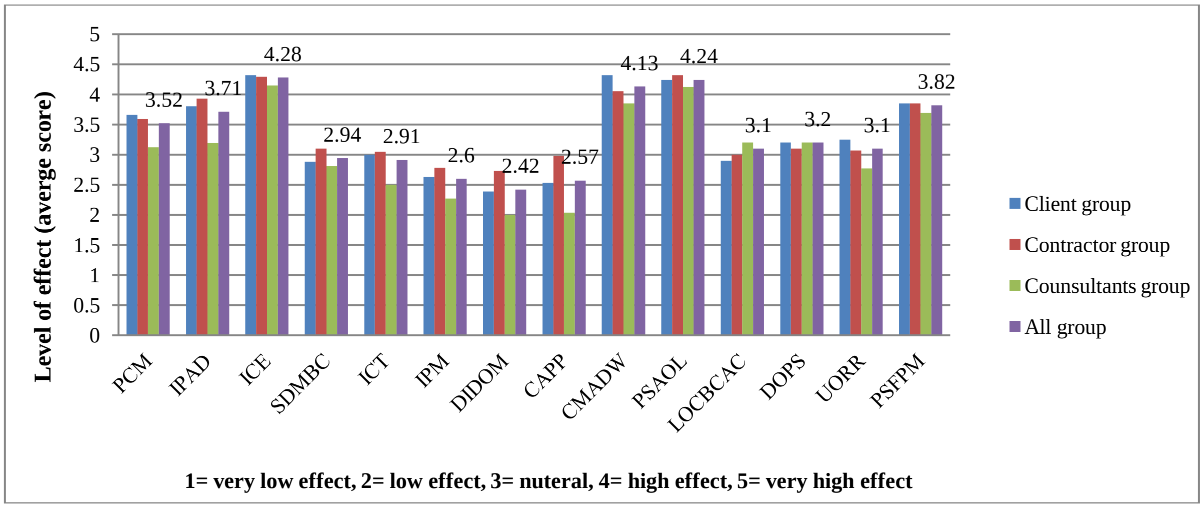

Figure 6.16: The effect of the factors on poor quality performance for DBB projects

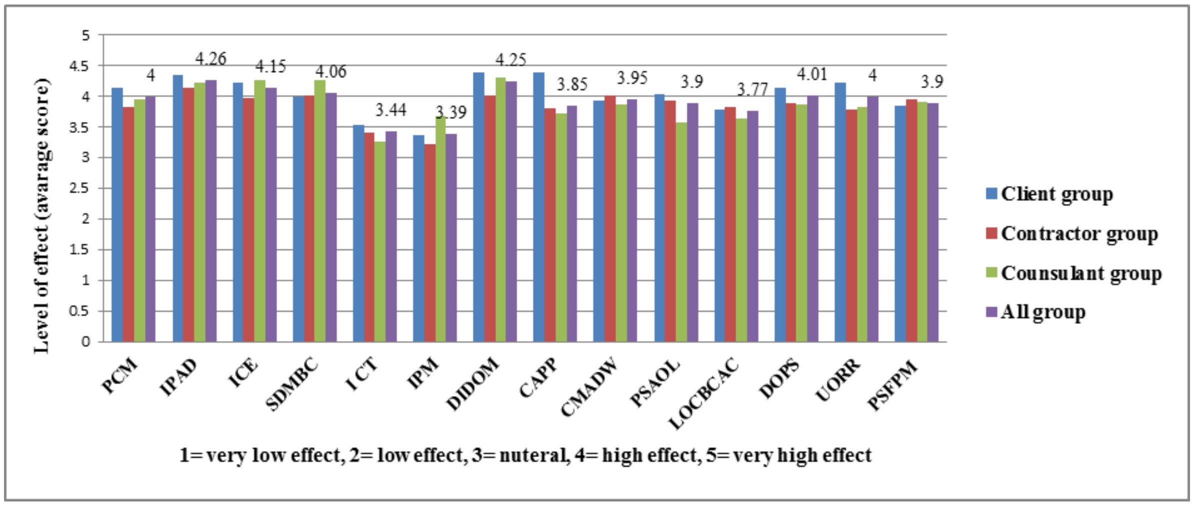

Figure 6.17: The effect of the factors on poor time performance for DB projects

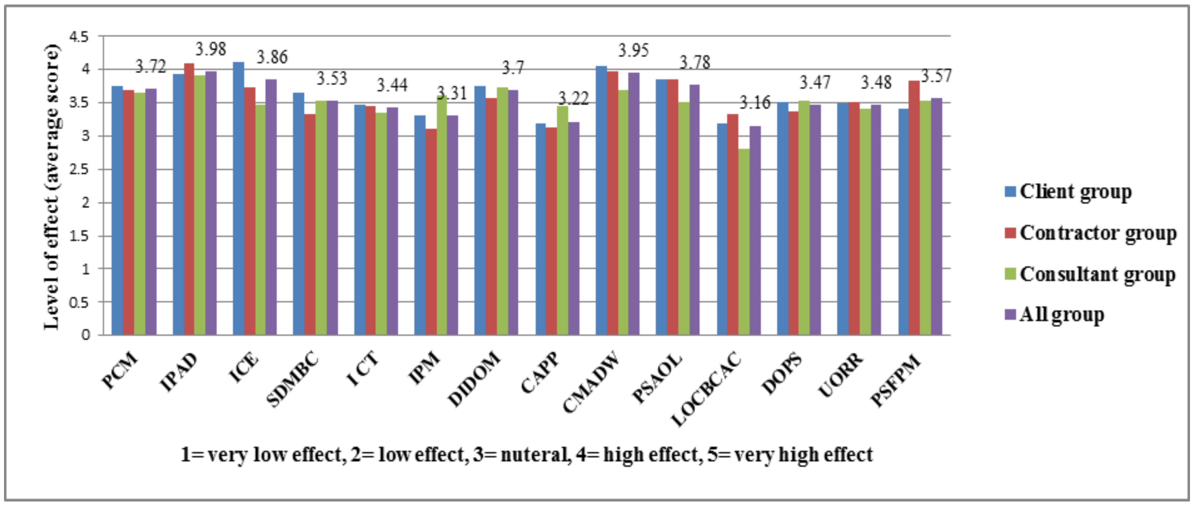

Figure 6.18: The effect of the factors on poor cost performance for DB projects

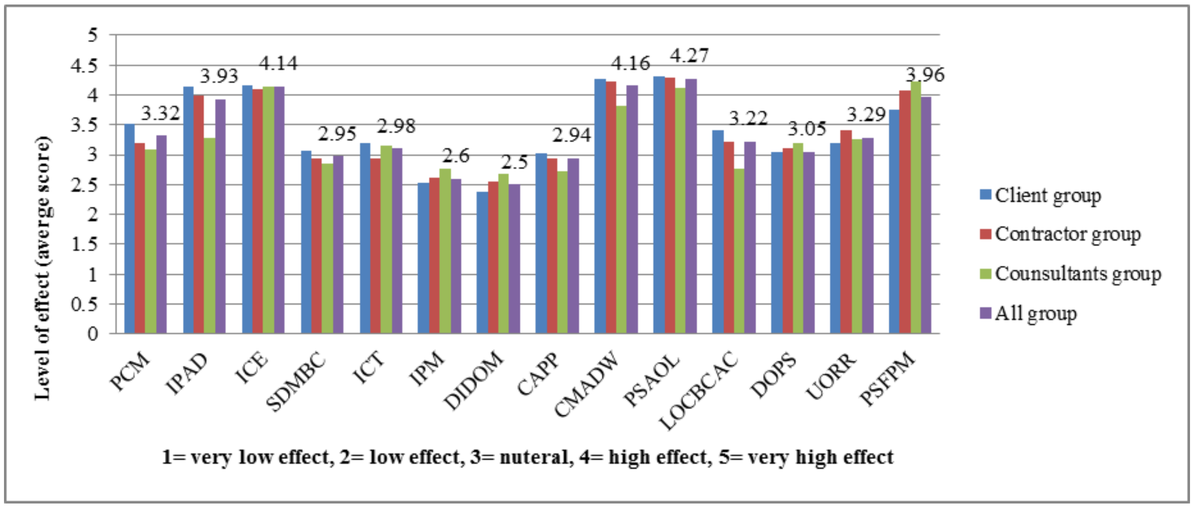

Figure 6.19: the effect of the factors on poor quality performance for DB projects

6.5.2.3 Reasons for selecting the common procurement methods

The purpose of this section was to find out the reasons behind cleints' decision to choose the most common PMs in LCI for their projects. As explained in chapter 2, selecting the most appropriate PM is a significant decision that has to be made by the client during the early stages of a project; an incorrect or flawed selection can lead to total project failure. In this respect***, the respondents were asked to indicate their level of agreement or satisfaction with the following reasons (identified as major reasons for selecting the common PM by project clients in Libya) using a five-point Likert scale where 1 represents "strongly disagree" and 5 represents "strongly agree":***

- Lack of client experience and knowledge with modern PMs.
- Rushed decision-making in PM selection by clients.
- Clients' reluctance to use modern PMs to deliver projects.
- External pressure (political-economic).

Relative satisfaction index (RSI) was used to rank and determine respondent's satisfaction with the four reasons aforementioned above as presented in Table 6.11**.**

Table 6.11: Reasons for selecting improper PMs

Factors	Overall		Consultants		Contractors		Clients	
	RSI	rank	RSI	rank	RSI	rank	RSI	rank
Lack of client knowledge and experience with modern PMs	0.871	1	0.907	1	0.915	1	0.892	1
Rushed decision-making in PM selection by clients	0.800	2	0.975	2	0.876	2	0.814	2
Client reluctance to use modern procurement	0.75	3	0.761	3	0.784	3	0.763	3

External pressure (political-economic)	0.728	4	0.723	4	0.761	4	0.736	4

The results indicate that, the three most significant reasons according to the respondents' perceptions are "lack of client experience and knowledge with the modern PMs", "rushed decision-making by client in selection PM" and "client reluctance to try and use modern procurement". These three factors were ranked in the 1st, 2nd and 3rd positions respectively. These issues therefore require more attention in the selection of appropriate procurement method.

Table 6.12 shows the levels of participants' (client, contractor and consultant) satisfaction with the aforementioned reasons. The results reveal that, the Kendall's Coefficient, *(W)* value was computed as 0.60, which was significant at 0.05. There is thus a significant degree of agreement among the groups in their rankings of the reasons of selection PM currently in use in LCI.

Table 6.12: Kendall's W for improper PM selection factors

N of cases	126
Kendall's Coefficient, (*W*)	0.60
Chi-square χ *2 sample*	410.55
Chi-square χ *2 critical* (= 0.05)	7.815
df = (N - 1)	3
Asymp. Sig. (P value)	.000

6.5.2.4 Extent of project parties' involvement in project delivery

This section presents the survey results on a question that sought to understand the extent of project parties' (client, contractor, consultant) involvement in project delivery. The purpose of this secion is to find out the level of project parties (client, contractor and consultant) involvment in achieving good project performance.

The respondants were asked to indicate on a scale of 1 to 5 (where 1 represents "very low involvement" and 5 represents "very high involvement") the level of project parties' involvement in achieving good PP for projects procured using DBB and DB methods. The results are presented graphically in Figure 6.20 and Figure 6.21.

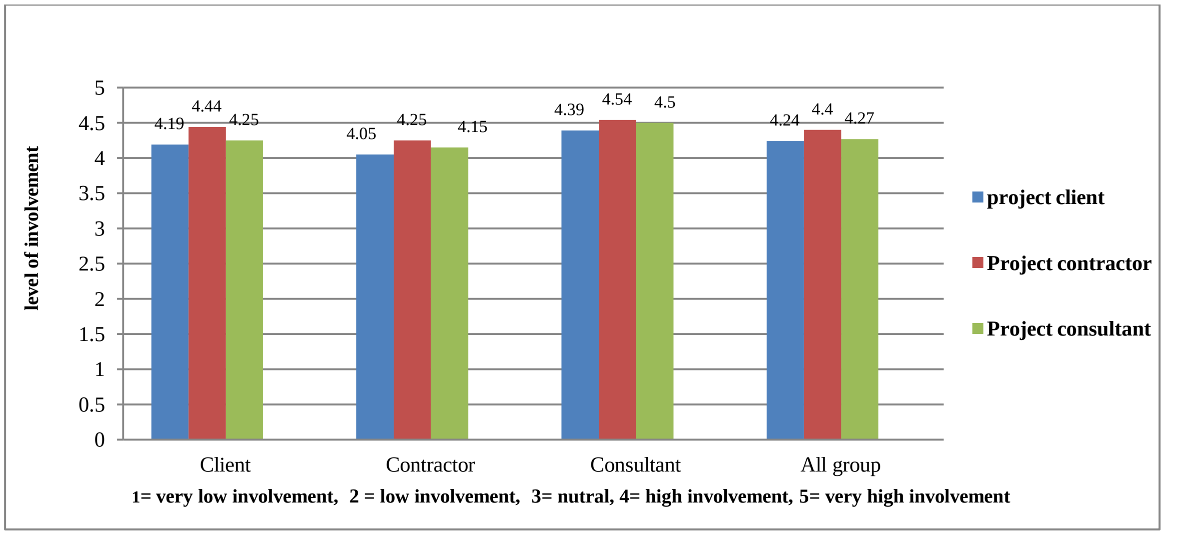

Figure 6.20: Project parties' involvement in DBB projects

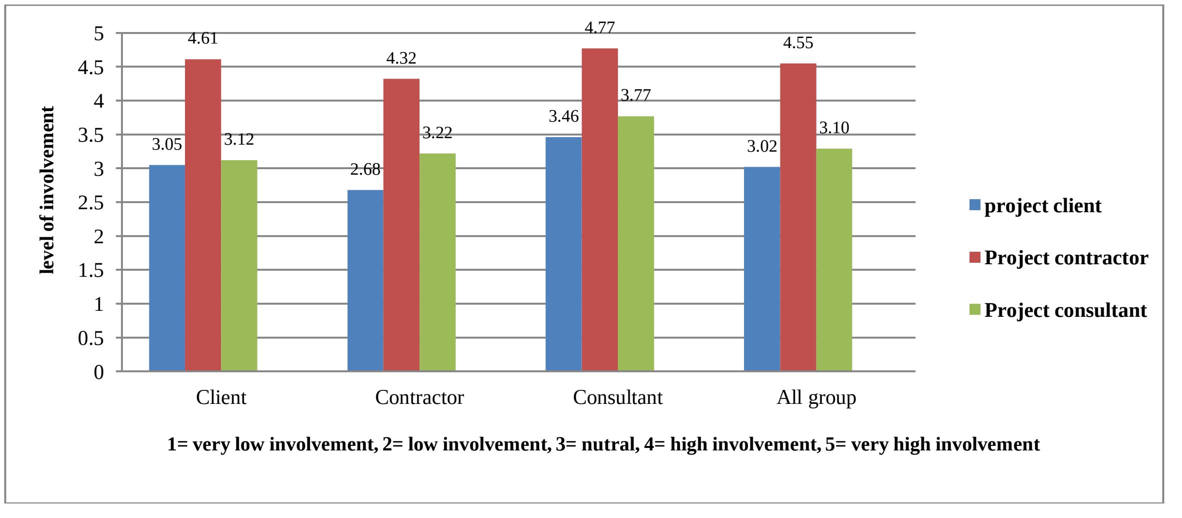

Figure 6.21: Project parties' involvement in DB projects

The results in the above figures show that, in DBB procurement method, the level of clients, contractors and consultants involvment in achieving good PP is more than 3, indicating high involvement. On the other hand, in DB method the level of client's and consultants's involvement in achieving good PP is neutral, and the contractor is high.

a. Ranking the role of project parties involvement in DBB projects

Table 6.13 summarises the ranking of the roles of project parties in achieving high-level PP for projects procured by DBB method.

Table 6.13: Ranking level of project parties' involvement in DBB projects

Project parties	Clients		Contractors		Consultants		Overall	
	RII	rank	RII	rank	RII	rank	RII	rank
Client	0.851	3	0.834	3	0.838	3	0.847	3
Contractor	0.888	1	0.873	1	0.907	1	0.879	1
Consultant	0.877	2	0.853	2	0.900	2	0.854	2

As can be seen in the table, the contractor scored the highest degree of involvement with RII value of 0.879 followed by consultants, and the client was the least invovled.

The Kendall's *W* value obtained as presented in Table 6.14 was 0.711, which was significant at 0.05. There is thus a strong degree of agreement among the groups in their rankings of the role of project party's involvement to achieving good PP (p is < 0.05)

Table 6.14: Kendall's W for parties' involvement in DBB projects

N of cases	126
Kendall's Coefficient, (*W*)	0.711
Chi-square $\chi 2$ *sample*	635.69
Chi-square $\chi 2$ *critical* (= 0.05)	7.815
df = (N - 1)	2
Asymp. Sig. (P value)	.000

b. Ranking the role of project parties involvement in DB projects

Table 6.15 presents a summary of the ranking of the roles of project parties' involvement in achieving high-level PP for projects delivered by DB method.

Table 6.15: Ranking level of project parties' involvement in DB project

Project parties	Clients		Contractors		Consultants		Overall	
	RII	rank	RII	rank	RII	rank	RII	rank
Client	0.610	3	0.536	3	0.692	3	0.603	3
Contractor	0.922	1	0.863	1	0.953	1	0.909	1
Consultant	0.623	2	0.644	2	0.753	2	0.657	2

The result analysis shows that, the contractor scored the highest degree of involvement with RII of 0.909 followed by consultant, and client respectively.

The Kendall's Coefficient, *(W)* value obtained was 0.66 (significant at 0.05). There is thus a strong degree of agreement among the groups in their rankings of the role of project party's involvement to achieving good PP (see Table 6.16).

Table 6.16: Kendall's W for project parties' involvement in DB projects

N of cases	126
Kendall's Coefficient, (*W*)	0.66
Chi-square χ *2 sample*	540.25
Chi-square χ *2 critical* (= 0.05)	7.815
df = (N - 1)	2
Asymp. Sig. (P value)	.000

6.5.2.5 Common types of contracts and tendering

The purpose of this section is to find out the suitability of using the following contract types (bill of quantity, lump sum and cost plus) and tendering (open tender, selective tender and direct order) for DBB method and DB method.

The level of respondents' satisfaction with using different types of contracts and tendering for projects procured under DBB method or DB was investigated using two questions. ***The first question asks respondents to indicate on a scale of 1 to 5 (where 1 represents "strongly disagree" and 5 represent "strongly agree") their level of agreement/satisfaction with the suitability of the following contract types: bill of quantity, lump sum and cost plus contracts for DBB method and then for DB method***.

The second question asks respondents to indicate on a scale of 1 to 5 (where 1 represents "very low frequency" and 5 represents "very high frequency") the frequency of using open tender, selective tender and direct order tender in the projects procured by the aforementioned methods of procurement.

a. Types of contracts commonly in use

Table 6.17 displays the ranking level of respondants' satsfication with the suitablity of using the following contract types: bill of quantity, lump sum and cost plus contracts for DBB and DB procurement methods.

Table 6.17: Rank respondents' satisfaction with contract types for DBB & DB projects

DBB	Clients		Contractors		Consultants		Overall	
Contract type	**RSI**	**rank**	**RSI**	**rank**	**RSI**	**rank**	**RSI**	**rank**
Bill of quantity	0.932	1	0.927	1	0.915	1	0.900	1
Lump sum	0.607	2	0.541	2	0.561	2	0.570	2
Cost plus	0.390	3	0.367	3	0.492	3	0.390	3
DB	**Clients**		**Contractors**		**Consultants**		**Overall**	
Contract type	**RSI**	**rank**	**RSI**	**rank**	**RSI**	**rank**	**RSI**	**rank**
Bill of quantity	0.718	2	0.770	2	0.754	2	0.742	2
Lump sum	0.726	1	0.788	1	0.784	1	0.728	1
Cost plus	0.500	3	0.346	3	0.462	3	0.446	3

The results reveale that, with projects procured by DBB method, the bill of quantities contract was ranked by all groups of respondents in the 1st position with RSI values of 0.900 whereas lump sum and cost plus were ranked in the 2nd and 3rd position respectively. On the other hand, with projects procured by DB the lump sum contract was ranked 1st with RSI values of 0.728 followed by bill of quantity and cost plus respectively.

Table 6.18 presents the results of the Kendall's *W* and Chi square tests to determine the degree of agreeemnt a moung respondants in their rankings of contract types.

Table: 6.18: Kendall's W for types of contracts in DBB & DB projects

DBB procurement method		DB procurement method	
N of cases	126	N of cases	126
Kendall's Coefficient, (*W*)	0.84	Kendall's Coefficient, (*W*)	0.69
Chi-square χ *2 sample*	702.31	Chi-square χ *2 sample*	601.45
Chi-square χ *2 critical* (= 0.05)	5.99	Chi-square χ *2 critical* (= 0.05)	5.99
df = (N - 1)	2	df = (N - 1)	2
Asymp. Sig. (P value)	.000	Asymp. Sig. (P value)	.000

The results show that there was a strong and signficant degree of agreement among the groups in their rankings as given by Kendall's Coefficient, (*W)* = 0.84 at 0.05 for projects procured by DBB and Kendall's Coefficient, (*W)* = 0.69 at 0.05 for DB projects. These results confirm that in the LCI, bill of quantities contract is the most commonly used in projects procured by DBB, while lump sum contracts is the most commonly used in DB projects.

b. Types of tendering commonly in use

The relative frequency index RFI and ranking of the tendering types commonly used for projects procured by DBB method and DB method are summarized in Table 6.19.

Table 6.19: Ranking of frequency of using tender types for DBB & DB projects

DBB	Clients		Contractors		Consultants		Overall	
Tender type	**RFI**	**rank**	**RFI**	**rank**	**RFI**	**rank**	**RFI**	**rank**
Open tender	0.607	3	0.346	3	0.600	3	0.565	3
Selective tender	0.749	1	0.775	1	0.692	1	0.731	1
Direct order	0.610	2	0.624	2	0.615	2	0.609	2
DB	**Clients**		**Contractors**		**Consultants**		**Overall**	
Tender type	**RFI**	**rank**	**RFI**	**rank**	**RFI**	**rank**	**RFI**	**rank**
Open tender	0.491	3	0.419	3	0.538	3	0.470	3
Selective tender	0.739	1	0.702	1	0.823	1	0.740	1
Direct order	0.606	2	0.653	2	0.746	2	0.650	2

The results show that, for both DBB and DB methods, selective tender received the highest level of frequancy by all respondants groups with RFI value of 0.731 for DBB method and 0.740 for DB method followed by direct order in the 2nd posiation. However, open tender was ranked 3rd.

In order to find out the degree of agrements between groups in their ranking, Kendall's *W* and Chi square tests were conducted. Table 6.20 presents the results of the Kendall's *W* and Chi square tests.

Table 6.20: Kendall's W for types of contracts in DBB & DB projects

DBB procurement method		DB procurement method	
N of cases	126	N of cases	126
Kendall's Coefficient, (*W*)	0.70	Kendall's Coefficient, (*W*)	0.65
Chi-square χ *2 sample*	613.82	Chi-square χ *2 sample*	520.32
Chi-square χ *2 critical* (= 0.05)	5.99	Chi-square χ *2 critical* (= 0.05)	5.99
df = (N - 1)	2	df = (N - 1)	2
Asymp. Sig. (P value)	.000	Asymp. Sig. (P value)	.000

The results show that, the Kendall's (*W)* among the groups on their rankings on the types of tenders were computed as 0.70 for DBB projects and 0.65 for DB projects (signficant at 0.05). This result means that, there is a high level of agreement between respondants groups in their ranking for tenders types. According to this results the selective tender is considered the most common and preferable in use in LCI irrespective of projects procured by DBB or DB method.

6.5.2.6 Influence of PMSC on choice of procurement method

As PMSC form the main basis by which the right PM is selected, investigating the extent to which these criteria were characterised by past DBB and DB projects in Libya therefore formed an important aspect of the enquiry into the influence of PMSC on PP. The purpose of this section is to examine the extent to which each PMSC did meet (or were compatible with) the requirements and characteristics of past projects delivered in the LCI.

As a result, ***respondents were asked to rank each of the PMSC as to the extent to which they satisfies (or were compatible with) the characteristics and requirements of past LCI projects , using a scale of 1-5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree". Respondents were also asked to add and rank any other criteria they feel are relevant but which were not included among the criteria presented.*** The results depicted graphically in Figure 6.22 and Figure 6.23 show the distribution of their answers.

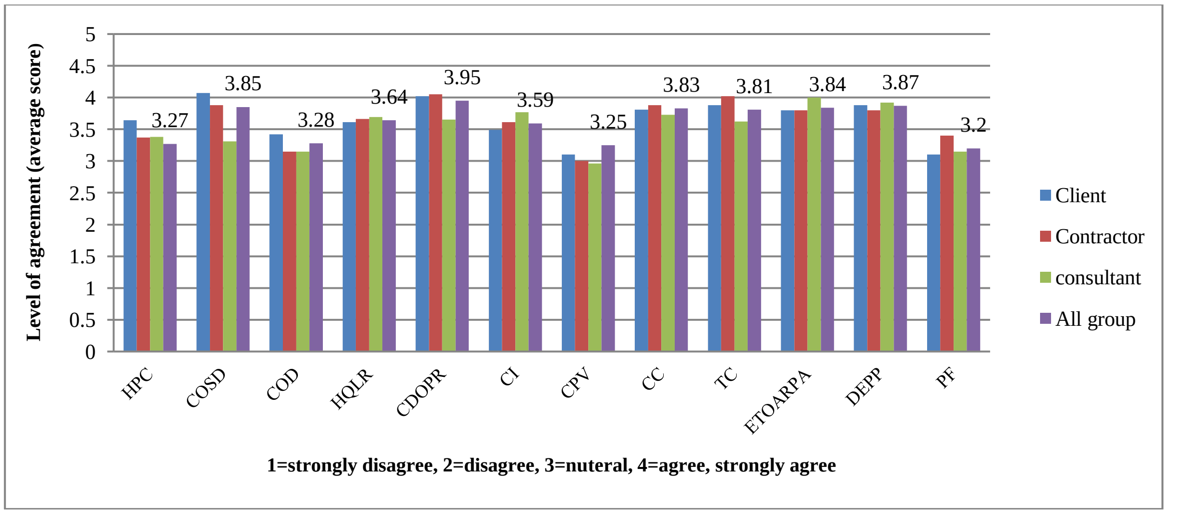

Figure 6.22: Extent of agreement on the matching of PMSC with DBB projects

High price competition (HPC), Clarity of scope definition (COSD), Complexity of design (COD), High quality level required (HQLR), Clear definition of project parties responsibilities (CDOPR), Client involvement in the project (CI), Controllable project variation (CPV), Cost certainty (CC), Time certainty (TC), Ease of organizing and reviewing project activities (EOARP), Desiring efficient project planning (DEPP), Project functionality (PF).

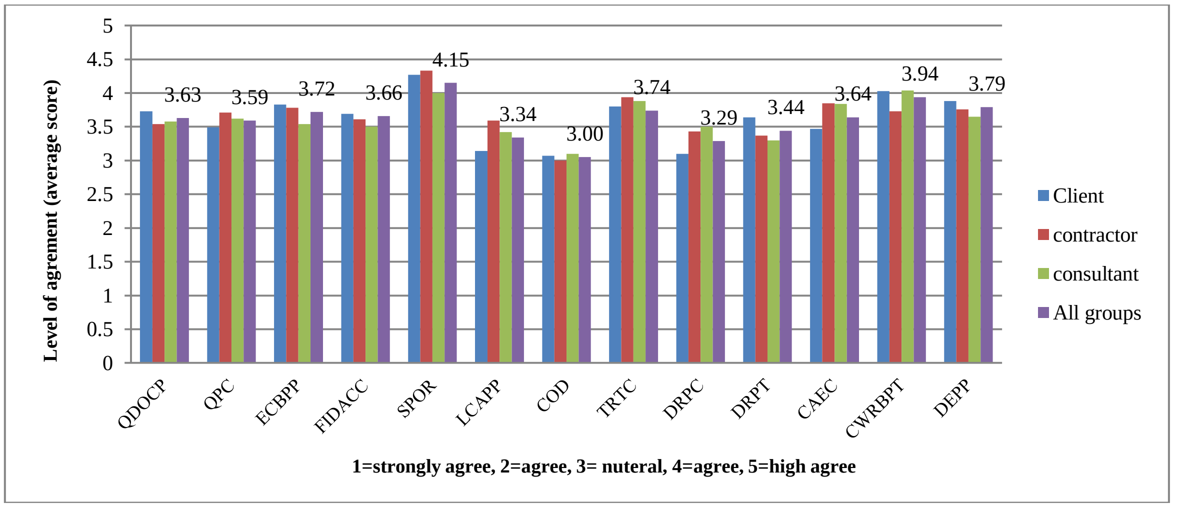

Figure 6.23: Extent of agreement on the matching of PMSC with DB projects

Quick delivery of construction processes (QDOCP), Quick project commencement (QPC), Effective communication between project parties (ECBPP), Flexibility in design and construction changes (FIDACC), Single point of responsibility (SPOR), Less conflict amongst project parties (LCAPP) Complexity of Design (COD), Transfer of risks to the contractor (TRTC), Desiring reduced project cost (DRPC), Desiring reduced project time (DRPT), Competent and experienced contractor (CAEC), Collaborative working relationship between project team (CWRBPT), Desiring efficient project plan (DEPP)

The results demonstrate that With the DBB method, the average level of agreement is greater than 3 for all criteria, which means that the respondents are in agreement with all criteria. With the DB method, the average level of agreement as greater than 3 for all criteria except the criterion of complexity of design, which is equal to 3; this suggests that the respondents are in agreement with all criteria except complexity of design, about which they are neutral.

a. Relative Important index (RII) of the PMSC for DBB and DB methods

To determine the relative importance of each of the criteria from the perspective of clients, contractors and consultants, their relative importance index was computed. The results presented in Table 6.21 and Table 6.22

Table 6.21: Relative important index and ranking of DBB criteria

Procurement criteria	Clients		Contractors		Consultants		Overall	
	RII	rank	RII	rank	RII	rank	RII	rank
1- High price competition	0.800	8	0.756	9	0.705	10	0.705	10
2- Clarity of scope definition	0.920	1	0. 894	2	0.822	3	0.862	3
3- Complexity of design	0.740	10	0.642	10	0.717	9	0.703	9
4- High quality level required	0.802	7	0.796	8	0.743	7	0.804	7
5- Clear definition of project parties responsibilities	0.858	3	0.943	1	0.897	1	0.872	1

6- Client involvement in the project	0.774	9	0.813	7	0.741	8	0.796	8
7- Controllable project variations	0.700	11	0.634	11	0.641	11	0.600	11
8- Cost certainty	0.836	5	0.878	3	0.784	5	0.838	5
9- Time certainty	0.819	6	0.853	5	0.782	6	0.828	6
10- Ease to organizing and reviewing project activities	0.842	4	0.862	4	0.820	4	0.860	4
11- Desiring efficient project planning	0.870	2	0.851	6	0.896	2	0.870	2
12- Project functionality	0.384	12	0.374	12	0.384	12	0.380	12

Table 6.22: Relative important index and ranking of DB procurement selection criteria

Procurement criteria	Clients		Contractors		Consultants		Overall	
	RII	rank	RII	rank	RII	rank	RII	rank
1- Quick delivery of construction processes	0.750	7	0.712	10	0.715	7	0.732	8
2- Quick project commencement	0.701	9	0.741	7	0.731	6	0.720	9
3- Effective communication between project parties	0.766	5	0.756	5	0.707	9	0.750	5
4- Flexibility in design and construction changes	0.752	6	0.726	8	0.715	8	0.736	6
5- Single point of responsibility	0.864	1	0.808	1	0.807	1	0.840	1
6- Less conflict amongst project team	0.729	8	0.692	12	0.638	12	0.690	11
7- Complexity of design	0.613	12	0.492	13	0.584	13	0.568	13
8- Transferor of risks to the contractor	0.776	4	0.751	6	0.731	5	0.759	4
9- Desiring reduced project cost	0.661	11	0.717	9	0.700	10	0.687	12
10- Desiring reduced project time	0.606	13	0.756	4	0.684	11	0.700	10
11- Level of competence and experienced contractor	0.695	10	0.707	11	0.738	4	0.735	7
12- Collaborative working relationship between project team	0.810	2	0.800	2	0. 754	3	0.806	2
13- Desiring efficient project planning	0.783	3	0. 770	3	0.792	2	0.760	3

The results of the test demonstrate that, in DBB method the criterion of “clear definition of parties’ responsibilities” comes first, with RII value of 0.872 followed by “desiring efficient project planning” and “clarity of scope definition”, with “controllable project variations” and “project functionality” at the bottom with RII values of 0.600 and 0.380.

On the other hand, with DB method the criterion of “single point of responsibility” comes first with RII value of 0.840 followed by “collaborative working relationship between project team” and “Desiring efficient project planning”. However, “desiring reduced project cost” and “complexity of design” comes at the bottom with RII values of 0.687 and 0.568.

To determine whether there is a degree of agreement among the three groups with respect to their rankings of the criteria, Kendall’s *(W)* and chi square test was carried out. A summary of the results is shown in Table 6.23.

Table 6.23: Kendall's W for PSC of DBB & DB methods

DBB procurement method		DB procurement method	
N of cases	126	N of cases	126
Kendall's *W*	0.68	Kendall's *W*	0.64
Chi-square χ *2 sample*	592.86	Chi-square χ *2 sample*	460.23
Chi-square χ *2 critical* (= 0.05)	19.68	Chi-square χ *2 critical* (= 0.05)	21.03
df = (N - 1)	11	df = (N - 1)	12
Asymp. Sig. (P value)	.000	Asymp. Sig. (P value)	.000

The results show that, the Kendall's *(W) value* obtained is 0.68 for project procured by DBB method and 0.64 for project procured DB method which was significant at 0.05. Therefore, there is a strong agreement between the respondents in their ranking to these criteria.

6.5.2.7 One-way ANOVA between groups

As highlighted in section 6.5, the one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences in the mean scores of three groups or more. The purpose of this test is to compare the mean scores given to each procurement criterion and investigate whether there is a significant difference between respondent groups.

The first point that needs to be checked in conducting this test is the homogeneity of variance. Levene's test of homogeneity of variance can check whether or not the variance in scores is the same for each three groups. If the Sig (P-value) is more than 0.05 this indicates that the assumption of the homogeneity of variance is not violated. As can be seen in Table 6.24, the Sig (P-value) for each criterion of DBB and DB methods is greater than 0.05, indicating the assumption is not violated.

Table 6.24: Test for homogeneity of variance

DBB procurement criteria	Levene Statistic	Sig. P value	DBB procurement criteria	Levene Statistic	Sig. P value
High price competition	0.241	0.786	Quick delivery of construction processes	2.365	0.099
Clarity of scope definition	1.183	0.310	Quick project commencement	.008	0.992
Complexity of design	2.672	0.073	Effective communication between project parties	2.363	0.098
High quality level required	0.460	0.633	Flexibility in design and construction changes	0.582	0.560
Clear definition of project parties responsibilities	1.794	0.171	single point of responsibility	1.882	0.160
Client involvement in the project	0.404	0.668	Less conflict amongst project team	1.844	0.163
Controllable project variations	2.463	0.089	Complexity of design	0.653	0.522
Cost certainty	3.786	0.025	Transferor of risks to the contractor	0.280	0.756
Time certainty	0.460	0.633	Desiring reduced project cost	2.360	0.099
Ease to organizing and reviewing project activities	1.225	0.297	Desiring reduced project time	0.878	0.418
Desiring efficient project planning	1.894	0.181	Level of competence and experienced contractor	2.362	0.098
Project functionality	3.604	0.052	Collaborative working relationship between project team	0.211	0.810
			Desiring efficient project planning	1.265	0.286

In order to check whether there is a significant difference between the mean scores between groups, ANOVA test was conducted (Pallant, 2010). This test gives information about sum square, df, mean square, F and sig or p value, as shown in Table 6.25 and 6.26. The most important dimension is the p value or sig. This can tell if there is a significant difference between groups. If the p value is less than or equal to 0.05, there is a significant difference somewhere between the mean scores of the variables in the groups (Pallant, 2010; Field, 2005). The test does not tell which group is different from others (Pallant, 2010). The "F ratio represents the mean square between the groups divided by the mean square within the groups. A large F ratio indicates that there is more variability between the groups" (Pallant, 2010).

Table 6.25: ANOVA results for DBB method

DBB Procurement Criteria		Sum of Squares	df	Mean Square	F	P value (Sig)
High price competition	Between Groups	2.309	2	1.154	1.134	.325
	Within Groups	125.191	123	1.018		
	Total	127.500	125			
Clarity of scope definition	Between Groups	10.477	2	1.172	1.420	.250
	Within Groups	93.658	123	.770		
	Total	104.135	125			
Complexity of design	Between Groups	2.364	2	1.182	1.532	.220
	Within Groups	94.913	123	.772		
	Total	97.278	125			
High quality level required	Between Groups	.137	2	.068	.068	.934
	Within Groups	122.792	123	.998		
	Total	122.929	125			

Clear definition of project parties	Between Groups	2.944	2	1.472	1.268	.285
	Within Groups	142.770	123	1.161		
	Total	145.714	125			
Client involvement in the project	Between Groups	1.422	2	.711	.734	.482
	Within Groups	119.117	123	.968		
	Total	120.540	125			
Controllable project variations	Between Groups	.450	2	.225	.175	.840
	Within Groups	158.351	123	1.287		
	Total	158.802	125			
Cost certainty	Between Groups	.347	2	.173	.146	.865
	Within Groups	146.455	123	1.191		
	Total	146.802	125			
Time certainty	Between Groups	2.669	2	1.335	1.114	.331
	Within Groups	147.299	123	1.198		
	Total	149.968	125			
Ease to organizing and reviewing project activities	Between Groups	.827	2	.414	.385	.681
	Within Groups	131.998	123	1.073		
	Total	132.825	125			
Desiring efficient project planning	Between Groups	.252	2	.126	.164	.849
	Within Groups	94.455	123	.768		
	Total	94.706	125			
Project functionality	Between Groups	8.680	2	1.193	1.623	.218
	Within Groups	90.431	123	.812		
	Total	99.111	125			

Table 6.26: ANOVA results for DB method

DB Procurement Criteria		Sum of Squares	df	Mean Square	F	P value (Sig)
Quick delivery of construction processes	Between Groups	1.204	2	.602	.666	.516
	Within Groups	111.122	123	.903		
	Total	112.325	125			
Quick project commencement	Between Groups	1.041	2	.520	.556	.575
	Within Groups	115.118	123	.936		
	Total	116.159	125			
Effective communication between project parties	Between Groups	1.582	2	.791	.716	.490
	Within Groups	135.791	123	1.104		
	Total	137.373	125			
Flexibility in design and construction changes	Between Groups	.765	2	.383	.404	.669
	Within Groups	116.536	123	.947		
	Total	117.302	125			
Single point of responsibility	Between Groups	6.498	2	3.249	7.304	.001
	Within Groups	54.716	123	.445		
	Total	61.214	125			
Less conflict amongst project team	Between Groups	3.733	2	1.867	1.917	.151
	Within Groups	119.759	123	.974		
	Total	123.492	125			
Complexity of design	Between Groups	7.138	2	3.569	2.764	.067
	Within Groups	157.550	122	1.291		
	Total	164.688	124			
Transferor of risks to the contractor	Between Groups	1.020	2	.510	.630	.535
	Within Groups	99.615	123	.810		
	Total	100.635	125			
Desiring reduced project cost	Between Groups	2.032	2	1.016	1.316	.272
	Within Groups	94.960	123	.772		

	Total	96.992	125			
Desiring reduced project time	Between Groups	4.909	2	2.240	2.852	.065
	Within Groups	88.591	123	.920		
	Total	93.500	125			
Level of competence and experienced contractor	Between Groups	4.358	2	2.179	2.090	.128
	Within Groups	127.194	122	1.043		
	Total	131.552	124			
Collaborative working relationship between project team	Between Groups	.064	2	.032	.052	.949
	Within Groups	75.809	123	.616		
	Total	75.873	125			
Desiring efficient project planning	Between Groups	4.307	2	2.153	2.553	.082
	Within Groups	103.733	123	.843		
	Total	108.040	125			

The results of this test reveal that the p-value for all DBB procurement criteria and DB procurement criteria is more than 0.05 which means that there is no significant different in mean scores given by the three groups (clients, contractors and consultants) to each criterion. The results of the ANOVA test for the other factors (factors responsible for poor PP, reasons of selecting the most common PM, extent of project parties' involvement in project delivery, types of contracts and tendering used) are shown in the appendix C. The results also show that the p value or sig for each factor is more than 0.05 which indicates that, there is no significant different in the mean score for all these factors.

6.5.2.8 Extent to which Completed Projects Meet Performance Standards

The different PMs have difference influence on PP outcomes, often measured using time, cost and quality criteria. Although this principle is well-known, knowledge on the extent to which the methods impacts on each of these performance criteria is limited in existing construction management literature. The purpose of this section is to check if whether or not the Libyan construction projects achieved their expected performance when they delivered by DBB method or DB.

The respondents were thus asked to indicate the extent to which the DBB and DB projects that they have been involved with achieved their expected performance in terms of outcomes of time, cost and quality, using a scale of 1 to 5 where 1 represents "very low frequency" and 5 represents "very high frequency".

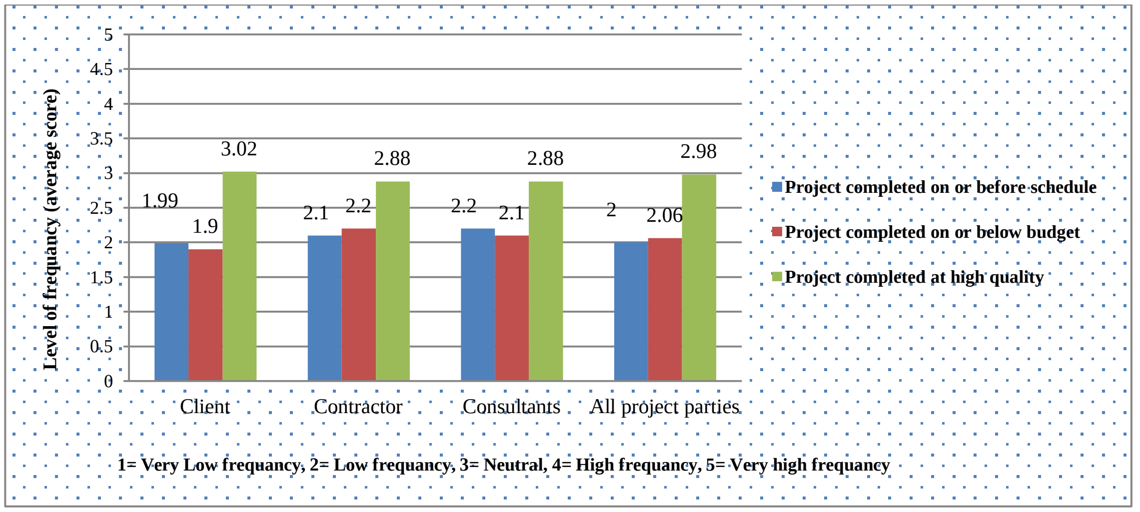

Figure 6.24: Extent of achieving performance outcomes for DBB projects

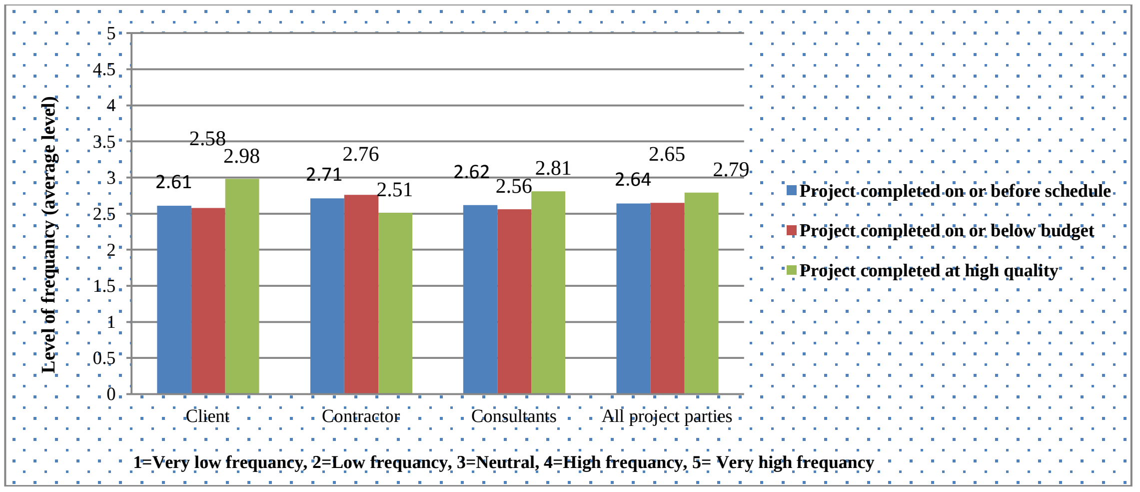

Figure 6.25: Extent of achieving performance outcomes for DB projects

The results (see Figure 6.24 and Figure 6.25) show that Libyan construction projects are generally not able to achieve their time and cost performance as depicted by low average values of 2.0 and 2.06, respectively, for DBB projects, and 2.64 and 2.65 for DB projects. However, the performance criterion based on quality was relatively higher, registering an average value of 2.98 for projects delivered by DBB method and 2.79 for projects delivered by DB method.

a. Ranking of the PP standards

Table 6.27 and 6.28 show the relative frequency index and rank of the performance standards in terms of time, cost and quality.

Table 6.27: The frequency of achieving performance outcomes for DBB projects

Performance Criteria	Clients		Contractors		Consultants		Overall	
	RFI	rank	RFI	rank	RFI	rank	RFI	rank
Completed projects on or before schedule	0.328	3	0.312	3	0.330	2	0.324	3
Completed projects on or below budget	0.343	2	0.331	2	0.307	3	0.332	2
Completed projects on good quality	0.603	1	0.757	1	0.343	1	0.595	1

Table 6.28: The frequency of achieving performance outcomes for DB projects

Performance Criteria	Clients		Contractors		Consultants		Overall	
	RFI	rank	RFI	rank	RFI	rank	RFI	rank
Completed projects on or before schedule	0.494	2	0.541	2	0.523	3	0.515	2
Completed projects on or below budget	0.474	3	0.551	1	0.530	2	0.51	3
Completed projects on good quality	0.583	1	0.502	3	0.561	1	0.552	1

It can be seen from the results that, with projects procured by DBB method, complete project on good quality was ranked 1st by clients, contractors and consultants with RFI of 0.595. Complete project within or below budget was ranked 2nd. However, complete project on or before schedule was ranked 3rd . On the other hand, with projects procured by DB method, complete project with good quality was ranked by all respondents in the 1st position with RFI of 0.552 followed by, complete project within or before schedule and complete project within or below budget in the 2nd and 3rd position respectively.

From these results we can conclude that, all the project parties believe that the frequency of completing projects with a good quality in the LCI is more than the frequent of completion within or before schedule and within or below budget irrespective of project procurement method. This suggests that project parties in Libya focus more on the quality component of projects than on time and cost performance.

6.5.2.9 Correlation between Procurement Selection Criteria and project Performance

The test used to determine the extent of the relationship between PMSC and PP, was Pearson correlation. This test was applied to the rank data plotted in Figure 6.22 and 6.24 for DBB, and data displayed in Figure 6.23 and 6.25 for DB. This test was used with objective is to determine the linear association between the criteria of PP results (as outputs or dependent variables) and the scaled PMSC (as inputs or independent variables). As highlighted in section (6.5 – H), the strength of the association was measured in terms of coefficient from 0 - ±1 continuum, with +1 representing a perfect positive association, -1 a perfect negative association and 0 representing no association. Also, as commonly assumed in statistical analysis, a coefficient with p value of < 0.05 indicates that the correlation is statistically significant, and vice-versa (Field, 2005; Pallant, 2010).The results determined the PMSC that have significant correlations with PP in terms of time, cost and quality from the project parties' overview. Table 6.29 shows a summary of the correlation analysis between DBB criteria and PP criteria.

Table 6.29: Correlation between PSC and PP outcomes for DBB

PP criteria / Traditional procurement criteria			**All groups**		
			CP on schedule	CP on budget	CP at quality
Person correlation	Complexity of design	Coefficient (r) Sig (P value) N	.176* .048 126	-	-
	High quality level required	Coefficient (r) Sig (P value) N	-.201* .024 126	-.345** .006 126	.322** .000 126
	Client involvement in the project	Coefficient (r) Sig (P value) N	-	.271** .008 126	-
	Controllable project variations	Coefficient (r) Sig (P value) N	-		.374** .000 126
	Time certainty	Coefficient (r) Sig (P value) N	-	.188* .039 126	-
	Ease of organizing and reviewing project activities	Coefficient (r) Sig (P value) N	.203* .023 126	-	-
	Project functionality	Coefficient (r) Sig (P value) N	.671** .000 126	.177* .048 126	-

The results presented in the above table show that only 7 out of 12 common variables, (defined as DBB selection procurement criteria), exhibited significant correlation with one or more output variables (defined as project performance criteria) the p value/sig is < 0.05. For instance, there is a significant positive correlation between "complexity of design", "ease of organizing and reviewing project activities", and time component of PP. "High quality level required" is negatively correlated with time and cost component of PP while it is positively correlated with quality. "Client involvement in the project" and "time certainty", are positively correlated with PP in terms of cost while "controllable project variations" is positively correlated with quality. "Project functionality" is positively corolated with PP in term of time and cost.

Table 6.30 shows a summary of the correlation analysis between DB selection criteria and PP criteria in terms of time, cost and quality.

Table 6.30: Correlation between PSC and PP outcomes for DB

Project performance criteria / Traditional procurement criteria			All groups		
			CP on schedule	CP on budget	CP at quality
Pearson correlation	Quick delivery of construction processes	Coefficient (r) Sig (2-tailed) N	.399** .001 126	.324** .001 126	-
	Quick project commencement	Coefficient (r) Sig (2-tailed) N	.396** .002 126	-	-
	Effective communication between project parties	Coefficient (r) Sig (2-tailed) N	. 375** .002 126	.297** .009 126	. -
	Flexibility of design & construction changes	Coefficient (r) Sig (2-tailed) N	. 249** .005 126	-	-
	Desiring reduced project cost	Coefficient (r) Sig (2-tailed) N	-	-	.190* .033 126
	Desiring reduced project time	Coefficient (r) Sig (2-tailed) N	.231* .006 126	-	-
	Collaborative working relationship between project team	Coefficient (r) Sig (2-tailed) N	.323** .003 41	-	-
	Desiring efficient project planning	Coefficient (r) Sig (2-tailed) N	.201* .024 126	.176* .049 126	-

The correlation analysis presented in the above table shows that there are eight PMSC exhibiting significant correlation with one or more criteria of PP (p value/sig < 0.05). Such criteria as “quick project commencement”, “flexibility in design and construction changes”, “desiring reduced project time” and “collaborative working relationship between project team” correlated positively with time component of PP. However, the criteria of “quick delivery of construction processes”, “effective communication between project parties” and “desiring efficient project planning” correlated positively with time and cost components of PP. The results also show that there is a significant positive correlation between “desiring reduced project cost” and PP in terms of quality.

6.6 Qualitative Data collection

The findings of the analysis the main questionnaire survey (quantitative data) highlighted in the section 6.5 revealed several issues, mostly related to the factors responsible for PP, types of contracts and tendering used to manage DBB and DB projects in Libya as well as which criteria of DBB and DB methods have significant correlation/relationship with PP criteria. Therefore, to give deep understand of how PMSC criteria influence PP and whether any other factors besides procurement may cause poor PP, interviews survey (qualitative data) were conducted.

As highlighted in Section 5.9.5.2, interviews based on semi-structured questionnaire designed to include both open and closed-ended questions, were conducted. The main objective of the interviews was to answer the ‘how’ questions of the research, which were not included in the questionnaire as they could not be addressed satisfactory through the main questionnaire surveys. The interviews survey was conducted in August 2012 involved 17 respondents who had experience of not less than 11 years in construction and project management sectors, and who were involved in different kinds of public and private construction projects in Libya, agreed to participate in the interviews and did so enthusiastically. The researcher then contacted them in advance in order to manage the time and plan for each individual separately. Fortunately, most of the individuals, who were contacted for interviews, were positively disposed and represented different work responsibilities, experiences and positions, which included project managers, design engineers, site engineers, architecture engineers and general supervisors. Each interview took approximately between 45-60 minutes to complete, and information was noted (with participants’ informed consent).

6.7 Qualitative Data Analysis

The qualitative data was analysis manually with aid of Microsoft Excel for window application software packages.

6.7.1 Section I - General Characteristics of the Sample

The vital purpose of the section is to describe the interviewees who participated in this study and completed the survey, with regard to the demographic variables, job position and work experience. Data was analysis using Microsoft Excel for window application software packages.

6.7.1.1 Interviewees category

Figure 6.26 shows the different categories of those employees who participated in the survey in terms of job position. Participant are categorised into five group; project managers and site engineers forming the same proportion 23.0%. Design engineers, general supervisors and architecture engineers forming 18% each.

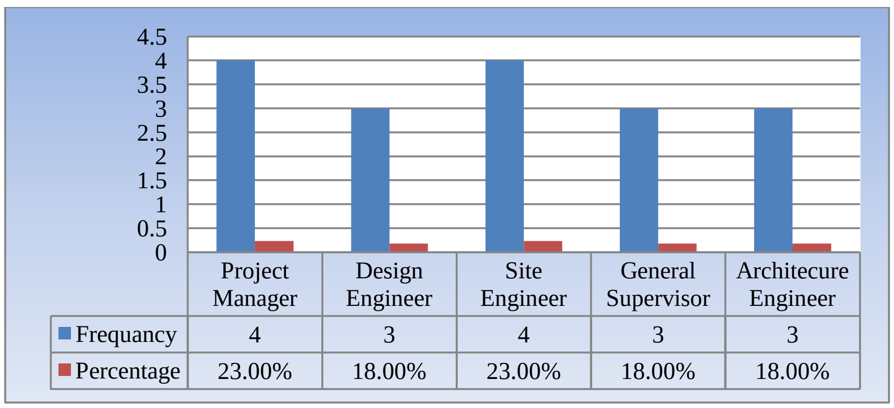

Figure 6.26: Respondents' professional distribution

This sample, therefore, brings a balanced response from participants that come from different sectors.

6.7.1.2 Experience

Participants are also grouped according to their year of experience into four different groups: 11-15 years, 16-20 years, 21-25 years, and more than 25 years.

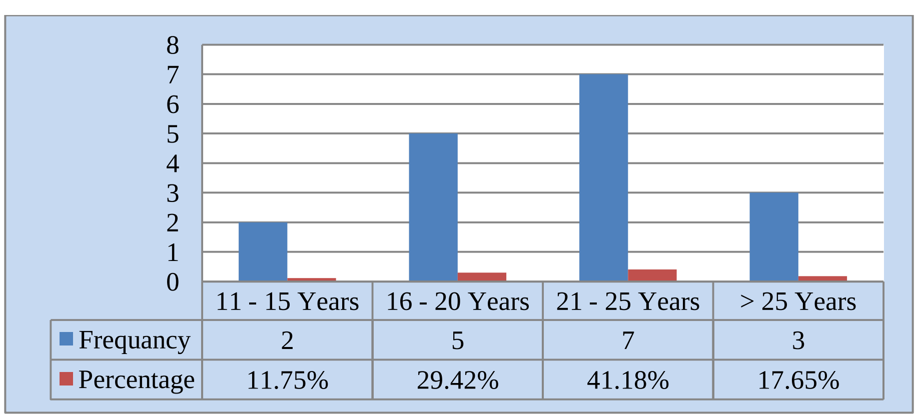

Figure 6.27: Interviewees' level of working experience

The results as depicted in the Figure 6.27 show that the highest proportion of participants fall in the category of having 21-25 years. A long period of experience means the participants are more aware and knowledgeable about construction projects. These results can tell that most of the respondents were experienced in the construction field.

6.7.2 Section II – The effect of procurement criteria on PP

The purpose of this section is to explain how the procurement selection criteria introduced in the main survey questionnaire were satisfied for past DBB and DB projects and the impact these might have had on PP. The qualitative data analysis is explained in the following sections.

6.7.2.1 Analysis of DBB Procurement Selection Criteria

a) High Price competition

The interviewees were first asked to indicate whether or not the contractors used for their DBB projects were selected on competitive basis, and if so or otherwise, how this affected PP. The results obtained, indicates that 88% of interviewees responded “yes” whereas 12% responded “no” to the first part of this question, those who responded yes indicated that limited number of contractors was often invited to bid competitively which affected clients’ ability to obtain bid price that offers good value for their projects. The other reason was that contractors were mostly selected based on lowest price, without taking into account the other criteria such as work experience and technical capabilities of the contractor, technical staff available and current list of work and resources (e.g. equipment and machinery). Such selection approaches usually reflect negatively on the performance of projects.

b) Clarity of scope definition

The interviewees were first asked to indicate whether or not the scope definition of the project was clear and well defined, and if so or otherwise, how this affected PP. The results reveal that 80% of interviewees responded “yes” while 20% responded “no” to the first part of this question. The interviewees who responded yes explained their answers in terms of the following aspects: (i) scope of work was clear and well defined. It described clearly the plan of the project in which starting and ending project activities. It gave accurate and clear description of the project specification, items and quantity of the materials (ii) the client's objectives and requirements were very clear (iii) scope of work sets up the procedures for how completed project will be verified and approved. All of these things reflect positively on the performance of projects. It has been confirmed by Cruzbuy (2013) that a scope of work describes and clarifies all works to be done. One of the major project success factors is that clarity of project tasks, specification and materials.

c) High quality level required

The concept of quality is closely related to client satisfaction, which represents the clients' feeling about whether the project outcomes provided meet the objectives of the project (Eriksson and Westerberg 2012). The quality of design, materials, equipment, machinery used and workmanship are the major requirements of the quality level (Oyedele, 2003; Thomas et al., 2002). In attempt to explore how the quality level affects PP, ***the interviewees were first asked to indicate whether or not the aforementioned quality parameters were adequate and high efficiency, and if so or otherwise they were then asked to explain how these affected PP.*** The responses show that 95% of interviewees responded "no" and 5% responded "yes" to the first part of this question. The interviewees who responded no gave the following explanations:

- The contractor and his staff were not experienced and highly skilled in construction work. The machinery and equipment used for implementing projects were not in good condition in terms of their efficiency. As result of that, the performance of the project was poor. According to Thomas et al. (2002), to achieve high level of project quality, three components should be available: quality of materials and equipment, workmanship and quality of design. Unavailability of any of these components will adversely impact PP.

In the light of the interviewees' responses it can be noticed that, the vast majority of interviewees are in agreement that the quality parameters comprised negatively influenced PP. This is probably due to lack of experience and skills on the part of project staff, and also unavailability of adequate resources such as high quality machinery and equipment to implement the project, as evident from the literature review (Chapter 4).

d) Complexity of design

In an attempt to explore how complexity of design impacts PP, ***the interviewees were first asked whether or not the contractors and project team were capable to handling complex project in terms of design, and if so or otherwise, how this affected PP***. the results analysis reveal that 90% of interviewees responded "no" and 10% responded "yes" to the first part of this question. Those who responded no gave reasons as follows:

- The lack of experience and knowledge of project team, contractors and sub-contractors in dealing with complex design project.
- The lack of appropriate contractors' resources for handling complex design project (e.g. high quality equipment, machinery and tools).

The vast majority of interviewees agreed that, these aforementioned reasons adversely affected PP. Pinto and Slevin (1998) concluded that one of the reasons that negatively influence PP is that the lack of knowledge and efficiency of contractors in dealing with complex project designs. He also indicated that the more difficult and complex a construction project is, the higher the possibility of it suffering from delays.

e) Clear definition of project party's responsibilities

The interviewees were first asked whether or not the project parties were committed to their responsibilities in the project, and if so or otherwise, how that attitude affected PP. The results demonstrate that, the vast majority of interviewees forming 82% responded "no", while 18% responded "yes" to the first part of this question. The interviewees who responded no indicated that the main reason why the project parties did not adhere to their responsibilities is that, the allocation and definition of project parties' responsibilities were not clear, accurate and well defined. Overlapping in these responsibilities between project parties has been created as result. These things helped to increase the conflicts between project parties which reflect negatively on the PP. Some examples of the negligence project parties to their responsibilities are that:

- Client delay in paying contractor.
- Unwillingness of contractor to comply with project specifications.
- Inability of contractor to control project team.
- Inability of contractor to organize and manage project.

- Lack of contractor commitment to project schedule.

According to the above, it can be concluded that the negligence of project parties in carrying out their responsibilities in the project do negatively affect the performance of projects.

f) Client involvement in the project

The interviewees were asked to indicate whether or not clients were highly involved in the projects, and if so or otherwise, how this affected PP. The results show that 90% of the interviewees responded “yes”, and 10% responded “no”. Those who responded yes indicated that: (i) the involvement of the client in the project helped to create good relationship and smooth communication between project team; (ii) the clients worked together with consultants and project team to solve the project problems; (iii) project clients always contact consultants when making decisions on important technical works; and, (iv) clients delegates full powers to project managers to manage, control and facilitate the work. Such involvement of clients reflects positively on the performance of projects.

g) Controllable project variation

The interviewees were first asked to indicate whether the project changes were controlled, and if so, they were asked to explain how they were controlled. The results show that, 80% of the interviewees’ responded “yes” however, 20% responded “no”. The interviewees who responded yes indicated that, the projects were well-defined wherein most contract documents, and drawings, designs and specifications were reviewed properly by clients and consultants in the early stage. As result of that, most expected changes were managed and controlled. These things affected positively the performance of the projects as they aid to prevent the cost and time overrun. These results were in-line with those of Hashim (2006), who found that, for DBB method the contract documents will be reviewed by clients and consultants before bidding stage and construction work, which aids control of changes during construction work and avoid increasing project time and cost.

h) Time and cost certainty

The interviewees were asked to explain how the certainty of knowing project duration and cost in advance affected project performance. The results show that the vast majority of the interviewees (90%) are in agreement that these two criteria positively affected PP. They indicated that, knowing project clients in advance the total project duration and cost helped clients and consultants to accurately plan, organize and control projects, to avoid any increase in duration and cost. According to Thomas et al. (2002), "time certainty" and "cost certainty" are crucial need of clients, particularly in larger projects, and these are considered to be very significant considerations in DBB selection. They also indicted that there is a strong relationship between time certainty and speed; the higher the degree of time and cost certainty, the greater the speed of the procurement system in facilitating timely project completion within cost certainty.

i) Ease of organizing and reviewing project activities

The interviewees were first asked to indicate whether or not the projects were well managed and organized and if so or otherwise, they were asked to explain how this affected PP. the result obtained, indicates that 92% responded "yes" and 8% responded "no" to the first part of the question. The interviewees who are in agreement that projects were well managed and organized indicated that most project documents (drawings, designs, schedules, bill of quantities and specification, etc.) were well-defined and accurate before commencement of construction processes, which facilitated managing, organizing and reviewing project activities. These were reflected in the ability of project managers (for clients and consultants) to develop, with no difficulty, good plans for organising and managing projects, and with clients' supervisors not experiencing any difficulty in reviewing construction works carried out by contractors according to the design and specification. These aspects positively influenced the performance of the projects. These results are consistent with the findings of Abdul Rashid et al. (2006), who found that DBB project delivery affords more opportunity for clients and consultants to review contract documents carefully in order to help contractors to implement projects accurately and project managers to manage, organize and review work carefully.

j) Project functionality

The interviewees were asked to indicate whether or not the functional and physical requirement of the project positively affected PP. The responses demonstrate that 80% of the interviewees said "yes" and 20% said "no". Those who respond yes explained that, the functional aspects of the project were clear and well defined before construction process commencement, which indicates that, this criterion positively affected PP.

6.7.2.2 Analysis of DB Procurement Selection Criteria

a) Quick delivery of construction processes

The interviewees were first asked whether or not the overlapping of the design and construction processes helped in speeding up project delivery, and if so or otherwise, how this affected PP. The results reveal that, 88% of interviewees responded "yes" while 12% responded "no" to the first part of this question. The interviewees who responded yes summarized their explanations as follows:

- The integration of design and construction work through DB method helped contractors to speed up construction works as well as managing and organizing the project properly.
- There was a direct relationship between clients and contractors, whereby the latter could make contact and communicate with the former directly. This relationship played an important role in solving the problems that faced project easily.
- Design and construction activities moved almost in parallel. Construction works started before the whole project design completion.
- The design project team was working under contactor's control and responsibility. The contractor could contact and deal with them directly, which helped to speed up project execution.

In the light of the above it can be understood that, the integration of design and construction work as well as the direct relationship among clients and contractors helped to speed up construction processes. This aspect normally reflects positively on PP outcomes. It has been confirmed by Thomas et al. (2002) and Seng and Yusof (2006) that the overlapping between design and construction for DB project delivery helped to accelerate construction processes to have the project completed on time or before. The design and construction work can be produced by contractors, and design and construction teams can work together, all of which contribute to effective acceleration of construction processes.

b) Quick project commencement

Since the contractor is undertaking the design work, there are opportunities to integrate the design and construction works and thus to make an early start on the site (Murdoch and Hugh, 2008; Shapiro, 2013). ***The interviewees were first asked to indicate whether the overlapping of the design and construction work helped to start construction work early, and if so or otherwise, how this affected PP***. The responses demonstrate that 77% of the interviewees responded “yes” while 23% responded “no” to the first part of this question. The interviewees who responded yes mentioned that, the design and construction phases were undertaken contemporaneously, and the construction works were initiated during the initial phases of the project while the later phases were being designed. Designed parts of the project entered the implementation phase directly, without waiting for other parts of design. These aspects helped to accelerate construction work and resulted in early project completion which reflected positively on the performance of the projects especially in terms of time. According to Shapiro (2013), Edmond et al. (2008) and Murdoch and Hugh (2008), DB project delivery allows construction processes to start before design completed. This can lead to achieving good PP, particularly in terms of time.

c) Effective communication between project parties

In an attempt to find out the effect of communication between projects parties on PP, ***the interviewees were first asked to indicate whether or not the communication between project parties was effective, and if so or otherwise, they were asked how this affected PP***. The results show that 82% of the interviewees responded “yes”, while 18% responded “no” to the first part of this question. The interviewees who responded yes explained that the overlapping of the design and construction works induce effective communication and direct contact between clients and contractors, which enables the latter to respond and adapt more quickly to the formers’ needs, and vice-versa. The direct communication between clients and contractors helped to facilitate the works carried out and solve the problems and obstacles that faced project quickly. Such communication among project parties usually reflects positively on performance of the projects (Seng and Yusof, 2006). It has been confirmed by Pinto and Slevin (1998) that contractors undertaking the design and construction works enable them to deal and communicate closely with clients in order to solve project problems and complete project within target duration and cost.

d) Flexibility of design and construction changes

With respect to the effect of flexibility of design and construction changes on PP, ***the interviewees were first asked to indicate whether or not there was flexibility of changes the design and construction works and if so or otherwise, they were asked how this affected PP.*** The results show that 85% of the interviewees responded "yes" whereas the remaining 15% responded "no" to this part of the question. The interviewees who responded yes explained that, the integration of the design and construction processes through DB method provides high level of flexibility for the design and construction changes. This is because the contractor is responsible for the design and construction works, and any necessary changes in the design were made during construction works without any effects on construction processes because both design and construction works were performed in parallel and under contractor's control.

e) Less conflict amongst project team

The interviewees were first asked whether or not the conflicts between project team were reduced during construction project and if so or otherwise, how this affected PP. The results show that the majority of interviewees 82% responded "yes" while 18% responded "no" to this part of the question. The interviewees who responded yes explained how reducing conflicts affected PP. They said that, as a result of delivering project by DB method, the design and construction teams worked closely together as one team. A high level of communication and cooperation was built among them. This helped to reduce the conflicts and disputes which reflected positively on PP. According to Mante et al. (2012) and Ndekkugri and Turner (1994), the integration of the design and construction processes in DB project delivery plays an important role in reducing the level of conflict among project team members, which reflects positively on PP.

f) Single point of responsibility

The interviewees were asked whether or not bearing the contractor the whole project responsibilities negatively affected PP. The results revealed that 91% of interviewees responded "no" whereas 9% responded "yes". The group of interviewees who responded no explained that, the contractor undertaking responsibility for design and construction enabled the acceleration of construction work, which reflected positively on the performance. Design and construction teams were working together with the contractor, enabling the latter to manage and organize the design and construction project more efficiently.

g) Level of competent and experienced contractor

The interviewees were first asked to indicate whether or not the contractor was highly experienced in order to carry out the project properly, and if so or otherwise, they were asked how this affected PP. The results indicate that 80% of interviewees responded “yes” and 20% responded “no” to the first part of this question. The interviewees who said yes explained that: most of the contractors were highly qualified to handle projects, having the necessary experience, skills, knowledge and ability to control, manage and organize design and construction processes. All of these things reflected positively on PP. According to Seng and Yusof (2006) and Chan et al. (2001), the experience, knowledge and competence of contractors in designing, managing and controlling projects contributes significantly to project success.

h) Desiring reduced project time and cost

In order to find out how these two criteria (reduced project time and cost) affect PP, ***the interviewees were first asked to indicate whether or not the overlapping of the design and construction work helped to minimizing project duration and reducing project cost, and if so or otherwise, they were asked how this affected PP***. The results obtained show that 85% of the interviewees responded “yes” whereas 15% responded “no” to the first part of this question. The interviewees who responded yes explained that, the overlapping of the construction and design processes allows the contractors to control the details of the design and use familiar construction methods and processes in building the structure, resulting in much more efficient construction, thus reducing costs and minimizing duration. These things usually reflect positively the performance of the projects. This result confirms the findings of Seng and Yusof (2006) and Albert (2000), which relate that timely project completion resulting from overlapping of design and construction phases is highly likely to reduce costs.

On the other hand, the group of interviewees who respond no cited that speeding up construction work to minimize project duration and cost negatively affected the quality of the project. The contractor in this situation gave most of his concentration and intention on the project time and cost without concern for project quality.

i) Collaborative working relationship between project team

In attempt to find out the effect of the relationship between project team on PP, ***the interviewees were asked to indicate the extent to which they think the collaborative working relationship between project team affected PP, using a scale of 1-5 where 1 = "very low extent" and 5 = "very high extent"***. As can be seen in Table 6.31, 50% of the interviewees ranked their level of extent with regards to the effect of collaborative working relationship among project team on PP on the very high level. They gave it score of 5. The remaining interviewees ranked their extent on the levels of low, neutral and high with percentage of 12.5% and 25%.

It can be concluded from these results that interviewees ranked the effect of working relationship between project team on the high level with an average score of 4. This means that, this criterion positively influence PP. The integration of design and construction works in DB method enables improving relationships among project team members (Turina et al., 2008). The construction and design team were working together with contractors, which engenders good communication and relations between them, and ultimately reflects positively on project execution (Seng and Yusof, 2006).

Table 6.31: The extent of collaborative relationship between project team

Interviewee	Scale				
	Very low	**Low**	**Neutral**	**High**	**Very high**
	1	2	3	4	5
1					✓
2				✓	
3		✓			
4			✓		
5				✓	
6					✓
7					✓
8					✓
Percentage (%)	0%	12.50%	12.50%	25%	50%
Average/Mean				4	

j) Desiring efficient project planning

The interviewees were first asked to indicate whether or not the project planning was efficient and if so or otherwise, how this affected PP. The results show that 86% of the interviewees said "yes" and 14% said "no". The interviewees who said yes explained that the overlapping among design and construction works through DB project created good collaborative arrangement for planning and construction. Both design and construction team worked closely together in a way that to fulfil project plans.

6.7.3 Section III - The performance of construction projects in Libya

6.7.3.1 Factors causing poor project performance

The purpose of this section is to introduce the general factors besides procurement that may be considered as being responsible for poor PP in LCI, ***the respondents were asked to indicate the most important factors that they think cause projects to run over budget or over time.*** The responses of the interviewees were analysed using the RII and then summarized as shown in Table 9.2. As can be seen, the results show that the six main important factors causing projects to run over budget are:

- Client's delay in payment to the contractor at the right time.
- Inappropriate experience of the consultants, contractors and clients' supervisors.
- Improper planning and design.
- Slow decision-making by client.
- Financial and administrative corruption.
- External pressure (political or economic).

The three least important factors are:

- The lack of coordination between the private and state sectors for implementation of projects.
- Instability of the administrative and financial projects.
- Contractor lobbying power with government being stronger than that of clients.

Table 6.32: Ranking of factors that cause poor PP

Factors in poor project performance	Frequency of responses	Percent of respondents (%)	Rank
Client's delay in payment to the contractor at right time	17	100	1
The lack of corporation and coordination between the sectors state in the implementation of the project	11	64.7	4
The difficulty and complexity of the procedures for obtaining drilling and construction permits of the relevant authorities	11	64.7	4
Instability of the administrative and financial project	8	47.0	6
Inappropriate experience of the consultants, contractor and clients' supervisors	17	100	1
Design errors	12	70.5	3

Improper planning and design	17	100	1
Poor contract management of the project	12	70.5	3
Client's delay in the approve of orders revisionism of the project	11	64.7	4
The difficulty and complexity of the procedures relating to hiring specialized expatriate labourers	11	64.7	4
Financial and administrative corruption	13	76.5	2
Slow decision-making by client	17	100	1
Contractor powers with the government being stronger than clients	10	58.8	5
External pressure (political or economic)	13	76.5	2

6.7.3.2 Non-compliance of Libyan Public Client to the ACR

The purpose of this section is to determine the reasons of why public project clients in Libya did not adhere to following the *Administrative Contracts Regulation* (ACR) in terms of contracting in the recent years. Construction projects in Libya are subjected to *Administrative Contracts Regulation* (ACR) (General People's Committee, 1999), which essentially determines the mechanisms of contracting and the obligations between the parties of the contract (see section 4.3.2). It was surprising that in recent years the public clients did not follow the ACR regarding the contracting of the projects (PPA, 2010). Due to this, ***the interviewees were asked about the reasons that are responsible for clients' non-compliance with the ACR when contracting out projects (until recently)***.

Overall, the interviewees gave similar response to this question, which is that clients tend to accelerate the completion of contractual procedures in order to finish projects quickly. They mentioned the cause of this attitude as particularly resulting from government's desire, within the period from 2002 to 2010, to expedite the execution of different construction and infrastructure projects by allocating large sums of money for this purpose. Therefore, some facilitation of projects was made with regard to the ACR in order to overcome some of the complicated procedures for it, particularly if the projects were procured by DBB. For instance, according to the ACR, open tender is the first option in selecting a contractor. This method usually takes a long time. Due to this, the government assigns other methods such as selective tenders and direct order to minimizing project time. These methods were assigned by most public clients due to the nature and circumstances of the period under which the projects were implemented, notably, the speed with which contracting and implementation were required to be progressed. This result has been confirmed by PPA. The PPA report about the implementation of buildings and infrastructures projects in Libya during the period between 2005 and 2010 shows that, more than 70% of the project were contracted using selective tender and direct order tender. The report also indicates that the main reason of this high percent is related to the government desiring to speeding up the contract procedure and finishing the projects early.

6.8 Summary

This chapter covers data collection and analysis of the initial and main survey carried out with clients, contractors and consultants, aimed at finding out, among others, the most common PMs used to deliver construction projects in Libya, and the influence that these PMs' selection criteria have on PP of Libyan construction projects. The chapter also presents the most common types of contracts and tendering used in construction projects in Libya and the factors besides procurement issues that influence PP. The conclusions drawn from the analysis of the initial and main survey are summarised below:

- *Initial survey*

For the initial survey, 30 questionnaires were emailed to the clients and contractors experts with experience of no less than 11 years of working in Libyan construction sectors. The majority of them were project managers with MSc degree holder. 25 completed questionnaires were received in the time allocated. Data was analysed using descriptive statistics analysis including test of frequency. A summary of the findings is listed below:

- The most common procurement type in use to deliver projects in Libya is DBB, being used for 92% of the country's projects. The remaining 8% are procured by DB method.
- Time, cost and quality are the three major criteria for measuring PP in Libya.
- The most important problems associated with using DBB are time overruns, cost overruns and poor quality. Time performance is considered the major criterion has source of project dissatisfaction followed by cost performance.
- The level of performance of construction projects in Libya has been classified under poor performance level

The findings obtained from the initial survey data collection and analysis were then used to devise the questions for a major questionnaire survey (main survey) that followed, wherein greater priority of the research rests. The reason for such priority lies in the fact that quantitative research approach is considered best when it comes to examining the relationship between research variables by deductive approach. The results of the first stage confirmed that the most common procurement strategy used to deliver construction projects in Libya are DBB and DB and so, the main survey was designed to capture experts' perceptions on projects of these two methods only.

- *Main questionnaire survey data collection and analysis (quantitative)*

For the main questionnaire survey, 200 questionnaires were distributed to construction organisations (clients, contractors and consultants) across Libya, receiving an overall response rate of 62% (n=126). The majority of the respondents were project managers with experience of no less than 11 years. Various statistical tests were performed to analyse the survey data, including screening and cleaning data, test of normality, test of reliability, relative index, Kendall's *W*, Chi square test, one way between group ANOVA and correlation testing. A summary of the findings is listed below:

- The two most important factors responsible for poor PP are "improper planning and design" and "inadequate contractor experience" irrespective of whether the projects procured by DBB or DB. The rank of these factors differs based on the project party's point of view.
- The lack of clients' knowledge of modern types of construction procurement is considered the main reason behind selection of improper PM.
- Bill of quantity contract and lump sum contract are considered the most common types of contracts that used in Libyan construction projects.
- Selective tender is the most commonly type in use for selection contractors in Libya, irrespective of project procured by DBB or DB methods.
- The three most likely procurement criteria influencing the selection of DBB method are: "clear definition of parties' responsibilities", "desiring efficient project planning" and "clarity of scope definition". However, the three most likely DB procurement criteria are: "single point of responsibility", "collaborative relationship between project team" and "desiring efficient project planning".
- Correlation testing between PMSC and PP indicated that for projects procured by DBB method 7 out of 12 procurement selection criteria significantly correlated with one or more PP criteria. These are: "complexity of design", "high quality level

required", "high involvement of the project client", "controllable project variations", "time certainty", "ease organising and reviewing project activities and project functionality. For projects procured by DB, it was found that 8 out of 13 procurement selection criteria exhibited a significant correlation with one or more PP criteria: these include: "quick delivery of construction processes", "quick project commencement", "effective communication between project parties", "flexibility of design and construction changes", "desiring reduced project cost", "desiring reduced project time", "collaborative working relationship between project team" and "desiring efficient project planning".

The findings of the main questionnaire survey identified several issues mostly related to the factors responsible for poor project performance, procurement selection criteria for DBB and DB methods and their correlation with PP. Therefore to offer deeper understanding of how PMSC criteria for (DBB and DB) influence PP, interviews survey (qualitative data) were conducted.

- *Interview data collection and analysis (qualitative)*

The data was collected via interviews with 17 experts in the Libyan construction and project management sector. The participants involved in different kinds of projects. The main purpose of the interviews is to explore how the criteria for selecting DBB and DB methods affect PP, as well as examining other factors besides procurement matters that may influence the performance of construction project in Libya. A summary of the survey findings indicated that. With DBB projects it was found:

- The client select the contractors based on the lowest price only without taking into consideration the other criteria such as experience and technical capabilities which adversely affected the performance of the projects.
- The performance of construction projects in Libya is adversely affected by the quality of design, materials, equipment, machinery used and workmanship, all of which were poorly and ineffectively sourced. Contractors and their staff lacked relevant experience for handling complex projects.
- The responsibilities and duties of the project participants was not defined properly which explain why the project participants negligence their responsibilities.

- Client involvement in the project played an important role in building up good and smooth communication between project team members which reflects positively on PP. the reviewing the design and specification of the projects in an early stage helped to manage and control changes that may occur during construction work as well as keeping projects on budget and time.
- The certainty of knowing the duration and total cost of the project positively affected PP. Knowing the project duration and cost in the early stage helped clients and consultants to prepare good plan for project in order to prevent time and cost overruns.
- The accuracy and clarity of contract documents (drawings, designs and specifications, etc.) helped consultants, project managers and clients' supervisors to review and monitor project execution properly, as well as managing and controlling the project.

For DB projects the findings reveal that:

- The overlapping of the design and construction work gave contractors an opportunity to accelerate construction, works and start the projects in the initial phase before design work completion. The integration of the design and construction works also provides strong communication between project parties which made them work more closely to facilitate the work and solve project problems. It also provides high flexibility for design and construction changes, which reflects positively on PP.
- The single point of responsibility of DB projects helped the contractor to manage any changes in the design works without any effect on PP. It also aided the contractor to manage to reduce time and cost. The contractors undertaking the design and construction work, in which familiar construction methods can be used efficiently to speed construction work and reduce project time and cost.
- "Collaborative working relationship between project team" highly affected PP. The design and construction team collaborations with contractors play an important role in reducing conflicts between them. This collaboration allowed them to prepare and produce good and efficient plan for the project and this positively influenced PP.

There are 15 factors besides procurement criteria affecting PP in the LCI. client's delay in payment to the contractor, inappropriate experience of the consultants, contractor and clients' supervisors, improper planning and design, slow decision-making by client, financial and administrative corruption and external pressure (political or economic) are the main factors responsible for poor project performance.

Generally, the findings of the data collection and analysis of the initial survey and main survey (quantitative and qualitative) will be used to determine the conclusion and recommendation for future research as well as developing the model of the forthcoming research

The next chapter will present the developing and validation of a mathematical models for exploring the PMSC that make a significant contribution to the project performance, in order to aid the prediction of the PP.

CHAPTER 7: MODELLING AND VALIDATION

7.1 Introduction

This chapter covers the development and validation of a model demonstrating the influence that PMSC have on PP. The model was developed using MRA technique based on the findings obtained from the previous chapter. This chapter is organised in 10 sections: The next section after this introduction presents the justification for using MRA technique to develop the model. This is followed by reviewing the assumptions of using MRA, including the testing of: multicollinearity, normality, linearity and outliers. The fourth section presents detailed evaluation of the model which includes R square test and ANOVA test. Section Five focuses on evaluating the independent variables (PMSC). Section six takes a detailed look at the selection criteria that are significant for both DBB and DB methods. This section covers the testing of the proposed hypotheses formulated on PMSC influence on the performance of projects procured by DBB and DB methods. Section Seven focuses on revising the developed model and this includes a presentation on the resulting various mathematical models for predicting PP. The section that follows presents the application of the model. Section Nine discusses the validation of the model while the last section presents a summary of this chapter.

7.2 Justification of using MRA

The purpose of the model development, as highlighted earlier on, is to examine the influence of PMSC (and their significant contribution) to PP, towards exploring its use as aids for predicting DBB and DB construction projects' performance in Libya. Knowing the criteria that significantly affect PP will enable clients to focus more (or give more weighting) to such criteria during DBB and DB selection process, if their projects' success are to be enhanced.

The justification of using MRA to develop the model is that, the MRA has been confirmed by a number of researchers (e.g., Pallant, 2010 and Hair et al., 2010) as being the best technique used to find out the relationship between single dependant variable and a number of independent variables and to determine those of the latter that make a strong contribution to the former (Hair et al., 2010). Pallant (2010) indicated that MRA can be defined as a statistical technique that allows prediction of score depending on one variable based on previous scores with several other variables. Braimah (2008) defined it as a statistical technique used to develop a model for observing and predicting the effect of a number of independent variables upon a dependent variable. MRA uses a mathematical expression or equation to represent the behaviour of the phenomenon being studied (Field, 2005, p.144; Pallant, 2010, p.148). The main difference between regression and correlation is that, the latter tells us nothing about the predictive power of variables (Field, 2005, p.144). However, multiple regression is based on correlation but allows more sophisticated exploration of interrelationships among a set of variables. It can tell how well a set of variables is able to predicate a particular outcome. A number of different types of multiple regression can be used to explore the relationships between variables such as standard or simultaneous, hierarchical or sequential and stepwise. In this study, standard multiple regression was employed to study the relationships between the PMSC and the PP criteria because it the most commonly used regression analysis technique (Pallant, 2010, pp.148-149). This type of regression can be expressed in the form of the following equation:

$$Y^{i} = b_0 + b_1 x_1 + b_2 x_2 + \ldots + b_n x_n + \varepsilon i; \quad I = 1 \ldots N$$

The model developed by this study was based on the main findings of the previous chapter. The findings of the previous chapter identified the common PMs currently in use (DBB and DB methods) and their criteria as well as the criteria of PP. The findings also identified the ranking of the DBB and DB criteria and PP criteria based on their importance. Furthermore they determined the correlation/relationship between the dependant variables (project performance criteria) and independent variables (procurement selection criteria). These findings represent the basic parameters that are considered for developing models based on MRA. According to Pallant (2010) prior conducting MRA the dependent and independent variables should be evaluated and ranked based on their importance as well as the relationship between them should be determined. Furthermore, the variables need to be tested in terms of normality and reliability.

7.3 The assumptions of using MRA

Before conducting MRA some assumptions should be checked, including multicollinearity, normality, linearity and outliers (Field, 2005; Tabachnick and Fidell, 2006; Pallant, 2010).

7.3.1 Testing of Multicollinearity

This refers to the relationship between variables in the model. Pallant, (2010) indicated that the independent variables must show at least some relationship with dependent variable (above 0.3) see Tables 6.29 and 6.30 in previous chapter. In addition, the correlation between each independent variable should not be too high (not more than 0.7) (Pallant, 2010). Tables 7.1 and 7.2 display the correlation between variables. As can be seen, most of the correlation between variables is not more than 0.7.

Table 7.1: Correlation between PSC for DBB

DBB procurement criteria	High Price competition	Clarity of scope definition	Complexity of design	High Quality level required	Clear definition of project parties' responsibility	Client involvement in the project	Controllable project variation	Cost certainty	Time certainty	Ease to organizing and reviewing project activities	Desiring efficient project planning	Project functionality
High price competition	1											
Clarity of scope definition	.161	1										
Complexity of design	.004	-.047	1									
High Quality level required	-.020	.426**	.078	1								
Clear definition of project parties' responsibility	.015	.415**	-.020	.544**	1							
Client involvement in the project	-.121	-.240**	.235**	-.128	.125	1						
Controllable project variation	.144	.270**	.061	.285**	.311**	.391**	1					
Cost certainty	.062	.109	.137	.170	.485**	.389**	.045	1				
Time certainty	-.130	.385**	.103	.230**	.414**	.293**	.037	.621**	1			
Ease of organizing and reviewing project activities	-.092	.331**	.207*	.241**	.345**	.354**	.129	.360**	.613**	1		
Desiring efficient project planning	-.059	.296**	.133	.250**	.385**	.253**	.234**	.237**	.469**	.680**	1	
Project functionality	.169	.478**	.220*	.435**	.394**	-.111	. 320**	.172	.344**	.384**	.531**	1

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

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

Table 7.2: Correlation between PSC for DB

DB procurement criteria	Quick delivery of construction process	Quick project commencemen t	Effective communicatio n between project parties	Flexibility in design & construction changes	Single point of responsibility	Less conflicts amongst project parties	Complexity of design	Transfer of risks to the contractor	Desiring reduced project cost	Desiring reduced project time	Level of competence & experienced contractor	Collaborative working relationship between project team	Desiring efficient project plan
Quick delivery of construction process	1												
Quick project commencement	.367**	1											
Effective communication between project parties	.551**	.140	1										
Flexibility in design & construction changes	.352**	.395**	.513**	1									
Single point of responsibility	.196*	.174	.312**	.396**	1								
Less conflicts amongst project parties	.417**	.197*	.409**	.305**	.215*	1							
Complexity of design	.105	-.071	.005	-.018	-.043	.128	1						
Transfer of risks to the contractor	.161	.034	-.097	-.104	.362**	.088	.156	1					
Desiring reduced project cost	.094	.140	.342**	.164	. 366**	.045	-.172	.085	1				
Desiring reduced project time	.278**	.086	.093	-.010	.192*	.065	-.173	.175*	.635**	1			
Level of competence & experienced contractor	.263**	-.049	.481**	.018	.166	.124	.106	-.025	.051	.456**	1		
Collaborative working relationship between project team	.307**	.038	.421**	.300**	.119	.403**	.329*	-.219*	.201*	.202*	.333**	1	
Desiring efficient project plan	.386**	.045	.434**	.329**	.090	.384**	.117	-.126	-.138	-.055	.296**	.506**	1

In testing of Multicollinearity, the Collinearity of the variables (Tolerance and VIF) also needs to be checked. Tolerance is defined as “*an indicator of how much of the variability of the specified independent is not explained by the other independent variables in the model*” (Pallant, 2010). However, VIF is the variance inflation factor. This factor is an inverse of the Tolerance. The value of the Tolerance should be more than 0.1 and VIF less than 10 (Pallant, 2010; Field, 2005). As can be seen in Tables 7.3 and 7.4, the values of Tolerance for each variable are not less than 0.1 therefore the multicollinearity assumption is not violated. This is also supported by the VIF value, which is less than 10 for each variable.

Table 7.3: The Collinearity of the DBB variables (Tolerance and VIF)

DBB procurement criteria	Time		Costt		Quality	
	Collinearity		Collinearity		Collinearity	
	TOLE	*VIF*	*TOLE*	*VIF*	TOLE	VIF
High price competition	.933	1.000	.905	1.105	.957	1.045
Clarity of scope definition	.814	1.221	.753	1.328	.905	1.105
Complexity of design	.752	1.330	.744	1.344	.814	1.221
High Quality level required	.727	1.376	.802	1.247	.963	1.038
Clear definition of project parties’ responsibility	.419	2.389	.778	1.285	.434	2.302
Client involvement in the project	.933	1.072	.922	1.085	.414	2.418
Controllable project variation	.682	1.466	.414	2.418	.964	1.037
Cost certainty	.413	2.424	.814	1.221	.414	2.418
Time certainty	.301	3.320	.301	3.318	.301	3.318
Ease of organizing and reviewing project activities	.264	3.789	1.00	1.00	.96	1.042
Desiring efficient project planning	.993	1.007	.451	2.216	.451	2.216
Project functionality	.9771	1.030	.954	1.048	.843	1.186

Table 7.4: The Collinearity of the DB variables (Tolerance and VIF)

DB procurement criteria	Time		Cost		Quality	
	Collinearity		Collinearity		Collinearity	
	TOLE	*VIF*	*TOLE*	*VIF*	TOLE	VIF
Quick delivery of construction processes	.450	2.225	.450	2.225	.450	2.225
Quick project commencement	.975	1.026	.698	1.432	.698	1.432
Effective communication between project parties	.804	1.245	.694	1.441	.694	1.441
Flexibility in design and construction changes	.495	2.019	.495	2.019	.495	2.019
Single point of responsibility	.657	1.521	.657	1.521	.657	1.521
Less conflict amongst project team	.671	1.490	.671	1.490	.671	1.490
Complexity of design	.917	1.091	.752	1.329	.752	1.329
Transfer risks to the contractor	.664	1.506	.664	1.506	.664	1.506
Desiring reduced project cost	.475	2.104	.475	2.104	.475	2.104
Possibility reduce project time	.430	2.328	.430	2.328	.430	2.328
Level of competence and experienced contractor	.734	1.363	.734	1.363	.734	1.363
Collaborative working relationship between project team	.763	1.310	.441	2.265	.441	2.265
Desiring efficient project planning	.524	1.910	.524	1.910	.524	1.910

7.3.2 Testing of normality and linearity

This assumption should be checked by inspecting Probability Plot (P-P) of the regression standardised residual and scatter plots (Pallant, 2010; Field, 2005). This can allow checking:

- Normality (the residual should be normally distributed, the skewness and kurtosis components should be lie within values of between ± 1.0) (see section 6.5-b)
- Linearity (the assumption of the linearity is that there is straight line relationship between variables).

In the normal plot the data should be lie in straight diagonal line from bottom left to top right. Figures 7.1 and 7.2 display the normal P-P plot of regression standardized residual for project procured by DBB and DB in terms of time, cost and quality. As can be seen from the figures, the data lies in straight diagonal line.

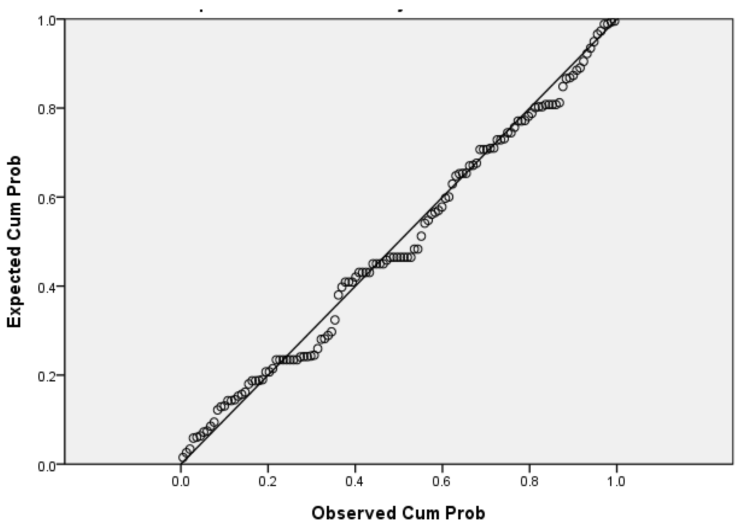

Figure 7.1: Normal P-P plot of regression standardized residual for DBB project dependent variable: project performance (Time, Cost, Quality)

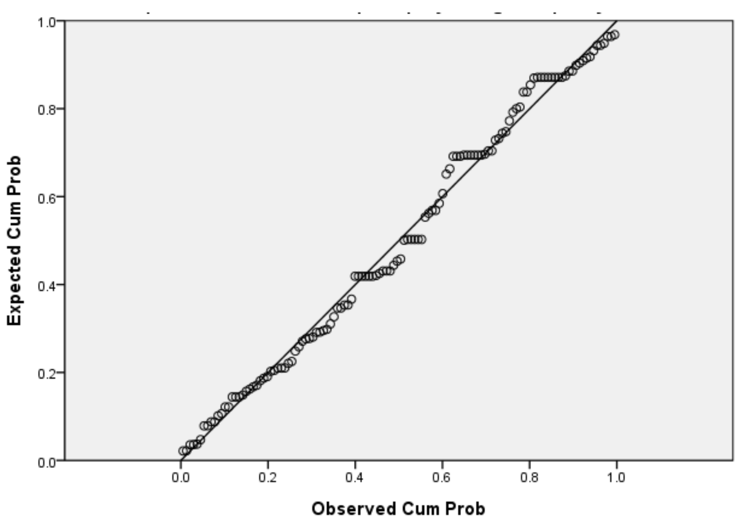

Figure 7.2: Normal P-P plot of regression standardized residual for DB project dependent variable: project performance (Time, Cost, Quality)

7.3.3 Testing of outliers

The outliers can be defined as the cases that have a standardised residual of (± 3.3), as displayed in the scatterplot (Pallant, 2010; Tabachnick and Fidell, 2006). The outliers' cases include incorrect data entry, failure to identify and error in the sampling. As can be seen in Figure 7.3 and Figure 7.4, there are no cases with a standard residual of more than +3.3 and less than -3.3, which means that there are no outliers.

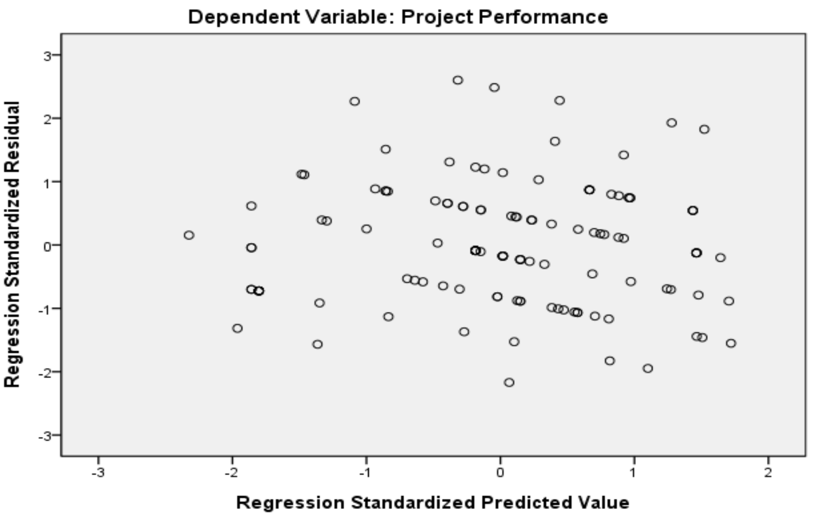

Figure 7.3: Scatter plot DBB project

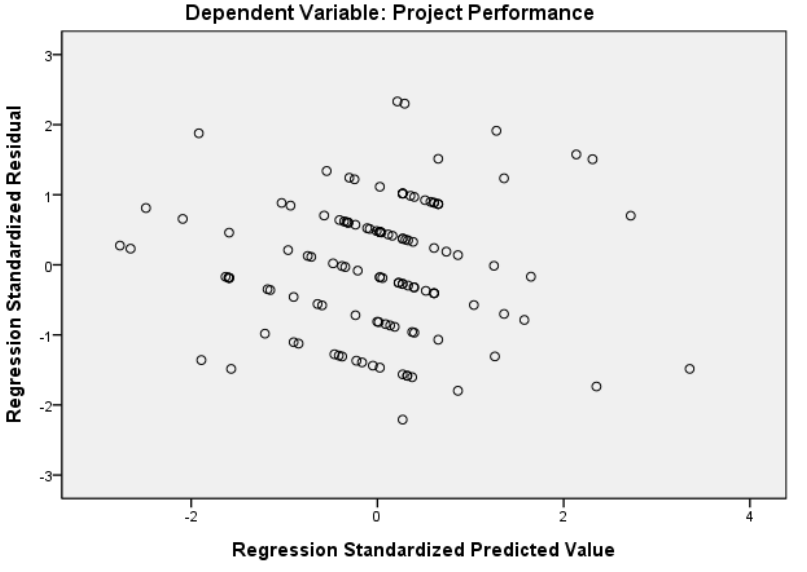

Figure 7.4: Scatter plot DB project

The Outliers can also be checked by inspecting the Mahalanobis distances that are produced by the MR programs. Mahalanobis do not appear on the output file but they present in the data file as an extra variable at the end of the file. In order to find out which cases are outliers, we need first to determine the critical chi-square value using the number of independent variables as the degrees of freedom. This value can be obtained from the list of critical chi-square value (Appendix G). The values of Mahalanobis distances which are more than critical chi-square indicates multivariate outliers. In this study, for projects procured by DBB the critical χ 2 (11) = 31.264; however, with DB method the critical χ 2 (12) = 32.909. The values of Mahalanobis distances for all cases are not greater than

31.264 for DBB method, and 32.909 for DB, which means that there are no multivariate outliers.

7.4 Evaluating the Model

Pallant (2010) indicated that the regression model can be evaluated using R square test and ANOVA test

7.4.1 R square test

Table 7.5 shows the summary of the MR model. The value of R Square indicates the degree of variation of the dependent variable (project performance criteria), which is explained by the model. Tabachnick and Fidell (2006) defined R-squared as "*a statistical measure of how close the data are to the fitted regression line. It is also known as the coefficient of multiple determinations for multiple regressions*".

Table 7.5: Model summary of the regression between PMSC for DBB - DB methods and PP criteria

DBB Model	**Time**		**Cost**		**Quality**	
	R Square	Adjusted R Square	R Square	Adjusted R Square	R Square	Adjusted R Square
Clients	0.769	0.742	0.271	0.231	0.401	0.332
Contractor	0.786	0.756	0.194	0.152	0.350	0.278
Consultant	0.617	0.601	0.580	0.523	0.785	0.717
All groups	0.666	0.655	0.421	0.403	0.500	0.490
DB Model	**Time**		**Cost**		**Quality**	
	R Square	Adjusted R Square	R Square	Adjusted R Square	R Square	Adjusted R Square
Clients	0.524	0.480	0.550	0.540	0.346	0.284
Contractor	0.377	0.326	0.450	0.430	0.100	0.077
Consultant	0.423	0.410	0.530	0.510	0.659	0.594
All groups	0.450	0.430	0.510	0.498	0.520	0.500

The results show that for projects procured by DBB method, the R Square values for all respondent groups in terms of time performance is 0.666, higher than that of cost and quality performance values of 0.421 and 0.50, respectively. This means that the model explains 66.6% of the variance in terms of time, 42.1% in terms of cost and 50.0% in terms of quality. Adjusted R^2 is adjusted for the number of variables included in the regression equation. This is used to estimate the expected shrinkage in R Square that would not generalize to the population (Pallant, 2010; Tabachnick and Fidell, 2006).

On the other hand, for projects procured by DB method the results reveal that the R Square values for all respondent groups are nearly the same. The R Square values are 0.450 in terms of time, 0.510 in terms of cost and 0.520 in terms of quality. This indicates that the model explains 45.0% of the variance in terms of time, 51.0% of the variance in terms of cost and 52.0% in terms of quality.

7.4.2 **ANOVA Test**

This test can tell whether the model is a significant fit of the overall data or not. Table 7.6 and Table 7.7 show the results of the ANOVA test. The threshold often set to help determine the statistical significance of model is 0.05 probabilities (p). If the p value < 0.05 the model is statically significant; if it is more than 0.05 the model is not statistically significant. The results show that the p values of all models are < 0.05 for projects procured by DBB and DB methods. This indicates that the models are statically significant

Table 7.6: Statistical significant of the model (ANOVA) for DBB procurement

Project performance	Model	Sum of Squares	df	Mean Square	Sig.
Complete project on schedule (Time)	Regression Residual Total	43.763 21.952 65.714	4 121 125	10.941 .181	.000
Complete project on budget (Cost)	Regression Residual Tota	11.519 48.806 60.325	4 121 125	2.880 .403	.000
Complete project on quality (Quality)	Regression Residual Tota	22.426 68.503 90.929	5 120 125	4.485 .571	.000

Table 7.7: Statistical significant of the model (ANOVA) for DB procurement

Project performance	Model	Sum of Squares	df	Mean Square	Sig.
Complete project on schedule (Time)	Regression Residual Total	23.473 91.234 114.706	4 121 125	5.868 .754	.000
Complete project on budget (Cost)	Regression Residual Total	10.086 83.025 93.111	1 124 125	10.086 .670	.000
Complete project on quality (Quality)	Regression Residual Total	10.604 88.253 98.857	3 122 125	3.535 .723	.003

7.5 Evaluating Independent Variables

This section examines which of the independent variables included in the model contributed to the prediction of the dependant variables. Table 7.8 display the results of the PMSC with significant contribution to the PP in terms of time, cost and quality for project procured by DBB, while Table 7.9 show the same results for projects procured by DB method. The columns labelled t and Sig (p) values gave a rough indication of the impact of each independent variable on dependent variable. The significance of predictor variables contributing to the model outcome is indicated by t-value. The suggested t-value should be more that 1.96 (Hair et al., 2006). A big absolute t-value and small p value suggests that the independent variable is having a large impact on the dependant variable. If the p value of any independent variable is less than 0.05, this variable makes a significant contribution to the dependant variable. The standardized beta coefficients give a measure of the contribution of each variable to the model. They also can tell which of the independent variable makes the strongest unique contribution to explaining the dependant variables. The independent variable that has the largest absolute value of beta makes the strongest contribution and has the greatest effect on the dependant variable (Pallant, 2010, p.161). Figure 7.5 explains the evaluation of each dependant variable.

Table 7.8: DBB procurement selection criteria with significant contribution to PP in terms of time, cost and quality

DBB procurement criteria		Time				Cost				Quality			
		B	Beta	t	SIG	B	Beta	t	SIG	B	Beta	t	SIG
High price competition	x_1	.124	.131	2.477	.015	-.028	-.030	-.326	0.745	.214	.191	2.36	.020
Clarity of scope definition	x_2	.118	.116	2.050	.045	.033	.031	.309	.758	-.222	.198	-2.35	0.324
Design complexity	x_3	.020	.021	.336	.738	.052	.054	.570	.570	.173	.096	1.989	.049
High quality level required	x_4	-.072	-.073	-1.164	.247	.254	.288	2.927	.004	.298	.225	3.15	.002
Clear definition of party responsibilities	x_5	.018	.017	.205	.838	.236	.235	2.539	.012	.108	.088	.720	.473
Client involvement in the project	x_6	.194	.209	3.839	.000	.189	.212	2.488	.014	.110	.101	.956	.341
Controllable project variation	x_7	.023	.029	.449	.654	-.002	-.003	-.027	.979	.281	.298	3.694	.000
Cost certainty	x_8	.029	.031	.368	.713	.258	.276	1.999	.049	.00	.00	.001	.999
Time certainty	x_9	-.034	-.035	-.362	.718	.252	.271	1.796	.075	-.114	-.099	-.680	.498
Ease of organizing and reviewing project activities	x_{10}	.131	.128	1.234	.220	.273	.278	2.135	.035	.231	.192	2.37	.019
Desiring efficient project planning	x_{11}	.115	.096	1.969	.033	-.009	-.008	-.067	.947	.178	.127	1.06	.291
Project functionality	x_{12}	1.684	.816	15.302	.000	.422	.213	2.549	.012	.063	.026	.296	.768

Table 7.9: DB procurement selection criteria with significant contribution to PP in terms of time, cost and quality

DB procurement criteria		Time				Cost				Quality			
		B	Beta	t	SIG	B	Beta	t	SIG	B	Beta	t	SIG
Quick delivery of construction processes	X_{13}	.047	.046	.381	.704	.069	.076	.584	.561	.087	.093	.715	.476
Quick project commencement	X_{14}	.229	.230	2.807	.010	.042	.047	.448	.655	.150	.176	2.000	.047
Effective communication between project parties	X_{15}	.172	.188	2.075	.040	.224	.272	2.763	.009	.149	.175	1.931	.049
Flexibility in design and construction changes	X_{16}	.084	.085	.737	.463	-.041	-.046	-.375	.709	-.053	-.058	-.465	.643
Single point of responsibility	X_{17}	-.065	-.047	-.469	.640	-.098	-.080	-.745	.458	-.213	-.167	-1.989	.049
Less conflict amongst project team	X_{18}	-.158	-.164	-1.643	.103	-.112	-.129	-1.214	.227	.062	.069	.655	.514
Complexity of design	X_{19}	.178	.213	2.51	.013	-.121	-.161	-1.612	.110	.194	.250	2.919	.004
Transfer risks to the contractor	X_{20}	.124	.116	1.160	.249	.108	.112	1.050	.296	-.029	-.029	-.271	.787
Desiring reduced project cost	X_{21}	-.139	-.127	-1.076	.284	-.078	-.079	-.631	.529	-.113	-.112	-.888	.377
Possibility reduce project time	X_{22}	.154	.139	1.117	.267	.027	.027	.203	.840	.005	.005	.037	.971
Level of competence and experienced contractor	X_{23}	.056	.060	.632	.529	-.006	-.007	-.068	.946	-.117	-.136	-1.338	.184
Collaborative working relationship between project team	X_{24}	.276	.202	2.179	.031	.191	.156	1.190	.237	.003	.003	.020	.984
Desiring efficient project planning	X_{25}	.022	.022	.192	.848	.003	.003	.027	.978	.091	.095	.790	.431

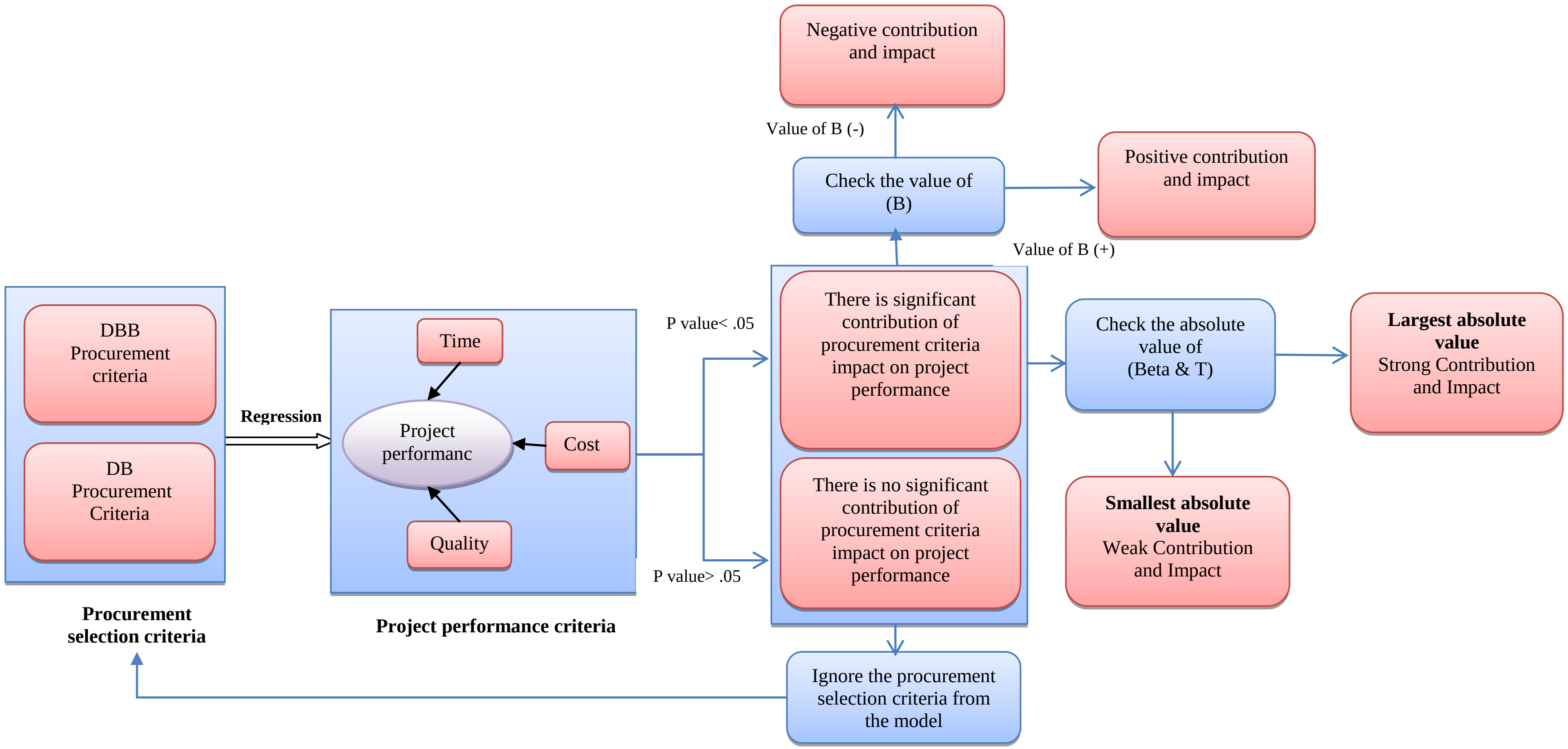

Figure 7.5: Evaluating the independent variables

7.6 DBB and DB Selection Criteria of significant PP influence

This section examines DBB and DB procurement selection criteria that make significant contribution to PP. These criteria have been determined based on testing the different DBB and DB proposed hypotheses introduced in Chapter 3. MRA was employed to find out the selection criteria that contribute significantly to PP as well as for predicting (in quantitative terms) the nature and extent of performance to be expected. As noted in Chapter 3, the variables predicted by the MRA are represented by PP criteria (dependent variables) whilst the variables used for the prediction are the PMSC (independent variables).

7.6.1 Testing the model hypotheses for DBB method

For projects procured by DBB method, the hypotheses behind the model, as formulated based on the review of literature (Chapter 3), are listed as follows:

- H1: High price competition has a positive effect on the PP (time, cost and quality)
- H2: Clarity of scope definition has a positive effect on the PP (time, cost and quality).
- H3: Complexity of design has a positive effect on the PP (time, cost and quality).
- H4: High quality level required has a positive effect on the PP (time, cost and quality).
- H5: Clear definition of project parties' responsibilities has a positive effect on PP (time, cost and quality).
- H6: Client involvement in the project has a positive effect on the PP (time, cost and quality).
- H7: Controllable project variation has a positive effect on the PP (time, cost and quality).
- H8: Cost certainty has a positive effect on the PP (time, cost and quality).
- H9: Time certainty has a positive effect on the PP (time, cost and quality).
- H10: Ease of organising and reviewing project activities has a positive effect on the PP (time, cost and quality).
- H11: Desiring efficient project planning has a positive effect on the PP (time, cost and quality).
- H12: Project functionality has a positive effect on the PP (time, cost and quality)

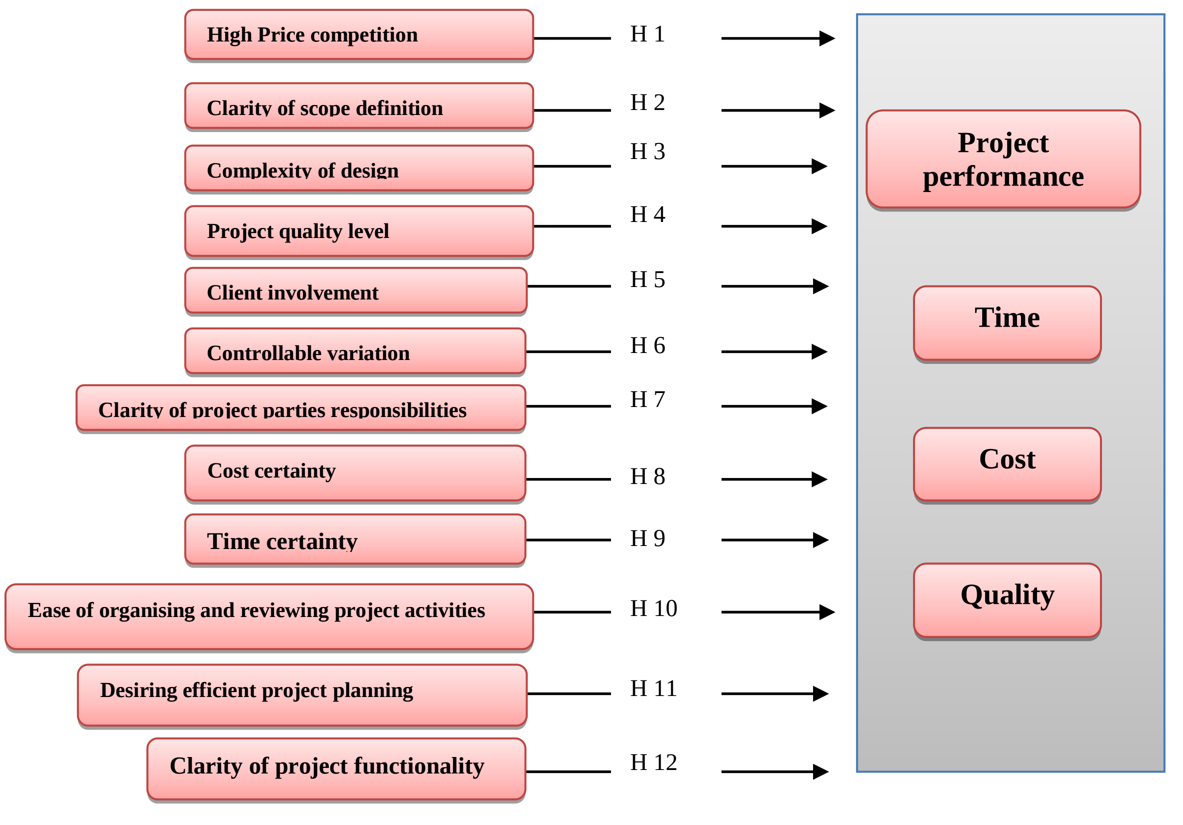

Figure 7.6: Proposed model hypotheses for DBB method

Table 7.8 shows the results of the MRA undertaken to test as to whether the DBB selection criteria influence PP in terms of time, cost and quality. The results show that:

(a) In terms of time there are five criteria make a significant positive contribution to PP. these are: “high price competition”, “clarity of scope definition”, “client involvement in the project”, “desiring efficient project planning” and “clarity of project functionality”. The P value of each criterion is < 0.05 which means these criteria have a significant positive influence on time performance and this confirms the hypotheses H1, H2, H6, H11 and H12. On the other hand, the other 7 criteria do not make significant contribution to time performance (P value > 0.05), so the hypotheses H3, H4, H5, H7, H8, H9 and H10 are to be rejected. The highest absolute value of t and beta come from “clarity of project functionality”, with t = 15.302 and beta = 0.816. This means that this DBB selection criterion makes the strongest contribution to time performance.

(b) In terms of cost the results indicate that “quality level required”, “clear definition of party responsibilities”, client involvement in the project”, “cost certainty”, “ease of organizing and reviewing project activities” and “clarity of project functionality” have a significant contribution and influence with cost component of PP (P value < 0.05) which confirms the hypotheses H4, H5, H6, H8, H10 and H12. On the other hand, the other 6 criteria do not make significant contribution to the cost performance wherein P value of each of them is > 0.05, so the hypotheses H1, H2, H3, H7, H9 and H11 are to be rejected. The highest absolute value of t and beta come from “high quality level required”, with t = 2.927 and beta = 0.288, which indicates that this criterion makes the strongest contribution to cost performance.

(c) In terms of quality the results show that the criteria that making a significant positive contribution with quality performance are “high price competition”, “design complexity”, “quality level required”, “controllable project variation”, and “ease of organizing and reviewing project activities” (P value < 0.05). This result confirms the hypotheses (H1, H3, H4, H7 and H10). On the other hand, the other 7 criteria do not exhibit any significant contribution to quality performance (P value > 0.05), so the hypotheses H2, H5, H6, H8, H9, H11 and H12 are to be rejected. The highest absolute value of t and beta come from the “controllable variations”, with t = 3.694 and beta = 0.298, which means that this criterion makes the strongest contribution and impacts on quality performance.

Based on the results of the regression analysis above, all the DBB research hypotheses have been examined. Table 7.10 presents the summary of the of the multiple linear regression results and indicates the supported and rejected hypotheses.

Table 7.10: Summary of accepted and rejected hypotheses of DBB criteria as a result of regression analyses

Hypothesis	Independent variable PMSC	Dependent variable PP criteria	Result of testing
H1	High price competition	Time	Accepted (p= 0.015)
		Cost	Rejected (p= 0.745)
		quality	Accepted (p= 0.020)
H2	Clarity of scope definition	Time	Accepted (p= 0.045)
		Cost	Rejected (p= 0.758)
		quality	Rejected (p= 0.324)
H3	Design complexity	Time	Rejected (p= 0.783)
		Cost	Rejected (p=0.570)

		quality	Accepted (p= 0.049)
H4	High quality level required	Time	Rejected (p= 0.274)
		Cost	Accepted (p= 0.004)
		quality	Accepted (p=0.002)
H5	Clear definition of party responsibilities	Time	Rejected (p= 0.838)
		Cost	Accepted (p= 0.012)
		quality	Rejected (p= 0.473)
H6	Client involvement in the project	Time	Accepted (p= 0.000)
		Cost	Accepted (p= 0.014)
		quality	Rejected (p= 0.341)
H7	Controllable project variation	Time	Rejected (p=0.654)
		Cost	Rejected (p=0.979)
		quality	Accepted (p= 0.000)
H8	Cost certainty	Time	Rejected (p= 0.713)
		Cost	Accepted (p= 0.049)
		quality	Rejected (p= 0.999)
H9	Time certainty	Time	Rejected (p= 0.718)
		Cost	Rejected (p= 0.075)
		quality	Rejected (p= 0.498)
H10	Ease of organizing and reviewing project activities	Time	Rejected (p= 0.220)
		Cost	Accepted (p= 0.035)
		quality	Accepted (p= 0.019)
H11	Desiring efficient project planning	Time	Accepted (p= 0.033)
		Cost	Rejected (p= 0.947)
		quality	Rejected (p= 0.291)
H12	Clarity of project functionality	Time	Accepted (p= 0.000)
		Cost	Accepted (p= 0.012)
		quality	Rejected (p= 0.768)

7.6.2 Testing the model hypotheses for DB method

For projects procured by DB method, the hypotheses behind the model, as formulated based on the review of literature (Chapter 3), are listed as followed:

- H13. Quick delivery of construction process has a positive effect on the PP (time, cost and quality).
- H14. Quick project commencement has a positive effect on the PP (time, cost and quality).
- H15. Effective communication between project parties has a positive effect on the PP (time, cost and quality).
- H16. Flexibility in design and construction changes has a positive effect on the PP (time, cost and quality).

- H17. Single point of responsibility has a positive influence on the PP (time, cost and quality).
- H18. Less conflicts amongst project team has a positive effect on PP (time, cost and quality).
- H19. Complexity of design has a positive effect on PP (time, cost and quality).
- H20. A transfer risk to the contractor has a positive effect on PP (time, cost and quality).
- H21. Desiring reduced project cost has positive effect PP (time, cost and quality).
- H22. Desiring reduced project duration has a positive effect on the PP (time, cost and quality).
- H23. The level of competence has positive effect on the PP (time, cost and quality).
- H24. Collaborative working relationship between project team has positive effect on the PP (time, cost and quality).
- H25. Desiring efficient project planning has a positive effect on the PP (time, cost and quality).

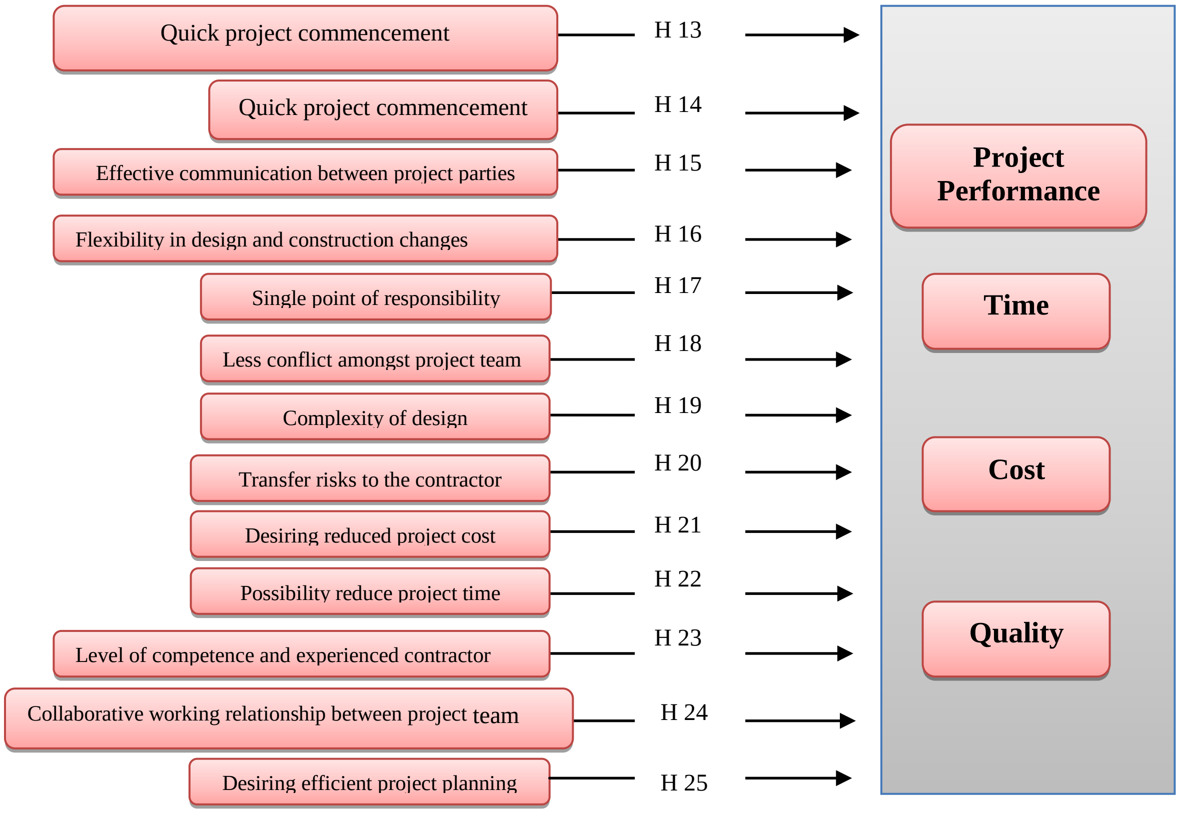

Figure 7.7 proposed model hypothesis for DB method

According to the MRA results presented in Table 7.9, the tests results as to whether the DB selection criteria influence PP in terms of time, cost and quality, show that:

(a) In terms of time there are four criteria make a significant positive contribution to PP ("quick project commencement", "effective communication between project parties", "complexity of design" and "Collaborative working relationship between project team"). The P value of each criterion is < 0.05 which means these criteria has significant positive influence on time performance and this confirms the hypotheses H14, H15, H19 and H24. On the other hand, the other 9 criteria do not make a significant contribution to time performance (P value > 0.05), so the hypotheses H13, H16, H17, H18, H20, H21, H22, H23 and H25 are to be rejected. The highest absolute value of t and beta come from "quick project commencement", with t = 2.807 and beta = 0.230. This indicates that this DB selection criterion makes the strongest contribution to time performance.

(b) In terms of cost only the criterion of "Effective communication between project parties" expiated a significant positive contribution and influence with PP (P value < 0.05) which confirms the hypotheses H15. On the other hand, the other 12 criteria do not make significant contribution to cost performance (P value > 0.05), so the hypotheses H13, H14, H16, H17, H18, H19, H20, H21, H22, H23, H24 and H25 are rejected. The highest absolute value of t and beta come from "high quality level required", with t = 2.763 and beta = 0.0.272, which indicates that this criterion makes the strongest contribution to cost performance.

(c) The results presents in table 7.9 also show that the criteria of "Quick project commencement", "Effective communication between project parties", "single point of responsibility", and "complexity of design" are positively contributed with quality component of PP (P value < 0.05). This result confirms the hypotheses (H14, H15, H17 and H19). On the other hand, the other 9 criteria do not exhibit significant contribution to quality performance (P value > 0.05) which means these criteria do not have influence on quality, so the hypotheses H13, H16, H18, H20, H21, H22, H23, H24 and H25 are rejected. The highest absolute value of t and beta come from the "complexity of design", with t = 2.919 and beta = 0.250, which means that this criterion makes the strongest contribution and impacts on quality performance.

Based on the regression analysis above all the DB research hypotheses have been examined. Table 7.11 summarises the results of the multiple linear regression and indicates the supported and rejected hypotheses.

Table 7.11: Summary of accepted and rejected hypotheses of DB criteria as a result of regression analysis

Hypothesis	Independent variable PMSC	Dependent variable PP criteria	Result of testing
H13	Quick delivery of construction processes	Time	Rejected (p= 0.704)
		Cost	Rejected (p= 0.561)
		quality	Rejected (p= 0.476)
H14	Quick project commencement	Time	Accepted (p= 0.010)
		Cost	Rejected (p= 0.655)
		quality	Accepted (p= 0.047)
H15	Effective communication between project parties	Time	Accepted (p= 0.040)
		Cost	Accepted (p=0.009)
		quality	Accepted (p= 0.049)
H16	Flexibility in design and construction changes	Time	Rejected (p= 0.463)
		Cost	Rejected (p= 0.709)
		quality	Rejected (p=0.643)
H17	Single point of responsibility	Time	Rejected (p= 0.640)
		Cost	Rejected (p= 0.458)
		quality	Accepted (p= 0.049)
H18	Less conflict amongst project team	Time	Rejected (p= 0.103)
		Cost	Rejected (p= 0.227)
		quality	Rejected (p= 0.514)
H19	Complexity of design variation	Time	Accepted (p=0.013)
		Cost	Rejected (p= 0.110)
		quality	Accepted (p= 0.004)
H20	Transfer risks to the contractor	Time	Rejected (p= 0.249)
		Cost	Rejected (p= 0.296)
		quality	Rejected (p= 0.787)
H21	Desiring reduced project cost	Time	Rejected (p= 0.284)
		Cost	Rejected (p= 0.529)
		quality	Rejected (p= 0.337)
H22	Possibility reduce project time	Time	Rejected (p= 0.267)
		Cost	Rejected (p= 0.840)
		quality	Rejected (p= 0.971)
H23	Level of competence and experienced contractor	Time	Rejected (p= 0.524)
		Cost	Rejected (p= 0.946)
		quality	Rejected (p= 0.184)
H24	Collaborative working relationship between project team	Time	Accepted (p= 0.031)
		Cost	Rejected (p= 0.237)
		quality	Rejected (p= 0.984)
H25	Desiring efficient project planning	Time	Rejected (p= 0.848)
		Cost	Rejected (p= 0.978)
		quality	Rejected (p= 0.431)

7.7 Revising the model base on PMSC with significant influence on PP

Based on the regression results and hypothesis test, the model was revised. Figure 7.8 and 7.9 represent the revised model produced based on the selection criteria found to contribute significantly to PP. For projects procured by DBB method there are five of such criteria that make significant positive contribution to time performance. These five criteria have been included in the revised model because they have an explanatory power of 66.6% (R^2= 66.6%) for time performance of Libyan construction projects as explained by the selection criteria in this time model.

In terms of cost, there are six PMSC that exhibited significant positive contribution to cost performance. These six criteria have been included in the revised model because they have an explanatory power of 42.1% (R^2= 42.1%) for cost performance of Libyan construction projects as explained by the selection criteria of this cost model.

Similarly, in terms of quality there are five criteria showing significant contribution and impact to quality component of PP. These five criteria have been included in the revised model because they have explanatory power of 50.0% (R^2= 50.0%) on quality performance of Libyan construction projects as explained by the selection criteria of this quality model. Therefore, the PMSC incorporated in the revised model could be used to determine the likely performance of DBB construction projects in Libya.

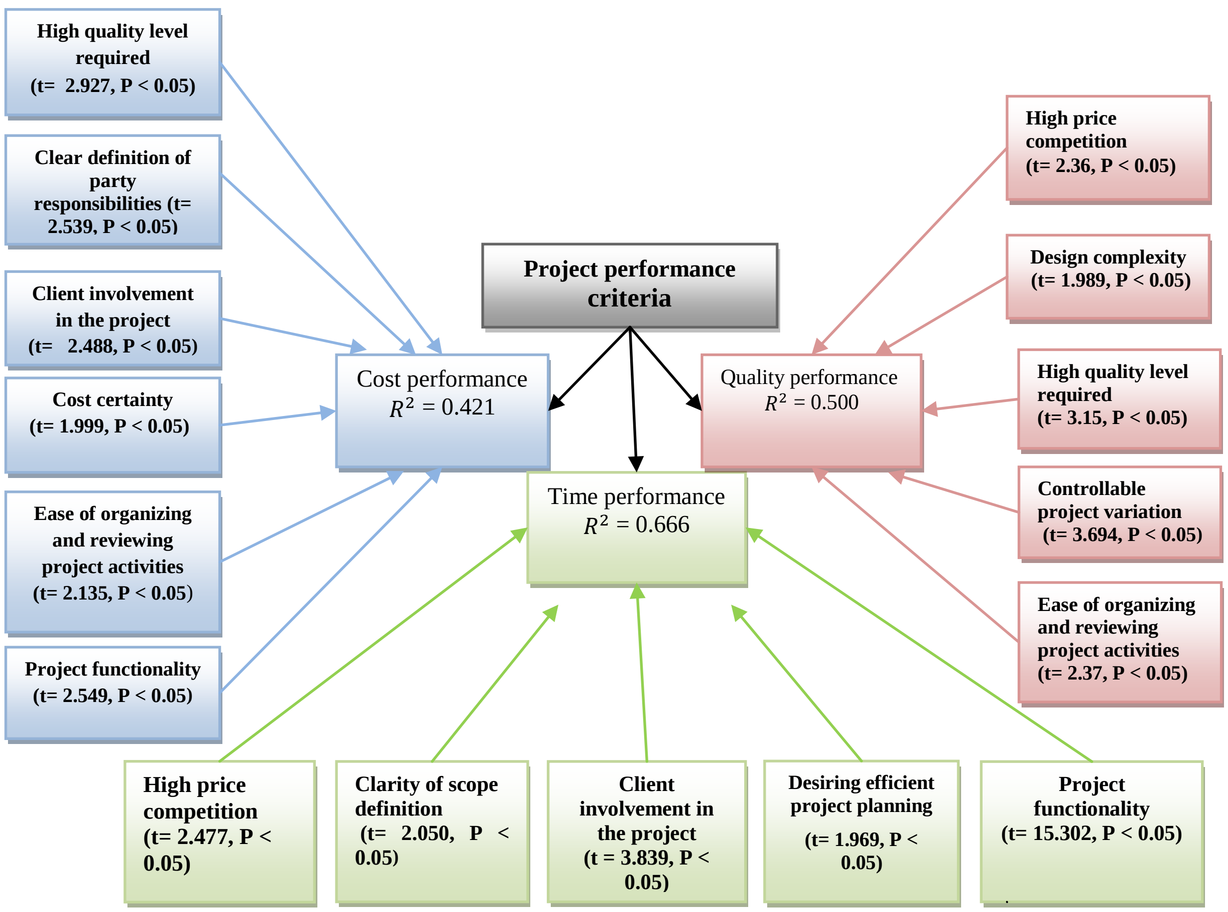

Figure 7.8: Revised model based on significant regression results (DBB method)

Three mathematical models have been developed to help predicate the performance of construction projects in Libya in terms of time, cost and quality based on the use of significant procurement selection criteria. Based on a significant regression level lower than probability of 0.05, (see Table 7.8 and Figure 7.8) these models are presented as following:

1- Regression model on the influence of PMSC have on PP in terms of time:

$$\mathbf{Y_t\ (Time) = -0.183 + 0.124\ x_1 + 0.118\ x_2 + 0.194\ x_6 + 0.115\ x_{11} + 1.684 x_{12} + 0.426}$$

2- Regression model on the influence of PMSC have on PP in terms of cost:

$$\mathbf{Y_c (Cost) = 0.723 + 0.254 x_4 + 0.236\ x_5 + 0.189\ x_6 + 0.258\ x_8 + 0.273 x_{10} + 0.422\ x_{12} + 0.635}$$

3- Regression model on the influence of PMSC have on PP in terms of quality:

$$\mathbf{Y_q\ (Quality) = 2.409 + 0.214\ x_1 + 0.173\ x_3 + 0.298\ x_4 + 0.281\ x_7 + 0.231\ x_{10} + 0.756}$$

For projects procured by DB method, it was found that only one criterion showed significant positive contribution and impact to PP in terms of cost. This criterion has been included in the revised model because it has explanatory power of 51.0% (R^2= 51.0) on cost performance of Libyan construction projects as explained by the selection criterion of this cost model.

Four criteria showed significant positive contribution and impact to time performance. These criteria have been included in the revised model because they explain 45.0% variance in time performance of Libyan construction projects as explained by the selection criteria of this time model.

In terms of quality four criteria showed significant contribution and impact to quality performance. These four criteria have been included in the revised model because they have explanatory power of 52% (R^2= 52.0) on quality performance of Libyan construction projects as explained by the selection criteria of this quality model. Therefore, the criteria in the revised model could determine the performance of DB construction projects in Libya

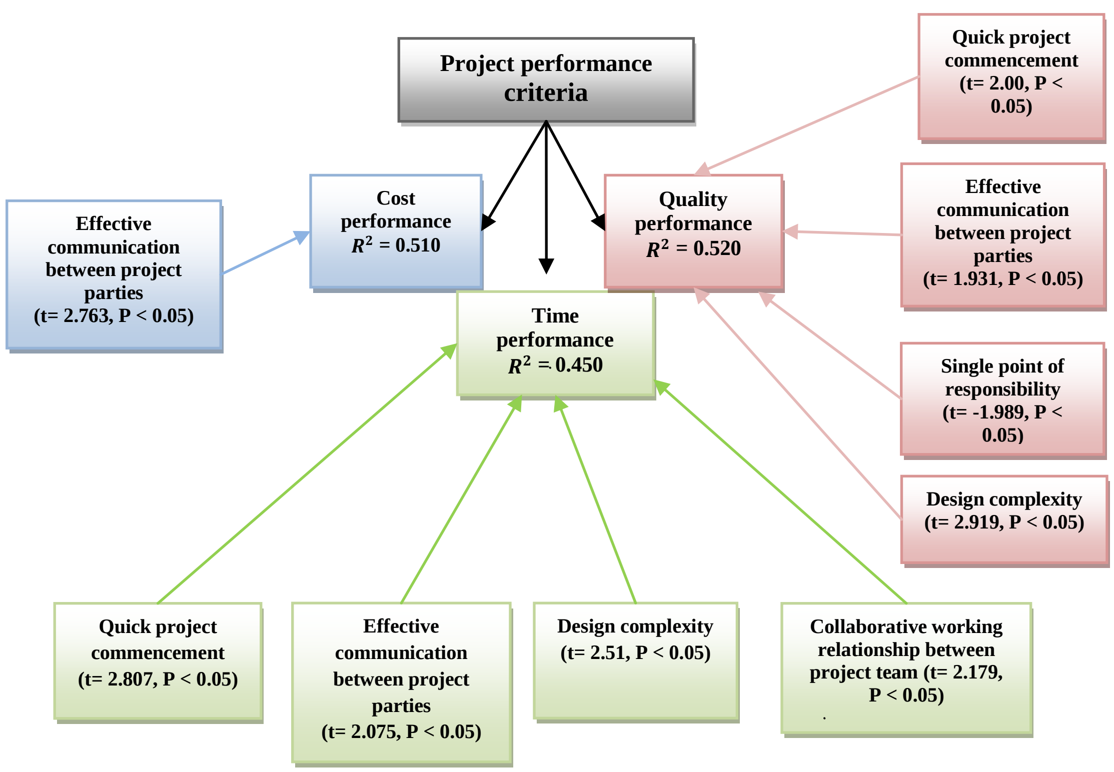

Figure 7.9: Revised model based on regression results (DB method)

Based on a significant level between procurement criteria of DB method and PP criteria for lower than probability of 0.05 (see Table 7.9 and Figure 7.9), three mathematical models were investigated to predicate PP in terms of time, cost and quality based on the use of significant procurement selection criteria. These models are presented as follows:

1- Regression model on the influence of PMSC have on PP in terms of time:

$$\mathbf{Y_{t\,(Time)} = 0.497 + 0.229\,x_{14} + 0.172\,x_{15} + 0.178\,x_{19} + 0.276\,x_{24} + 0.868}$$

2- Regression model on the influence of PMSC have on PP in terms of cost:

$$\mathbf{Y_{c}\ (Cost) = 1.610 + 0.224\,x_{15} + 0.818}$$

3- Regression model on the influence of PMSC have on PP in terms of quality:

$$\mathbf{Y_{q}(Quality) = 2.541 + 0.150\,x_{14} + 0.149\,x_{15} + 0.213\,x_{17} + 0.194\,x_{19} + 0.851}$$

7.8 Model Application

7.8.1 Traditional procurement method (DBB)

An example of how the model could be used in a project is now given. For any given project to be procured by DBB, the project parties (clients, contractors and consultants) will first have to rate their satisfaction/agreement with the extent to which each of the PMSC given in the Model (Eq. 1, 2 and 3) meet or comply with the project characteristics or requirements using a five-point scale where 1 = “strongly disagree”, 3 = “moderately agree” and 5 = “strongly agree”.

Suppose there is a DBB project, which perfectly satisfies (or are fully compatible with) all the selection criteria and thus make this method the most suitable procurement method for ensuring maximum performance success of the project in terms of time, cost and quality. The PMSC (independent variables) presented in the models (Eq. 1, 2 and 3) would then be rated as follows.

1) Time performance

- High price competition (x_1) = 5
- Clarity of scope definition (x_2) = 5

- Client involvement in the project (x_6) = 5
- Desiring efficient project planning (x_{11}) = 5
- Project functionality (x_{12}) = 5

These ratings are input into Eq. 1, to obtain:

$$Y_{t\ (Time)} = -0.183 + 0.124\ x_1 + 0.118\ x_2 + 0.194\ x_6 + 0.115\ x_{11} + 1.684 x_{12} + 0.426$$

$$Y_t = -0.183 + 0.124\ (5) + 0.118\ (5) + 0.194(5) + 0.115(5) + 1.684\ (5) + 0.426 = \underline{11.418}$$

This result represents the best score for time performance achievable by this project.

The worst time performance score would be represented by the value:

$$Y_t = -0.183 + 0.124\ (1) + 0.118\ (1) + 0.194(1) + 0.115(1) + 1.684\ (1) + 0.426 \underline{= 2.478}$$

And finally for this project, the moderate time performance score would be represented by the value:

$$Y_t = -0.183 + 0.124\ (3) + 0.118\ (3) + 0.194(3) + 0.115(3) + 1.684\ (3) + 0.426 = \underline{7.131}$$

It is hardly perfect (or otherwise) for a real project in practice to fully meet (or be fully compatible with) the criteria that indicate DBB's selection as the most suitable method for achieving successful PP. Therefore, between the extreme scores of 2.478 and 11.418 lies the continuum of possible scores that represent time performance scores expected of projects procured by a DBB method chosen on the basis of the significant selection criteria. It is reasonable to assume that any score less than the moderate (7.131) represents poor project performance in terms of time.

Similarly analyses were carried out for cost and quality performance criteria as follows:

2) Cost performance

- High quality level required (x_4) = 5
- Clear definition of project parties responsibilities (x_5) = 5
- High involvement of the project client (x_6) = 5

- High certainty of project cost (x_8) = 5
- Ease of organizing and reviewing project activities (x_{10}) = 5
- Project functionality (x_{12}) = 5

$$Y_c(Cost) = 0.723 + 0.254x_4 + 0.236\,x_5 + 0.189\,x_6 + 0.257\,x_8 + 0.273x_{10} + 0.422\,x_{12} + 0.635$$

These ratings are input into Eq. 2, to obtain:

$$Y_c = 0.723 + 0.254(5) + 0.236(5) + 0.189(5) + 0.257(5) + 0.273(5) + 0.422(5) + 0.635 = \underline{9.513}$$

This result represents the best cost performance score achievable by DBB projects. The worst performance score is:

$$Yc = 0.723 + 0.254(1) + 0.236(1) + 0.189(1) + 0.257(1) + 0.273(1) + 0.422(1) + 0.635 = \underline{2.99}$$

The moderate score is:

$$Yc = 0.723 + 0.254(3) + 0.236(3) + 0.189(3) + 0.257(3) + 0.273(3) + 0.422(3) + 0.635 = \underline{6.51}$$

The range of possible cost performance scores for any DBB project lies between the continuum of the extreme values of 2.99 and 9.513. Any score less than the moderate (6.51) represents poor project performance in terms of cost.

3) Quality performance

- High price competition (x_1) = 5
- Complexity of design (x_3) = 5
- High quality level required (x_4) = 5
- Controllable project variation (x_7) = 5
- Ease of organizing and reviewing project activities (x_{10}) = 5

$$Y_q\ (Quality) = 2.409 + 0.214\,x_1 + 0.173\,x_3 + 0.298\,x_4 + 0.281\,x_7 + 0.231\,x_{10} + 0.756$$

These ratings are input into Eq. 3, to obtain:

$$Y_q = 2.409 + 0.214(5) + 0.173(5) + 0.259(5) + 0.281(5) + 0.231(5) + 0.756 = \underline{8.09}$$

This value represents the best quality performance score achievable by DDB project. The worst performance score is:

$$Y_q = 2.409 + 0.214(1) + 0.173(1) + 0.259(1) + 0.281(1) + 0.231(1) + 0.756 = \underline{4.32}$$

The moderate score is:

$$Y_q = 2.409 + 0.214(3) + 0.173(3) + 0.259(3) + 0.281(3) + 0.231(3) + 0.756 = \underline{6.645}$$

The range of possible quality performance scores for any DBB project thus lies between the continuum of the extreme values of 4.32 and 8.09. Any score less than the moderate (6.645) represents poor project performance in terms of quality.

7.8.2 Design and build procurement methods (DB)

As presented in the preceding section, similar analyses were carried out for DB as follows.

1) Time performance

- Quick project commencement (x_{14}) = 5
- Effective communication between project parties (x_{15}) = 5
- Complexity of the design (x_{19}) = 5
- Collaborative working relationship between project team (x_{24}) = 5

$$Y_{t\,(Time)} = 0.497 + 0.229\,x_{14} + 0.172\,x_{15} + 0.178\,x_{19} + 0.276\,x_{24} + 0.868 \ldots\ldots\ldots \quad (4)$$

These ratings are input into Eq. 4, to obtain:

$$Y_t = 0.497 + 0.229\,(5) + 0.172\,(5) + 0.178\,(5) + 0.276\,(5) + 0.868 = \underline{5.64}$$

This represents the best time performance score that is achievable by DB projects. The worst performance score is given by:

$$Y_t = 0.497 + 0.229\,(1) + 0.172\,(1) + 0.178\,(5) + 0.276\,(1) + 0.868 = \underline{2.048}$$

The moderate score is:

$$Y_t = 0.497 + 0.229\,(3) + 0.172\,(3) + 0.178\,(3) + 0.276\,(3) + 0.868 = \underline{3.396}$$

The range of possible time performance scores for DB projects thus lies between the continuum of the extreme values of *2.048* and *5.64*. Any score less than the moderate (3.396) represents poor project performance in terms of time.

2) Cost performance

- Effective communication between project parties (x_{15}) = 5

$$Y_c \text{ (Cost)} = 1.610 + 0.224\ x_{15} + 0.818 \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{ (5)}$$

These ratings are input into Eq. 5, to obtain:

$$Y_c = 1.610 + 0.224\,(5) + 0.818 = 3.548$$

This is the best score of the time performance can be obtained from the project. The worst performance score is:

$$Y_c = 1.610 + 0.224\,(1) + 0.818 = 2.652$$

The moderate score is:

$$Y_c = 1.610 + 0.224\,(3) + 0.818 = 3.10$$

The range of possible cost performance scores for DB projects thus lies between the continuum of the extreme values of 2.652 and 3.548. Any score less than the moderate (3.10) represents poor project performance in terms of cost.

3) Quality performance

- Quick project commencement (x_{14}) = 5
- Effective communication between project parties (x_{15}) = 5
- Single point of responsibility (x_{17}) = 5

- Complexity of design (x_{19}) = 5

$$Y_q(Quality) = 2.541 + 0.150\, x_{14} + 0.149\, x_{15} + 0.213\, x_{17} + 0.194\, x_{19} + 0.851$$

These ratings are input into Eq. 4, to obtain:

$$Y_q = 2.541 + 0.150\,(5) + 0.149\,(5) + 0.213\,(5) + 0.194\,(5) + 0.851 = \underline{6.922}$$

This is the best score of the quality performance can be obtained from the project. The worst performance score is:

$$Y_q = 2.541 + 0.150\,(1) + 0.149\,(1) + 0.213\,(1) + 0.194\,(1) + 0.851 = \underline{4.10}$$

The moderate score is:

$$Y_q = 2.541 + 0.150\,(3) + 0.149\,(3) + 0.213\,(3) + 0.194\,(3) + 0.851 = \underline{5.510}$$

The range of possible quality performance scores for DB projects thus lies between the continuum of the extreme values of 4.10 and 6.922. Any score less than the moderate (5.51) represents poor project performance in terms of quality.

7.9 Validation of the model

Validation covers " *part of model development process which increases confidence in the model and make it more valued*" (Braimah, 2008). Macal (2005) concluded that, validation of a model is the most important step in obtaining a better understanding of its abilities, limitations and appropriateness in addressing the problem being modelled. The importance of validation in research, its definition, and the techniques for establishing it can be seen from different viewpoints (Creswell, 2007). From a modelling position, validation is defined as the process of defining whether the model is a meaningful, significant and accurate representation of the real system in a specific problem domain (Borenstein, 1998). Sargent (1998) argues that if a model is established for a specific application (e.g. to investigate relationships between variables, or to compare variables) its validity should be determined with respect to that application.

In order to validate the model developed in this study, the researcher decided to conduct case study based on nineteen recent projects undertaken in Libya, eleven of which were procured by DBB method and the remainder by DB method. Face to-face semi-structured interviews with the respondents (identified as project managers, site engineers and general supervisors) who were highly involved in these projects was conducted. The main purpose of conducting these interviews was to validate the developed model. The interviewees were asked to answer questions related to the extent to which the DBB and DB procurement criteria used in developing the model influence the performance of projects they have been involved with. They were also asked to provide information on other factors that they think were responsible for performance issues experienced in these projects.

Following the design of the validation questionnaire (see Section 5.10.2), the heads of some public and private construction organizations directly responsible for construction projects in Libya were contacted to assist with the data collection. Firstly, they were asked to provide list of the construction projects completed in the last 10 years. They were then asked to select suitable persons in their organizations who were involved in these projects to participate in the study. Based on this initial contact a group of respondents, totalling 14 who were actively involved in these projects happily elected to participate in the interviews. The interviewees were then contacted via telephone in order to arrange for suitable date, time and place for the interview. Each interview took between 30 and 60 minutes, and was held at the participants' personal offices, after guaranteeing the privacy of the information provided by them.

Table 7.12 presents the profile of the interviewees. It can be seen that most of the participants were highly experience in their field with 11 to 25 years of experience. The types of projects that they involved with were residential buildings, institutional buildings and infrastructure projects.

Table 7.12 Interviewee profile

Number of interviewees	Position	Types of projects	Year of experience
7	Project manager	Residential buildings, Institutional and infrastructure	16-20 years
4	Site Engineer	Residential buildings, Institutional and infrastructure	11-15years
3	General Supervisor	Residential buildings, Institutional and infrastructure	21-25years

7.9.1 Types of contracts and tenders used in the projects

Table 7.13 shows the types of contracts and tendering using in these projects. It can be seen that, only Bill of quantity and Lump sum contracts were used for these projects. For projects procured by DBB method, the majority of the projects (72.2%) were contracted by Bill of quantity, while with DB method the majority of the projects represent 62.2% contracted by Lump sum.

With regards to the types of tendering used, it was found that selective tendering and direct order are only the two types in use irrespective of whether projects procured by DBB or DB methods. With projects procured by DBB method the proportion that used selective tendering was 54.5%, while direct order was 45.5%. On the other hand with projects procured by DB methods, the majority of the projects (62.5%) were tendered by selective tendering.

Table 7.13: Types of contracts and tendering for DBB and DB projects

Contract types	**DBB projects**		**DB projects**	
	Frequency	**Valid percent (%)**	**Frequency**	**Valid percent (%)**
Bill of quantity	8	72.7	3	62.5%
Lump sum	3	27.3%	5	37.5%
Total	11	100.0%	8	100.0%
Tendering types	**DBB projects**		**DB projects**	
	Frequency	**Valid Percent (%)**	**Frequency**	**Valid Percent (%)**
Selective tender	6	54.5%	5	62.5%
Direct order	5	45.5.5%	3	37.5%
Total	11	100.0%	8	100.0%

7.9.2 The extent to which DBB and DB selection criteria influence PP

The interviewees were asked to indicate the extent to which the DBB and DB selection criteria influenced the performance of the projects they have been involved with using a Likert scale of 1 to 5 where 1 represents "low influence" and 5 represents "High influence". The results, depicted graphically in Figures 7.10 and 7.11, show the distribution of the answers. The results demonstrate that with project procured by DBB method the average level of influence is more than 3 for all criteria which means that all DBB criteria positively influence PP.

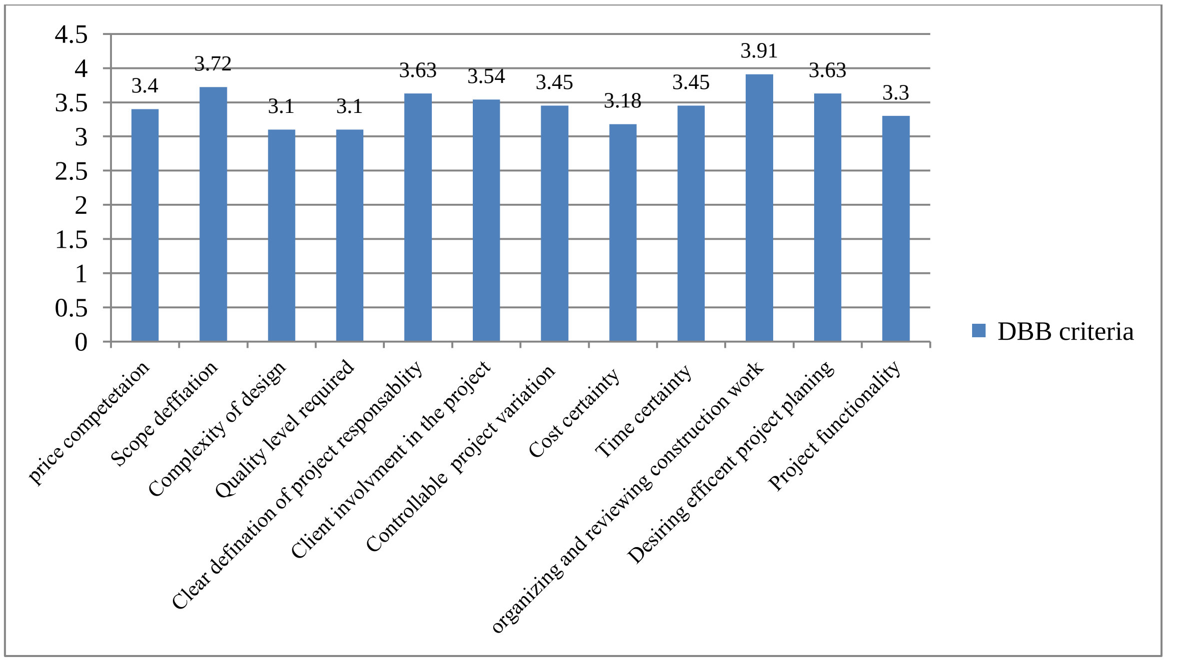

Figure 7.10: The extent of influence of DBB selection criteria on PP

On the other hand with projects procured by DB, it was found that 7 out of 13 DB criteria expiated average level of influence as greater than 3. These are: “quick project commencement”, “effective communication between project parties”, “single point of responsibility”, “complexity of design” “level of competent and experienced contractor”, “collaborative working relationship between project team” and “accessibility to project plan and design time”), which means that only these criteria positively influence the performance of projects.

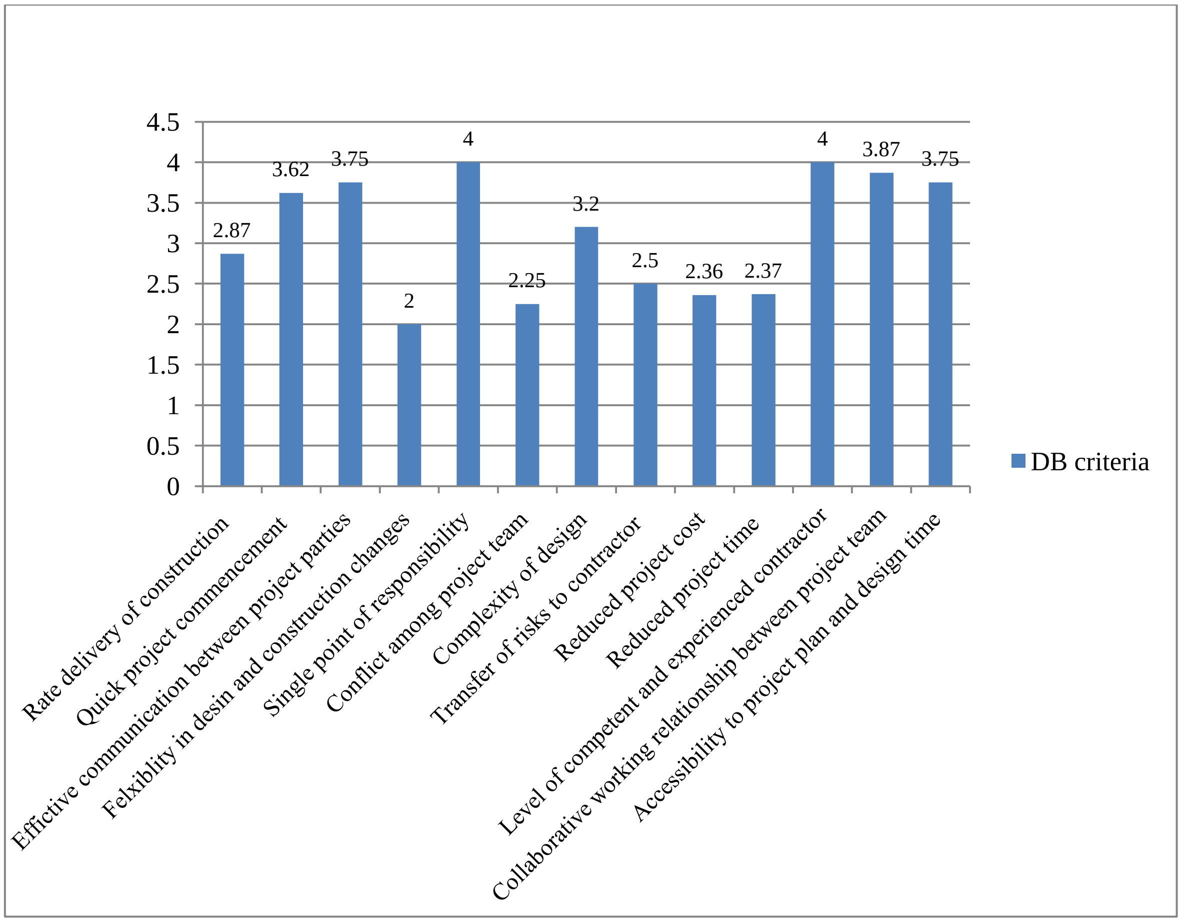

Figure 7.11**: The extent of influence of DB selection criteria on PP**

7.9.3 The steps followed in validating the model

The main process underpinning the validation exercise is to first use the developed models to predict the performance of projects in terms of time and cost based on (i) data collected via main questionnaire survey, and (ii) data collected through interviews on case-study of projects. The second step involved comparing the results of the project performance outcomes, as predicted by the above two data set, to ascertain whether the results are close enough to each other or otherwise. Obtaining similar or close results was used as a measure of the validity of the models since this confirms the capacity of the same model to yield comparable PP outcomes when data from different samples of the population are inputted in the model. The summary of validation exercise includes the following points:

1- Identifying the PMSC that impact on PP (see Section 7.7)
2- Determining the average/mean scores of the PMSC as ranked by the respondents through the main survey questionnaire.

3- Determining the average/mean scores of the PMSC as given by interviewees through the data obtained by the case-study interviews survey (see Section 7.9.2).

4- Using the mathematical models developed (see Section 7.7) to determine the project performance outcomes in terms of time and cost (Y_t &Y_c), based on:

a) data collected via main questionnaire (point 2 above, now called "Sample 1");

b) data collected via project case study (point 3 above, now called "Sample 2")

5- Compare the results of the project performance outcomes (Y_t &Y_c) based on the two different samples mentioned in point 4 about.

Table 7.14 shows the average respondents' scores of DBB and DB procurement criteria based on Sample 1 and Sample 2.

Table 7.14: The average/mean respondents score to the procurement selection criteria

DBB procurement method			**DB procurement method**		
Procurement criteria	**Average respondents scores (sample 1)**	**Average respondents scores (sample 2)**	**Procurement criteria**	**Average respondents scores (sample 1)**	**Average respondents scores (sample 2)**
High price competition	3.27	3.40	Quick delivery of construction processes	3.63	2.87
Clarity of scope definition	3.85	3.72	Quick project commencement	3.59	3.62
Complexity of design	3.28	3.10	Effective communication between project parties	3.72	3.75
High quality level required	3.64	3.10	Flexibility in design & construction changes	3.66	2.00
Clear definition of project parties' responsibilities	3.95	3.63	Single point of responsibility	4.15	4.00
Involvement of the project client	3.59	3.54	Less conflict amongst project team	3.34	2.25
Controllable project variation	3.25	3.45	Complexity of design	3.00	2.87
Cost certainty	3.83	3.18	Transfer of risks to the contractor	3.74	2.50
Time certainty	3.81	3.45	Desiring reduced project cost	3.29	2.36
Ease of organizing and reviewing project activities.	3.84	3.91	Desiring reduced project time	3.44	2.37
Desiring efficient project planning	3.87	3.63	Level of competent and experienced contractor	3.64	4.0
Project functionality	3.20	3.30	Collaborative working relationship between project team	3.94	3.87
	-	-	Desiring efficient project planning	3.79	3.75

For projects procured by DBB method, the PP outcomes in terms of time and cost (Y_t &Y_c) are computed using the regression equation/mathematical model as follows:

1) Time performance outcome (Y_t)

$$\boldsymbol{Y_t = -0.183 + 0.124x_1 + 0.118x_2 + 0.194x_6 + 0.115x_{11} + 1.684x_{12} + 0.426}$$

Y_t (Sample 1) = -0.183 + 0.124 (3.27) +0.118 (3.85) + 0.194(3.59) +0.115(3.87) + 1.684 (3.20) + 0.426= *<u>7.63</u>*

Y_t (Sample 2) = -0.183+0.124 (3.40) +0.118 (3.72) + 0.194(3.54) +0.115(3.63) + 1.684 (3.30) + 0.426= *<u>7.76</u>*

2) Cost performance outcome (Y_c)

$$\boldsymbol{Y_c = 0.723 - 0.254x_4 + 0.236x_5 + 0.189x_6 + 0.257x_8 + 0.273x_{10} + 0.422x_{12} + 0.635}$$

Y_c (Sample 1) =0.723 + 0.254(3.64) + 0.236(3.95) + 0.189(3.59) + 0.257(3.83) + 0.273(3.84) + 0.422(3.20) +0.635= *<u>7.28</u>*

Y_c (Sample 2) =0.723 - 0.254(3.10) +0.236(3.63) + 0.189(3.54) + 0.257(3.18) + 0.273(3.91) +0.422(3.30) +0.635= *<u>6.95</u>*

It can be seen from the above results that, the outcomes of the project performance in terms of time and cost (Y_t & Y_c) for Sample 1 and Sample 2 are nearly the same. For instance, in terms of time the project performance outcomes (Y_t) from Sample 1 is 7.63, while that from Sample 2 is 7.76. In terms of cost, the project performance outcomes (Y_c) of the sample 1 is 7.28 whereas that from Sample 2 is 6.95. The results thus demonstrate that the model gives nearly the same results to the project performance outcomes for data coming from different samples, suggesting that the model is valid.

Similarly for projects procured by DB method, the PP outcomes in terms of time and cost (Y_t &Y_c) were computed as follows:

1) Time performance outcome

Y_t = 0.497 + 0.229x_{14}+ 0.172x_{15} + 0.178x_{19} + 0.276x_{24} + 0.868

Y_t (Sample 1) = 0.497 +0.229(3.59) + 0.172(3.72) + 0.178 (3.00) + 0.276(3.94) +0.868 = 4.448

Y_t (Sample 2)= 0.497+0.229(3.62) +0.172(3.75) + 0.178(2.87) +0.276(3.87) + 0.868 = 4.418

2) Cost performance outcome

Y_c = 1.610 + 0.224 x_{15} + 0.818

Y_c (Sample 1) = 1.610 + 0.224(3.72) + 0.818 =3.261

Y_c (Sample 2) = 1.610 + 0.224(3.75) + 0.818 =3.268

Comparing the outcomes of project performance in terms of time and cost (Y_t &Y_c) obtained from the data from samples 1 and 2, the results revealed that, the outcomes of the project performance are close to each other. The outcome (Y_t) from Sample 1 is equal to 4.448, whereas that from Sample 2 is equal to 4.418. On the other hand the outcome (Y_c) from sample 1 is equal 3.261 whereas that from sample 2 is equal to 3.268. From these results it can be concluded that the models are valid since they are capable of producing similar comparable results of project performance outcomes in terms of time and cost for data coming from different samples.

7.10 Summary

This chapter has presented the design and validation of models demonstrating the contribution that PMSC have in influencing project performance outcomes. The model was developed using MRA technique based on the findings of the previous chapter. This technique has been discovered by many researches as the best for exploring the relationship between dependant variables and set of independent variables as well as to exploring which of independent variables can make the strongest significant contribution with dependant variables. The findings of MRA showed that:

For projects procured by DBB methods, five criteria were found with a significant contribution to PP in terms of time, six in terms of cost and five in terms of quality: these criteria are:, “high price competition”, “clarity of scope definition” “complexity of design”, “High quality level required”, “clear definition of the project party’s responsibilities”, “client involvement in the project” and “controllable variation”, “cost certainty”, “ease of organizing and reviewing construction work” “Desiring efficient project planning” and “project functionality”. The largest absolute value of t and beta in terms of time and quality performance outcome were recorded on “project functionality”. In terms of cost performance they were recorded on “High quality level required”. This means that these selection criteria make the strongest contribution to PP. The highest R square value for overall groups was recorded in terms of time with 0.666. This means that the model (which includes selection procurement criteria) explains 66.6% of the variance in terms of time performance. A nova test showed that the model is a significant fit of the overall data. The p value < 0.05 indicates that the model is statically significant.

With DB method, it was found four criteria have a significant contribution to PP in terms of time, one criterion in terms of cost, and four criteria in terms of quality. These are: “quick project commencement”, “effective communication between project parties”, “single point of responsibility”, “complexity of design” and “collaborative working relationship between project team”. The largest absolute value of t and beta in terms of time was recorded on “quick project commencement”, while it was recorded on “complexity of design” in terms of quality and on “effective communication between project parries in terms of cost”. This indicts that, these three criteria make the strongest contribution to PP. The highest R square value for overall groups was recorded in terms of quality with 0.520 which means the model (which includes selection procurement criteria) explains 52.0% of the variance in terms of quality. A nova test showed that the model is a significant fit of the overall data. The p value < 0.05 indicates that the model is statically significant.

The model was validated through case study based on recent projects undertaken in Libya. Nineteen of such projects were used, eleven of which were procured by DBB method and the remaining by DB method. Semi-structured interviews were conducted with respondents of different designation who were highly involved in these projects. Predictive validation techniques were used for validating the model. Descriptive statistical tests including frequencies were used to analyse data. The data obtained from the main questionnaire survey and interview case study has been used in the model developed in order to find out the PP outcome in terms of time and cost for each of them. The findings demonstrate that with projects procured by DBB and DB method, the outcomes of the PP in terms of time and cost (Y_t & Y_c) using data collected via main questionnaire survey (sample 1) and case study interviews (sample 2) are nearly the same. These two different data sets were used to test for the validity of the same model, which resulted in nearly the same results of PP outcomes. This gives an indication that the model is valid.

The next chapter provides detailed discussion of the research findings as well as the conclusion and recommendations for future works.

CHAPTER 8: DISSCUSIONS, CONCLUSIONS AND RECOMENDATION

8.1 Introduction

This chapter presents the discussions, conclusions and recommendations of the research. Firstly, the discussions are guided by the set of research objectives and how these objectives have been achieved. Secondly, the conclusions drawn are presented followed by discussions on the study limitations. The last section suggests recommendations for future research.

8.2 Discussions

This section discusses the results obtained from the analysis of the initial and main survey data collection and it is guided by the research objectives. This research aimed to investigate the influence PMSC have on PP in Libya. This aim was achieved through several specific research objectives. The specific tasks of this research and the key findings are summarised below with respect to the original research objectives.

Objectives 1 – Exploring construction tendering and contracts procurement strategies in general and in the context of LCI

To achieve this objective a review of literature in the area of contract procurement strategy and construction tendering as presented in Chapters 2 and 4 were conducted. The reviews aid to explore the most common tendering and contracts procurement strategies in use generally, and in the context of Libya, in particular. This investigation was supported by questionnaire survey with a sample of 126 experts identified as clients, contractors and consultants of the Libyan construction sectors presented in Chapter 6. The findings show that:

a) The common contract procurement strategies

It has been highlighted in the Section 2.2.4.1.1 that the terms of contract refers to an agreement between project parties (Abd-Elshakour, 2011; Murdoch and Hugh, 2008). This agreement is usually defined in terms of an offer made by one party and an acceptance of that offer by the other (Murdoch and Hughes, 2008). This agreement outlines the responsibilities and duties of each party during the life cycle of the project (Abd-Elshakour, 2011; Kate, 2010).

Based on the review of literature carried out and the survey conducted, the findings show that for projects procured by DBB method, bill of quantity type of contract is the most common procurement strategy in use, followed by lump sum and cost-plus. A number of studies and government reports (for e.g., Grifa, 2006; HIB, 2010 and PPA, 2010) confirm these findings, and also cite a number of reasons for the popularity of bill of quantity type of contract as resulting from its: appropriateness for competitive bidding, relatively ease for contractor selection, flexibility for dealing with scope of work, and ability to make final project price known before actual construction process starts (Kate, 2010).

On the other hand, for projects procured by DB the lump sum contract was found the most preferable in us. According to Grifflths (1989), DB procurement has become increasingly popular as it allows the client to obtain competitive bids for alternative designs and to contract with a single organization. This contract is usually priced on a lump sum fixed price. Antoniou et al. (2012) also confirmed that lump sum contract is preferable in use for projects procured by DB this because: (a) the contractor takes most of the cost risk (Veld and Peeter, 1989); (b) it is an efficient method for obtaining value for money (Berends, 2000; Veld and Peeter, 1989); (c) there is no high financial risk for the client (Berends, 2000; Veld and Peeter, 1989); (d) the contractor has highly incentive to achieve early completion (Berends, 2000); and (e) the contractor hopes to complete the job as quick as possible, to reduce overheads and maximize profit, which minimizes overall project duration (Albert, 2000; Abd-Elshakour, 2011).

b) Common Types of Tendering

Tendering is the process by which bids are invited from interested contractors to carry out specific aspects of construction work. This process begins with tender preparation and ends with tender completion (contract awarding) (Rosmayati et al., 2010). The findings of the literature review carried out and the survey conducted to find out the construction tendering types currently in use in the context of Libya show that selective tendering is the most common in use for Libyan construction projects irrespective of whether projects procured by DBB or DB method. Therefore, it can be considered the most preferable type, preferred by all project parties. This is understandable because in selective tender a limited number of potential contractors are allowed to bid (Laryea, 2011; Rosmayati et al., 2010), and the bidders are selected from a list of contractors who are experienced and prequalified in particular work (Rosmayati et al., 2010). This thing can decreases competition, which reduces the time and resources borne in the tendering processes, while ensuring that the work will be carried out by expert contractors (Rosmayati et al., 2010).

Objectives 2 - Reviewing PMs currently in use and their selection criteria in general and in the context of LCI

This objective has been achieved based on reviewing the literature in the area of construction procurement in chapter 2 and 4 as well as the initial field survey conducted in chapter 6. The findings of reviewing the literature reveal that, different types of PMs are used to deliver projects, but they differ largely in terms of allocation of risks and responsibilities among project parties as well as the project delivery processes and procedures. In a much broader view of what construction procurement entails, procurement strategies are often classified into three main systems (separated and cooperative, integrated and management oriented systems) based on the relationship and interaction between design and construction processes. Both DBB and DB procurement methods were found to be the most commonly used approaches for delivering construction projects in general. The often cited reasons behind DBB popularity are because it is regarded as: a familiar delivery method, simple process to manage, able to fully defined project scope for both design and construction, both its design team and the contractor are responsible to the client (Al-Khalil, 2001; Chan, 2000; Lee, 2006; Park et al., 2009). On the other hand, the motivation behind DB popularity is because it: facilitates faster project delivery, facilitates good coordination and communication between client and contractor, enable project time and cost to be minimized, less prone to conflicts and disputes among project team members (Natkin, 1994; Park et al., 2009; Seng and Yusof, 2006).

The findings also identified a set of twenty-three procurement selection criteria (from a critical review of the literature) as being the main criteria for selecting DBB and DB procurement methods. 12 of them are used for DBB selection while the remaining 11 are for DB selection. There are however two of the criteria that are appropriate for both methods. The PMSC for DBB are: “high price competition”, “clarity of scope definition”, “high quality level required”, “clear definition of project parties’ responsibilities”, “client involvement in the project", "controllable project variation", "cost certainty", "time certainty", "ease of organizing and reviewing project" and "project functionality" Conversely, "quick delivery of construction processes", "quick project commencement", "effective communication between project parties", "flexibility in design and construction changes", "single point of responsibly", "less conflicts amongst project parties", "transfer of the risks to the contractor", "desiring reduced project cost", "desiring reduced project time", "level of competent and experienced contractor", and "collaborative working relationship between project team" are the criteria for selecting DB method. Those criteria that are common to both project delivery systems are "complexity of design" and "desiring efficient project planning".

Selection of PM based on these procurement criteria can aid to reduce the likelihood of the time and cost overruns in construction projects and enhance the performance of these projects. Many studies in the area of procurement (see section 1.2) confirmed the importance of the PMSC for selection the most appropriate PM. These studies also confirmed that many projects have suffered from time and cost overran as result of wrongly selecting the criteria that are appropriate for the PM.

In the context of Libya, the findings of the reviewing the literate and the initial survey conducted demonstrate that, the PMs commonly used to deliver construction projects in Libya are the DBB and DB methods, with the former accounting for 92% of construction projects, whilst the latter accounts for the remaining 8%. They also indicated that the level of understanding of DBB is very high. One common reason for this high rate of DBB usage is the lack of knowledge and experience with modern and innovative types of PMs on the part of clients and consultants, who are the main parties often responsible for making decisions on the choice of PMs. The other reasons cited are: (a) client unwillingness to take the risk of using the modern types of procurement (b) most of the construction projects in Libya fall under the control and domination of Libya's Decision No. 8 of 2004 contractual agreement which recommends DBB method as the first option to deliver construction projects. In addition, the contractual agreement does not encourage other modern PMs to deliver construction projects. Relying largely on DBB method as the main option to delivering construction projects contributes to the poor performance of projects. The review of the literature also stated that there is no specific criteria can help client to select the PMs. Due to this project client usually use their experience on the previous projects as the main criteria when they decide which procurement method to be used.

Objective – 3 To Review the criteria for assessing and measuring PP

This objective has been achieved based on reviewing the literature in the area of PP presented in chapter 2 and the initial field survey conducted in chapter 6. The findings of reviewing the literature revealed a number of criteria for measuring and evaluating the performance of the projects. These are: time, cost, quality, environmental, health and safety, innovation, client satisfaction and communication but time, cost and quality were found the most common in use. In the context of Libya the findings demonstrate that time, cost, and quality are the three commonly preferred performance evaluation dimensions. These criteria were identified as the most preferable measures (or proxies) for gauging PP based on two main reasons. Firstly, they have been confirmed by many studies and researches in construction PP literature as the most common criteria for measuring the successes of projects. For instance, Arti et al. (2013) stated that:

> "Time has been addressed as a criterion by which to evaluate a project's degree of success as well as it can help the other criteria to be met. Cost has been addressed as a very important success criterion, where as having an intellectual budget plan and proper cost estimation have been mentioned as prominent success factors in some studies. On the other hand, quality also considered one of the most important success criterions which facilitates the success of other criteria and factors"

Secondly, the findings of the survey conducted in the context of LCI demonstrated that the performance of the projects in Libya measured based on completion projects on time, cost and quality which indicate these criteria are the most common in use to measure the performance of the construction projects. The findings also indicated that the quality component of PP was ranked by all project parties in high position compared with time and cost component which means that the quality performance can be achieved in Libyan construction projects whereas time and cost are not. This may be due to high attention and focus often given by clients and consultants for quality performance than for time and cost.

Objective 4- To develop relevant hypotheses and a conceptual framework of the relationship between PMSC and PP as influenced by PM use

The primary aim of the conceptual frame work is to establishing the theoretical base of the influence and the relationship between PMSC and PP. This objective of developing a conceptual framework has been achieved based on extensive review of literature on the most appropriate construction PMs, their selection criteria and PP measures, as presented in Chapter 2. The criteria for selecting PMs were identified and discussed in details based on review of the literature. The purpose of this discussion is to theoretically establish the kind of relationship that exist between PMSC on PP, culminating in the formulation of relevant hypotheses and a conceptual framework. Understanding this relationship and its influence in much more details provide essential background setting for the subsequent testing of the hypotheses for their acceptance (or rejection) and the development of the regression model to illustrate the criteria with significant contribution to PP.

Objective 5 - Developing a model on the relationship between PMSC and PP that demonstrates the criteria with significant influence on PP

The model was developed using MRA technique. The findings identified a set of DBB and DB selection criteria with significant contribution with project performance. The findings from the MRA modelling identified a set of procurement criteria with significant contribution to PP. With projects procured by DBB method, the MRA reduced the criteria of selection DBB method from 12 to only: 5 criteria in terms of time; 6 criteria in terms of cost; and 6 criteria in terms of quality. It should be noted that only these criteria were found significant to be represented in the model with the other criteria not found significant to be included in the model. Thus, the DBB selection criteria included in the final model are those criteria that make a significant positive contribution to PP. In addition, they are the most useful criteria in predicting the level of PP to be expected.

With projects procured by DB method, the MRA minimized the criteria of selection DB method from 13 to only: 4 in terms of time; 1 in terms of cost; and 4 in terms of quality. It should also be elucidated here that the other DB procurement criteria were not represented in the model because they were not found to be significant. Thus, the DB criteria represented by the model are those found to be significant, which form useful criteria for predicting the level of PP to be expected. The DBB and DB criteria that significantly contribute to PP are discussed as following:

a) DBB selection criteria

1. High price competition

“High price competition” was found contributes positively with PP in terms of time and quality. This means that, this criterion positively influences project performance in terms of time and quality. Many researcher include for example Love et al. (1998), Chan (2007), Cheung et al. (2001) and Chan et al. (2001) confirmed that high price competition is very important for selection DBB procurement method. The main reason for that is to improve the price competition in order to help client to select the best price (Brook, 2004).

2. Clarity of scope definition

The clarity of the project scope and client requirements in early stage can affect the decision of selection PMs (Songer and Molenar, 1997). The multiple regression results show a positive contribution between this criterion and time component of PP indicating that, the clarity of scope definition in terms of the accuracy of the project specifications, quantities of work involved, detailed design as well as the clarity of project, plays an important role in enhancing the performance of the project. These aspects help to avoid mistakes, conflicts and additional works that may occur during construction works, which would prolong the project duration (Al Khalil, 2001). This result was confirmed by Chan and Kumaraswanmy (2002), who found that the clarity of scope definition is significantly influence project performance particularly in terms of time as it can control the project and keep it on the schedule.

3. High quality level required

“Quality level required is also described as the extent to which the constructed project can perform the function for which it was designed for” (Faniran et al., 1994). The MRA results show a significant positive contribution existence between this criterion and PP in terms of cost and quality and there is no contribution with time. This suggests that delivering projects by DBB in Libya is not capable of achieving good time performance for projects requiring high quality standards of the finished work, which is in-line with the views in some previous studies (Alhazmi and McCaffer, 2000; Cheung et al., 2001; Hashim et al., 2008; Love et al., 2008). The reason for this could be explained by the way and manner of design and construction teams’ work within DBB project settings. High quality standard involves dealing with many different quality parameters, notably quality of materials, workmanship and design concept (Love et al., 2012; Thomas et al., 2002), which requires close working collaboration between the designer and the contractor, which tends to be inhibited in DBB contracts (Ameyaw, 2009; Perkins, 2009). Thomas et al, 2002 indicated that achieving the high level of quality performance and appearance of any project requires high contractor's experience, professional staff (engineers and builders), specialist equipment and materials. These things will normally improve the overall shape and appearance of the project but at the same time can prolong the duration of the project.

4. Clear definition of the project party's responsibilities

This criterion directly affects PP, such as in terms of time and cost (Hashim, 2006). Determining the responsibility of all project parties is very important factor to avoid any disputes that may occur between them. The responsibilities of the project must be very clear and should not be any overlap of these responsibilities among project (love et al, 2008). The regression results demonstrate that, this criterion makes a significant positive contribution with PP in terms of cost. DBB method can provide better allocation of responsibility as a result of the segregation the project into design and construction phases. For instance, design team and consultants are responsible for design works while contractors are responsible for construction work. These responsibilities are known for each party in the early stage of the project and there is no interaction of these responsibilities. These things can reduce the conflicts and disputes among project parties which reflect positively on cost performance. Love et al. (2012) indicated that the degree of responsibility of the parties involved in a project plays an important role in avoiding any conflict and disputes between them, thereby positively affecting PP, particularly the cost component.

5. Client involvement in the project

This involvement entails clients working together with the other project team members in order to facilitate the works, prevent delays and errors, take decisions in the timely manner and hence contributes to improve PP (Kometa et al., 1995; Siva and London, 2012). The regression results show that, "client involvement in the project" contributes positively with PP in terms of time and cost. This is consistent with the findings of Poon et al. (2000), Edmond et al. (2008) that public clients have the attitude of focussing more on time performance criteria than any other criteria. The involvement of the client in all project processes in order to solve problems and take importance decisions at the right time without delays is considered very important aspect that lead to reduce the probability of the time and cost overruns. Other studies (Al Khalil, 2002; Ameyaw, 2009 and Lim and Ling, 2002) have also observed that, the clients' involvement has a positive effect on project success. For a significant positive effect to be achieved, the involvement should not only be high but should also transpire across the different phases of the project (Poon et al., 2000). High client involvement in the project during planning and production phases also improves satisfaction as it help to ensure that, the wider set of the project objectives are emphasised continuously for all to concentrate on (Lim and Ling, 2002; Munns and Bjeirmi, 1996).

6. Controllable project variations

Variations (or changes) usually tend to affect PP negatively (Ibbs, 1997, 2003). The magnitude of this effect largely depends on how flexible it is to accommodate or implement variation, which in turn depends mainly on the stage of the project at the time of the variation order, complexity of the project, the design process and coordination of activities (Edmond et al., 2008; Thomas et al., 2002). As highlighted in section 3.3.1 the extent to which the variation could have been contemplated prior to the project construction stage has been used to classify variations as controllable or uncontrollable (Perkins, 2009).

Whilst variations are known to impact negatively on PP in various ways, notably contributing to both cost and project time overruns (Enshassi et al., 2010; Hashim et al., 2006; Ibbs, 1997, 2003; Oladapo, 2007), the results of MRA in this study did not indicate significant negative contribution between this criterion and time and cost components of performance; rather, it was found a significant positive contribution with the quality component. This finding is consistent with the converse feature of project variation, namely its potential to yield beneficial impacts as in, for example, variations issued to improve quality standard, implement value engineering or take due advantage of technological change (Ibbs et al., 2001). The achievement of such benefits are however predicated on having a number of measures in place to manage the variation orders carefully, including resolving the variation in a timely manner, knowing the logic and justification behind the proposed variation and having a prior clearer view of its potential impacts (Arain and Pheng, 2006; Cox, 1997; Ibbs et al., 2001).

7. Cost certainty

The desire for high cost certainty has therefore been part of construction clients' top priorities in the project (Chinyio et al., 1998; Soetanto et al., 2001), and as such it is often considered when selecting the best PM (Love et al, 2008; Thomas et al., 2002). The regressing results show that, there is a significant positive contribution between this criterion and PP in terms of cost only. This finding concurs with the research of Xiao and Proverbs (2003), a comprehensive study on the performance and practice of contractors in Japan, the UK and the US, which concluded that "cost certainty" positively, influences the cost of projects. They stated that Knowing project client the expected project time and cost at early stage help them to manage and prepare good plan in order to finish project on budget (Thomas et al., 2001). A similar conclusion was reached by Thwala and Mathonsi (2012), who found that this criterion has a positive effect on PP.

8. Ease of organizing and reviewing project activities

Organisation, managing and reviewing project activities have always been part of the key processes for ensuring smooth planning and delivering of projects (Winch and Kelsey, 2005). Without these processes, appropriate project schedule for the project would be deficient, which would affect proper planning and monitoring of the works (Gidado, 2004). The results of MRA show that "Ease of organizing and reviewing project activities" exhibited a significant positive contribution to PP in terms of cost and quality. This is quite understandable since managing, organising and reviewing activities help to determine physical progress and appropriate programme recovery strategies necessary for ensuring good control over time and cost of projects, as well as enhancing their quality level (Laufer et al., 1994; Winch and Kelsey, 2005). Also, numerous empirical studies on factors responsible for project management success identified this aspect of organising and reviewing the construction activities as a major contributor to reduce the cost of the project and enhance the quality performance (Faniran et al., 1994; Gidado, 2004; Winch and Kelsey, 2005).

9. Desiring efficient project plan

Previous studies have confirmed that the "desiring efficient project planning" can play a key role in reducing the time and cost of the project which explained why this criterion is considered for selecting DBB method (Faniran et al., 1994). The regression results found a significant positive contribution between this criterion and time performance outcomes. There are a number of DBB characteristics that go to explain why this criterion exhibited such positive effect on project performance. For instance, in DBB, The client and consultant work closely together to facilitate proper development, implementation and management of the construction plan (Molenaar and Songer, 1998; Eriksson and Westerberg, 2011). The contract documents (drawing, design, specification and others) available before construction commencement which enable the client and consultant to review these documents accurately and develop good plan to control and organise the project and keep it on planning schedule

10. Project functionality

"Project functionality" is one of the success measures that clients tend to be keen on (Ratnasabapathy et al., 2006). It is thus often considered when selecting construction PM (Albert et al., 2002; Ratnasabapathy et al., 2006). The findings of regression analysis show a significant positive contribution between this criterion and both time and cost performance outcomes, which is consistent with the results of some previous studies (Abdul Rashid et al., 2006; Chan and Chan, 2000; Ratnasabapathy et al., 2006). The report of Davis et al. (2008) highlighted that DBB allows "*design lead and the client to have a direct influence which can facilitate a high level of functionality and improve the quality in the overall design*". A possible reason that explains this outcome is that project functionality is highly required, such as for defining the project scope, without which it would be difficult to plan out the project to help prevent problems that are likely to incur time and cost overruns.

b) DB selection criteria

1. Quick project commencement

As typical of any project, clients sometimes would want their projects commenced earlier than originally anticipated, for obvious reasons related to economic, business and political uncertainty among other things. The results of MRA indicate significant positive contribution between this criterion and time and quality components of PP. An obvious explanation for this finding is the fact that, DB method allows for construction to start before design is completed, hence increasing the likelihood of achieving good performance in terms of overall project time duration (Edmond et al., 2008; Love et al., 1998). The other thing is that, the integration between the design and construction process allows the design and construction team to work closely to each other to improve and enhance the quality component of PP.

2. Effective communication between project parties

This criterion plays a critical role in ensuring good project performance irrespective of the types of the project to be used (Mohsini and Davidson 1991). Direct contact between the client and the contractor as provided by a DB system enables the contractor to respond and adapt more promptly to the client's needs.

The results in this study reveal a significant positive contribution between this criterion and PP in terms of time, cost and quality. This was to be expected, as effective communication between project client and contractor has a strong positive effect on PP (Park et al., 2009; Seng and Yusof, 2006). With projects procured by DB method there is a direct contact between client and the contractor. This aspect gives the contractor chance to respond more instantly to the client's needs. The client and contractor will communicate closely during the process stage of the project. This helps to control project cost and time and prevent any increase in time or cost as well as enhance the quality performance of the project. It has been confirmed by Pinto and Slevin (1998) and Edmond et al. (2008) that, contractors undertaking the design and construction works enable them to deal and communicate closely with clients in order to solve project problems and complete project within target duration, cost and quality.

3. Single point of responsibility

One of the main feathers of DB procurement method is that, it provides single point of responsibility, which means the project should be executed without intervening consultants and the central contractual agreement between the client and contractor. The contractor, who is responsible for the execution of the project, has the power to dominate the whole enterprise (Adnan et al., 2011; Tooky et al., 2001). Due to this, this criterion is an important consideration in the selection of DB method (Songer et al., 1997; Turina et al., 2008). The MRA results indicate that "single point of responsibility" makes a significant positive contribution to quality performance. This is understandable because the contractor of the project responsible for the design and construction process gives him the opportunity to speed up construction work and prepare good plan enabling him to complete project below budget and before a schedule.

4. Collaborative working relationships between project team

The DBB approach to delivering construction projects is often blamed for an adversarial attitude and relationship between contracting team (Alhazmi and McCaffer, 2000; Ibbs et al., 2003). The need to reduce this adversarial culture and its associated high level of disputes has been a major drive behind the introduction of new procurement methods such as the DB (Edmond et al., 2008; Tang et al., 2006).

The results of the regression analysis show a significant positive contribution between this criterion and the time component of PP outcome only. This finding is quite understandable because running of design and construction operations concurrently in DB calls for better coordination and collaborative relationship amongst project team members (Edmond et al., 2008; Love, 1998), thereby contributing to faster project delivery (Bogus et al., 2005; Tang et al., 2006). Other past research for instance Seng and Yusof (2006) and Hibberd and Djebarni (1998) have also found there is positive associations between this criterion (Collaborative working relationships between project team) and time components of PP.

c. Criteria appropriate for DBB and DB methods

1. Complexity of design

"Complexity of project design" is characterised by a complicated design process and high levels of uncertainty (Gidado, 1996; NEDO, 1986). This criterion always considered for selecting DBB and DB method (Hashim et al. 2006; Thomas et al., 2002). The results of the study shows, that for DBB method there is a significant positive contribution between this criterion and quality component of PP. This finding is consistent with views in the literature. For instance, Hashim et al. (2006) and Chan (2007) indicated that, this criterion is one of the significant factors required for the successful selection of PM, and that different levels of complexity usually determine the use of different types of procurement system, with DBB method being suitable for a moderately complex project. Although previous studies suggest that, complexity of design influences PP in terms of time, cost and quality (Al Khalil, 2002; Cheung et al., 2001; Love et al.; 1998; Thomas et al., 2002), there was no contribution found between this criterion and the criteria of PP in terms of time and cost based on the results of MRA. With project procured by DB this criterion shows significant positive contribution with time and quality components of PP which is consistent with views in the literature. For example, Seng and Yusof (2006) and Hasim et al. (2006) stated that the overlapping of design and construction processes through the DB method aids to create good collaboration and communication between design and construction team, as well as facilitating direct relationship between client and contractors. This collaboration and communication can reduce projects' design and specification errors, which can enhance the quality of the project, and also help prevent time overruns of projects.

Objective 6 – Validation of the model developed

This objective has been achieved base on case study of the recent projects undertaken in Libya presented in chapter 7. Semi structured interviews were conducted with different engineers involved in these projects in order to obtain information to support the model developed, increase its confidence and make it more veiled. The results obtained from the semi structured interviews conducted (Figures 7.11 and 7.12) have been used to predicate project performance outcome in terms of time and cost. The results obtained were compared with the outcomes of the project performance based on the results obtained from main questionnaire survey presented in chapter 6 (see Figure 6.22 and 6.23). The project performance outcomes in terms of time and cost of the model developed was found nearly the same in the two aforementioned cases irrespective of project procured by DBB or DB method. The explanations of such results are attributed to the fact that there is not that much difference in the nature, behaviour and circumstances of Libyan construction projects. The information were obtained from different samples of respondents based on their insights into PMs and PP, and then inputted into the model, which yielded nearly the same results.

Objective – 7 Exploring the factors besides PM that influence the PP in Libya

To achieve this objective a review of literature on the area of PP as presented in chapter 2 and 4 were carried out. The purpose of the review is to find out the major factors that influence PP in general and in particular of context of LCI. This investigation was supported by questionnaire and interview survey with a sample of experts in Libyan construction sectors presented in chapter 6. The findings as presented in chapter 6 sections 6.5.2.1 show that:

With project procured by DBB method the three major factors responsible for PP performance are: “improper planning and design”, “inadequate contractor experience”, and “poor contract management”. It is not surprising to find these are known as the major factors responsible for poor performance, because the project contractor is considered the main party responsible for the construction process. If the project contractor is not sufficiently experienced, this will reflect negatively on PP (Chan et al., 2001; Pinto and Slevin, 1998). The project plan is considered the main issue that affects PP. If the project plan is not accurate and clear, the project will suffer from time overruns (Odeh and Battaineh, 2002). These results were in line with the study of Puspasari (2005), Sambasivan and Soon (2006) which concluded that, inadequate contractor experience, improper planning and design and poor contact management are the main factors responsible for poor PP. Ralph and Iyagba (2012) also confirmed that, the “improper planning and design” is one of the poor performance factors that affect DBB projects. Odeh and Battaineh (2002) also stated that “poor contract management” and “inadequate contractor experience” are among the top ten important factors responsible for poor performance of DBB projects.

For DB projects the findings indicated that, the main factors responsible for poor PP are: “inadequate contractor experience”, “improper planning and design” and “construction mistakes and defective work” and “slow decision-making by client”. These factors are discussed as listed below:

a) Improper planning and design

One of the contractor’s responsibilities under DB arrangement is to develop plan for the project to show in detail the project activities and how they are to be achieved. The failure of the contractor to develop good plan for the project will reflect negatively on project success. The Ambiguity of scope work considers significant factors responsible for improper planning and design (Olupolola et al., 2010).

b) Inadequate contractor experience:

This refers to the lack of experience and knowledge on the part of contractors in handling projects. DB projects usually require contractors who have a great deal of experience especially as the contractor will be responsible for the design, as well as the construction processes. A number of study includes (e.g Alaghbari et al., 2007; Olupolola et al., 2010 and Sambasivan and Soon, 2006) stated that the lack of contractor experience is one of major factor that adversely influence the performance of construction projects.

c) Slow decision-making by clients:

This refers to the attitude of project clients not making decisions about the conduct of works in a timely manner (Alaghbari et al., 2007).This factor directly affects PP in terms of time; it is understandable that projects may suffer time overruns if there are any delays with clients' decisions. Olupolola et al. (2010) and Mezher and Tawil (1998) are in agreement with this, as they concluded that projects tend to perform poorly in terms of time due to slow decision-making by clients.

8.3 Conclusions of the Research

One of the causes of poor PP is often attributed to the use of inappropriate PM. Whilst employing an appropriate method is known to result in project success, limited research has so far been devoted in exploring this relationship. The available studies in the area of procurement so far can be put into five categories, as highlighted in Chapter 1. In an attempt to fill the gap in construction management research on the impact PM selection has on PP, This research aims to investigating the influence of PMSC has on PP in the context of LCI. This investigation can offer much deeper understanding of which PMSC with significant contribution to PP. The main focus of the research firstly is to investigate the construction PMs currently in use to deliver construction projects in Libya, the criteria of selecting the most appropriate PMs and the influence they have on the performance of the projects. The research also looked at the other factors besides procurement that influence the performance of construction projects in Libya. This was achieved through: (i) reviewing the relevant literature in the area of PMs and PP (ii) conducting initial field survey, comprising of telephone interviews and questionnaire survey of a sample of experts in construction management sector in Libya (iii) conducting main questionnaire survey with construction organisations from client, contractor and consulting groups, and subsequently running interviews with a sample of the respondents (reported in Chapters 6). Base on the above steps the aim and objectives of the research have been achieved. The main key conclusions deduced in respect of the research aim and objectives are as described below.

1. Selection of inappropriate PMs in Libya considers one of the main reasons responsible for poor PP wherein a large number of construction projects in Libya were delivered with poor performance as results of the inappropriate procurement selection. The main reason of the wrong selection of PMs is that, the Libyan project clients did not consider the procurement criteria when they decide which the method of procurement should be used for delivering projects. The main conclusions drawn from the review of the literature on the LCI is that so far, there is no specific technique or systematic approach used to help clients determine which criteria need to be given more focus when deciding on which PM is best to use for project delivery. Therefore, the criteria for PM selection are usually used intuitively, largely based on clients' experience with previous projects. This issue has created a considerable number of problems with Libyan construction projects such as time and cost overruns. Due to this, there is the need to develop a systematic approach which can aid clients to determine the right and significant criteria for selecting the most appropriate PM that would ensure successful PP outcomes.

2. DBB and DB methods are only the two project delivery used to procure construction projects in Libya. DBB method is the most common and preferable in use wherein the vast majority of country projects were delivered by DBB method however, DB method is really in use. Project clients in Libya prefer using DBB method irrespective of whether is appropriate for project or not. The common reason for this includes the lack of knowledge and understanding of modern and innovative PMs. To avoid this blanket adoption of using DBB method with little or no due consideration of their suitability for a project at hand, there is the need to encourage and promote Libyan project clients to embrace the use of modern and innovative PMs, if improvement in project performance is to get any better.

3. A total of 23 procurement selection criteria have been identified based on literature review carried out as being the most appropriate for selection DBB and DB methods. 10 of them are suitable to DBB method, 11 are suitable for DB method and 2 are appropriate for

both. Using these criteria to determine the right PM selection can increase the probability of success construction projects and therefore improve the performance.

4. The involvement of project parties in construction projects in Libya varies due to the method of procurement used. For instance, for DBB method, there is high level of involvement of all project parties (client, contractor and consultant), which showed a strong correlation with high PP. Good relationships and smooth communication between project parties are built as result of the close involvement of clients in projects, which reflects positively on the projects. On the other hand, for DB method, the level of contractor involvement in project is higher than client and consultant which correlates well with good PP. This is because for DB method the contractor is responsible for both design and construction works.

5. Bill of quantity contract and lump sum contract are considered the most common types of contracts used in Libyan construction projects. Project client prefer using Bill of quantity contract for projects procured by DBB. However, lump sum contract is the most appropriate in use for projects procured by DB method. Cost plus contract is rarely used due to lack of project parties' experience with this contract type.

6. Project clients in Libya usually select the contactors using one of the following approaches: Open tender, selective tender and direct orders, representing the main three types of tenders used for selecting contractors. Although the ACR has recommend that construction contracts should be carried out by open/public tender, selective tender remains the most frequent in use to select contractors recently, irrespective of whether the project is procured by DBB or DB method. Using open/public tenders to select contractors has many disadvantages. First, it usually takes long time because of complicated procedures the tender processes involve. Secondly, it is difficult to ensure that the rightly qualified contractor is selected to do the work as a whole range of contractors of different capabilities are welcome to tender for the project. Therefore, the government should has to encourage and promote the use the other types of tendering (selective and direct orders) to select contractors in order to reduce the duration of contracting projects.

7. The performance of the construction projects in LCI is measured and evaluated based on time, cost and quality criteria. These criteria are often used to assess the level of success or failure of construction projects in LCI, as they consider them as being more appropriate

and relevant to project expectations and requirements in the LCI. The consideration of the additional criteria such as environmental, health and safety, innovation, client satisfaction and communication is as a result of the subjective nature by which project success is seen or measured by different project stakeholders.

8. The research model developed identified the influence of DBB and DB procurement criteria on PP. Among others, this model demonstrates the selection criteria that contribute significantly to PP.

I) For DBB method the criteria relating to:

a. "clarity of scope definition" and "desiring efficient project planning" contribute positively to time performance;
b. "clear definition of project parties responsibilities" and "cost certainty" make a significant positive contribution to PP in terms of cost;
c. "complexity of design" and "controllable project variations" make a significant positive contribution to quality performance;
d. "high price competition" contributes positively to both time and quality components of PP;
e. "client involvement in the project" and "project functionality" make significantly positive contribution to time and cost performance;
f. "High quality level required" and "ease to organising and reviewing project activities" contribute positively to both cost and quality components of PP.

As these criteria make significant contribution to PP, project clients should give a great attention to them and particularly focus on them when selecting the most appropriate PMs, by taking measures such as:

- The project scope should be very clear and well defined in terms of contract documents (designs, drawings, quantities, specification, materials and equipment). The project objectives and the methods used to execute projects should be well defined.

- The project client and consultant should be very accurate in the contractor selection stage. High price competition should be considered by invited many contactors in order to improve and enhance the price competition. The other thing is that the client should not considering cost efficiency to be an overriding concern in the evaluation and comparison of contractors' bids. Other criteria such as work experience, reputation and financial and technical capabilities of the contractors should be given priority.

- The responsibilities and authorities of each party involved in the project should be clear and from free any overlap in their roles and responsibilities.
- The project client should be highly involved in the project in order to take decisions in a timely manner, to work harmoniously with project teams and to create smooth communication between project members. This involvement plays an important role in solving any problems that may arise, especially, during early stages of the project.
- For projects with complex design the consultant, designer and architect in the pre-construction stage should give deep attention and adequate time to facilitate the project designs and drawings in order to make them simple, clear and understood by the project construction team (e.g site engineers, construction engineers, general supervisors and others). They should also make these designs and drawings easy to implement in the site.
- As highlighted in the above section the project designs, drawings and specification is supposed to be non-ambiguous and unclear. The consultants and designer team should provide clear and accurate designs, drawings, specifications, and quantities for the project items. This can help to prevent or reduce the changes and make them controllable during the construction phase.
- The project cost should be accurately estimated in advance and before commencing construction, to allow the client to budget for the construction process and to plan for any contingencies.
- The client and consultant should pay great attention to the quality of the project, spending adequate time in order to develop good contract documentation in terms of design, materials and specification. The project materials and equipment should be high quality; the staff of the project should be highly skilled and qualified. The

specification of the project should be clear and accurate. This issue can reflect positively on the level of project quality required.

- The plan of the project should be given important consideration by project parties. For a DBB project the client can work together with consultants to prepare the project plan in the early stage. In this regard, they should demonstrate clearly and accurately the method used to implement the project, the order of implementation of the project stages and the period of time and cost for each stage, and finally the period of time and cost for the whole project.

- The construction works should be easy to organise and reviewing. This can be obtained by for example; dividing the construction work into separate unites of activities to facilitate the planning, organising and reviewing them. The designs, drawings, specification and quantities of the project should be also clear and accurate to facilitate reviewing the works executive in the site.

- The client and project manager should be ensuring that project completed according to all technical performance specification. In this regards the project manager of the client together with his team should do all measures, revisions, and technical studies that confirm the project is implemented according to contract documents.

II) For projects procured by DB method, the criteria relating to:

a. "effective communication between project parties" showed a significant positive contribution to pp in terms of time, cost and quality;
b. "quick project commencement" and "complexity of design" showed a significant positive contribution to the time and quality components PP;
c. "single point of responsibility" positively contributes to quality performance;
d. "collaborative working relationship between project team" contributes positively to time performance.

As these criteria make significant contribution to PP, they should be given great attention by project clients when selecting the most appropriate PMs, especially, by taking measures such as:

- The contractor of the project should manage and organise project properly to finish it early. One of the contractor's responsibilities is to start the actual construction work of the project early before completion of the design work. In this regard, the contractors should speed up construction work. Each stage which is completely finished in terms of the design should be executed without waiting for the design of the other stages. This can save time and facilitate early project completion.

- The communication between project parties should be effective. The parties in the project should be aware of the importance of mutual communication for project successes. In this regard, the project parties should communicate actively during the design and construction stages, fostering direct and good relationships. They should also help each other sharing the information and ideas with regards to the design and construction works.

- The project contractor should be clearly aware of his responsibilities and duties for the design and construction works. In terms of design, the contractor and design team should manage to prepare clear and accurate designs, drawings and specifications of the project. However, in terms of the construction work the contractor should manage and control project staff and provide good materials, equipment and machinery to carry out the construction work. The contractor also should ensure that project team is highly skilled and efficient.

- As the contractor is responsible about the design and construction works, he should manage to minimise errors and changes, facilitate the complex design and make it easy to implement in the site.

- One of the contractor responsibilities in the project is to build up strong and efficient relationships with the project team to enable them to work together harmoniously and to facilitate collaboration in the execution work. Such collaboration and communication between project team will have positive effect on the PP.

9. The model developed was validated via case study based on recent projects undertaken in Libya. The findings obtained from this validation support and strength the application of the model as well as increasing its confidence and validity for adoption in the LCI.

10. In terms of applications of the developed model:

- the afore-listed recommendations represent a useful set of guidance that would benefit LCI's clients immensely by way of helping them to decide on the best measures (in the light of the characteristics/nature of the significant criteria) that must be taken, prior to construction commencement or during its currency, to improve on the performance of DBB or DB projects .
- Not only would clients be able to make PM selection decisions much faster by virtue of the need for them to only focus on the criteria with significant influence on PP, they are also able to work out, in quantitative terms, the PP outcomes to be expected for each of the method that could be selected.
- This latter information would enable clients to compare the PP outcome values expected from their decisions to select DBB and DB, and then be able to conclude which of these two options offer a better procurement strategy for any given project.

11. Many factors besides procurement have been found adversely influence performance of DBB and DB projects in Libya; these factors could be attributed mainly to the clients-related, contractors-related, consultants-related, projects-related and external and environment- related. These factors are: "improper planning and design", "inadequate contractor experience", "poor contract management", "slow decision-making by client", "client's delay in payment to the contractor", "inappropriate experience of the consultants and clients supervisors", "financial and administrative corruption", "external pressure (political or economic)" and "design errors". Therefore, a significant attention should be given to these factors from all project participants (client, contractor and consultant) in order to control them and prevent their occurring.

8.4 Recommendations for Future Research

Through the discussion and analysis in this study, several subjects and themes have arisen which are suggested as subjects for future research. The main future research areas recommended are described below.

1. The research data used for developing the model has been obtained from a field survey (questionnaire and interviews). The field survey did not cover most of the

Libyan regions, as a result of the political instability of the country during the data collection. Although areas covered to collect data represent the active regions of the country in terms of construction and operation, regions that were not included could offer useful data that make the results more accurate. For this reason, it is recommended that a similar survey be conducted to cover all of Libya's regions in order to improve the model and make it more efficient.

2. A high percentage of Libyan construction projects do suffered from time and cost overruns as a result of clients selecting an inappropriate PM. DBB has been dominate method with very little awareness and use of innovative and modern forms of procurement methods. It is thus recommended that the government of Libya conduct nationwide seminars, studies and training courses on the advantages and the importance of using the modern PMs in order to improve the understanding and knowledge of the clients, architects, engineers, quantity surveyors and contractors. They should also be encouraged to partner and undertake projects via these procurement methods.

3. The weights (scores) of PMSC which were given by respondents were obtained based on their level of satisfaction/agreement of the criteria as to the selection of DBB and DB. These weights are, however, likely to change with time due to dynamic nature of the construction industry or the appearance of other important procurement criteria in future. For this reason, it is recommended that similar surveys be repeated at periodic intervals in order to update the model to maintain its accuracy and applicability over time.

4. The study results and model have the potential of benefit of neighbouring countries since they have similar culture, lows, environment of projects, and procurement police. It is recommended that in future similar studies be carried out in other countries to ascertain if the attributes identified are generalizable across different countries.

5. The literature review of this study suggests that, there are various approaches to deliver construction projects and their influence on project performance is different.

This study only focused on the impact of the DBB and DB methods on PP in the context of Libya. This is because these methods of procurement monopolize the LCI. Future research is needed to find out the applicability and relevance of alternative types of procurement methods, such as management contracting, construction management, project finance and partnering on PP.

6. As highlighted in section 8.3, this study has identified a number of factors besides procurement that adversely influence the performance of the Libyan construction projects. Further research in future would be useful in assessing and evaluating these factors as well as determining the best approaches for addressing them. New approaches for educating and training project staff on how they should deal with these factors during project execution are also needed. The major purpose of such research and training is to improve the understanding, skills and the abilities of the project staff in dealing and controlling these factors

8.5 Scope and limitations

The key sources of data used in this research were based on the perspectives of clients, contractors and consultants in relation to their experience with consultant procurement project with LCI particularly on the selection and administration of the most common PMs. This study focused only on public clients' and consultants' organisations (government owned), because most projects are initiated by the government. It also focused on private contracting firms.

The data collection was limited to stakeholders who were operating within safer regions of the country due to a serious political instability at the time of the fieldwork (2011), when some construction companies had to freeze their activities, especially in the eastern regions of the country. In addition, accessing these regions became very difficult and personally dangerous for the researcher. As a result of this extraordinary situation, study had to focus only on subjects from the southern and western regions, especially Tripoli and its environs. Fortunately, Tripoli is the capital city and the most advanced area in terms of economic and infrastructural development, including the construction industry. Although the number of respondents involved in the study did not reach the targeted number, they were adequate enough for the study. However, further research in this field might be necessary to conduct in future to cover all the regions in Libya.

A second limitation is that only DBB and DB methods of procurement were considered in this study. This was not because of any conceptual or theoretical deficiency in the study itself, but because these methods of procurement proved to be ubiquitous in the LCI, to the exclusion of alternatives.

A third limitation is the fact that the main study data came from respondents' personal assessment of their experience of past projects as opposed to basing it on actual existing records of these projects. The subjectivity of the respondents was however directed towards specific past projects in which they actively participated in their selection and delivery but not to a hypothetical situation.

However, regardless of these limitations, the results of this study together with the model developed have significant implications and useful application in Libya, as well as comparable countries with similar socio-cultural, economic and geographical factors, such as elsewhere in the Middle East and North Africa (MENA) (e.g. Egypt, Tunisia, Algeria and the Arabian Gulf). As the study was based on LCI, the model might not be applicable in developed countries; not least because the operating environment of construction industries in such countries is totally different from that prevailing in Libya.

BIBLIOGRAPHY

Abbas, H. (1997) *Industrial Development and Migrant in Libya: Study of Migrant Workers from the Village of Solug at the Cement Factory in Benghazi*. Unpublished PhD thesis, University of Manchester.

Abd-Elrazek, R. H. (1998) “Quality improvement in Egypt: methodology and implementation”, *Journal of Construction Engineering and Management*, 124, (5), pp. 354–360.

Abd-Elshakour, H. (2011) “Construction contracts”, available at: http://faculty.ksu.edu.sa/ algahtani/GE%204021/GE402-Topic_10 contracts.pdf (Accessed: 7 March 2011).

Abdul Rashid, R., Mat Taib, I., Wan Ahmad, W.B., Nasid, M.A., Wan Ali, W.N. and MohdZainordin, Z. (2006) "Effect of procurement systems on the performance of construction projects", *International Conference on Construction Industry, 21st – 25th June*, Padang, Indonesia.pp. 1-13.

Abn-Altieef, M., Al-Maggbub, H. (1998) “The practice of engineering studies and consulting works in Libya”, *Paper presented at the Second Conference of Libyan Engineers*. Misrata, Libya.12th -15th September, pp. 381-388.

Abuarroush, M. M. (1996) *A Cross-Cultural Study of Locus of Control and Self- Esteem as Related to Socio Cultural Factors Among Libyan and British Postgraduate Student*. Unpublished PhD Thesis Manchester University.

Abubaker, A. E., Greenwood, D. and Osborne, A (2008) A study of project planning on Libyan Construction Projects. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, pp. 789-798.

Adam, C. and David, B. (2004) "Project success-A survey", *Journal of Construction Research,* 5, (2), pp. 211-223.

Adnan, H., Bachik, F., Supardi, A. and Marhani, M. A. (2011) “Success factors of design and build projects in public universities”, *Social and Behavioural Sciences*, 35, pp. 170-179

Adeyemi, A. Y., Ojo, S. O., Odeyinka, H. A. and Fagbenle O. I. (2002) “An Evaluation of the Cost Effectiveness of Direct Labour System on Housing Project Execution in Lagos State, Nigeria”, *an interdisciplinary task World congress; 30th , Housing; housing construction : an interdisciplinary task; 355-362*

Aibinu, A. and Jagboro, G. (2002) "The effects of construction delays on project delivery in Nigerian construction industry", *International Journal of Project Management*, 20, (8), pp. 593-599.

Aimi, K. and Al-Ghafly, M. (1999) "Delays in public utility projects in Saudi Arabia", *International Journal of Project Management*, 17, (2), pp.101-106.

Akintoye, A. and Fitzgerald, E. (1995) “Design and build: a survey of architects' views”, *Engineering, Construction and Architectural Management*, 2, (1), pp. 27-44

Al-Abbar, A. (1999) "Libyan efforts in anti-corruption", *Paper presented at the Ninth International Anti-Corruption Conference (IACC),* Durban, South Africa, 10th-15th October 1999.

Alaghbari, W., Kadir, M. R. A., Salim, A. and Ernawati (2007) “The significant factors causing delay of building of construction project in Malaysia”, *Journal of Engineering and Architectural Management*, 14, (2), pp. 192-206.

Albert, P. C., David, S. and Edmond W. M. (2002) “Framework of Success Criteria for Design and Build Projects”, *Journal of Management in Engineering*, 18, (3), pp. 120-128

Albert, P. C. C. (2000) “Evaluation of enhanced design and build system – a case study of a hospital project”, *Construction Management and Economics*, 8, (7), pp. 863-871

Alderman, N. and Ivory, C. (2007) “Partnering in major contracts: paradox and metaphor”, *International Journal of Project Management*, 25, (4), pp. 386–393.

Alhazmi, T. and McCaffer, R. (2000) "Project procurement system selection model", *Journal of* Construction *Engineering and Management*, 126, (3), pp. 176-184.

Ali, Z. A., Zakaria, N. and Che-Ani, A. I. (2012) “The Effect of Procurement System towards the Performance of Refurbishment Works”, available at: www.wseas.us/e-library/conferences/2011/Venice/.../EEDSCC-08.pdf (accessed 2 May 2012).

Al Khalil, M. I. (2002) "Selecting the appropriate project delivery method using AHP", *International Journal of Project Management*, 20, (6), pp. 464-469.

Al-Tmeemy, S. M. H. M., Abdul-Rahman, H. And Harun, Z. (2010) Future criteria for success of building projects in Malaysia, *International Journal of Project Management*, 29, (3), pp. 337–348.

Ameyaw, C. (2009) “Comparative Performance Evaluation of the Traditional Design-Bid-Build (DBB) and Design-Build (DB) Procurement”, Available at: http://www.academi.edu/505633/ComparativePerformance_Evaluation_of_the_Traditional Design-Bid-Build_(Dbb)_and Design-Build_(Db) Procurement (accessed: 12 December 2012).

Andi, S. and Minato, T. (2003) "Design Documents Quality in the Japanese Construction Industry: Factors Influencing and Impacts on Construction Process", *International Journal of Project Management*, 21, (7), pp. 537-546.

Antoniou, F., Aretoulis, G. N., Konstantinidis, D. and Kalfakakou, G. P. (2012) "Selection Criteria used for choice of contract type for major highway construction projects", *Procedia - Social and Behavioral Sciences*, Volume 48, 2012, pp. 3508–3517

Arain, F. M. and Pheng, L. S. (2006) “Effective Management of Contract Variations using a Knowledge Based Decision Support System”, (Working Paper No. 10). *The Higher Education Academy*, Published by the Centre for Education in the Built Environment, Cardiff University, UK.

Arditi, D. and Gunaydin, H. M. (1998) "Factors that affect process quality in the life cycle of building projects", ASCE *Journal of Construction Engineering and Management*, 124, (3), pp. 194–203.

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

Arti, J. J., Pankaj, P. And Bhangale (2013) “To Study Critical Factors Necessary for a Successful Construction Project”, *International Journal of Innovative Technology and Exploring Engineering*, 2, (5), pp. 2278-3075

Asley D.B., (1994) “Design and Build: A Survey of Construction Contractors’ Views”, *Journal of Construction Management and Economi*c, 12, (2), pp.155-165

Ashworth, A. (2006) “*Contractual Procedures in the Construction Industry”*, Unitec, New Zealand. 5th edn.

Asiedu, W. G. (2009) "Assessing Construction Project Performance in Ghana: Modelling Practitioners’ and Clients’ Perspectives" Available at: http://www.tue.nl/en/publication/ep/p/d/ep-uid/234018/, (Accesses: 27 April 2012).

Assaf, S. A. and Al-Hejji, S. (2006) "Causes of delay in large construction, projects", *International Journal of Project Management*, 24, (4), pp. 349-357.

Atkinson, R. (1999) "Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria", *International Journal of project management*, 17, (6), pp. 337-342.

Avison, D and Myers, M. D. (2002) *An Introduction to Qualitative Research in Information Systems. London*: Sage,

Babbie, E. (2005) *the Practice of Social Research.* Belmont, CA, Wadsworth

Baker, M. J. (2003) "Data Collection - Questionnaire Design", *The Marketing Review*, 3, (5), pp. 343-370.

Ballard, G. and Howell, G. (1998) "Shielding production: essential step in production control", *Journal of Construction Engineering and Management*, ASCE, 124, (1), pp.11-17.

Barber, P., Tomkins, C. and Graves, A. (1999) "Decentralised site management-a case study", *International Journal of Project Management*, 17, (2), pp. 113-120.

Bassioni, H. A., Price, A. D. F. and Hassan, T. M. (2004) "Performance measurement in construction", *Journal of Management in Engineering*, 20, (2), pp. 42-50.

Barnet, V. (1991) *Sample Survey Principles and Method*. Edward Arnold, London.

Bell, E. and Bryman, A. (2003) *Business Research Methods.* 2nd edn. USA: Oxford University Press, New York

Bentley, J. (1987) Construction Tendering and Estimating. Routledge, London, E.& F.N. Spon.

Bernard H. R. (1995) *Research Methods in Anthropology.* 2nd edn. London: Sage Publications,

Bland J. and Altman D. (1997) "Statistics notes: Cronbach's alpha", BMJ. 1997; 314: 275, available at: http://www.bmj.com/content/314/7080/572 (Accessed: 20 July 2012).

Blumberg, B, Cooper, D R & Schindler, S (2008), *Business Research Methods*. 2nd European edn. London: McGraw-Hill Higher Education.

Blumberg, B., Cooper, R. and Schindler, P. S. (2011) *Business Research Methods.* London: McGraw-Hill Education.

Bogdan, R. C. and Biklen, S. K. (1992) *Qualitative Research for Education: An Introduction to Theory and Methods*, Allyn and Baccon, Boston.

Bogus S. M., Molenaar, K. R. and Diekmann, J. E. (2005) "Concurrent Engineering Approach to Reducing Design Delivery Time", *Journal of Construction Engineering and Management*, 131, (11), pp. 1179-85.

Bon, R. and Crosthwaite, D. (2000) *The Feature of International Construction*. London, Telford.

Borenstein, D. (1998) "Towards a practical method to validate decision support systems", *Decision Support System*, 23, (3), pp. 227-239.

Bowen, P. A., Pearl, R. G., Edwards, P. J., Town, C. and Africa, S. (1999) "Client briefing processes and procurement method selection: a South African study", *Engineering, Construction and Architectural Management*, 6, (2), pp. 91-104.

Brad, (2012) "introduction to research and research methods", Available at: http://www. brad.ac.uk/management/media/management/els/Introduction-to-Research-and Research-Methods.pdf (Accessed: 12 May 2012).

Brannen, J. (2005) "Mixed methods research: A discussion paper" *Institute of Education, University of London.*

Briamah, N. (2008) "An investigation into the use of construction delay and disruption analysismethodologies", Available at: http://wlv.openrepository.com/wlv/bitstream/2436/38824/3/Braimah_PhD%20thesis.pdf (Accessed: 25-july-2012).

Brook, M. (2004) *Estimating and tendering for construction work.* 3rd edn. Boston: Butterworth Heinemann

Brown, D., Ashleigh, M., Riley, M. and Shaw, R. (2001) "New Project Procurement Process", *Journal of Management in Engineering,* 17 (4)**,** pp**.**192-201.

Bryde, D. and Brown, D. (2004) "The influence of a project performance measurement system on the success of a contract for maintaining motorways and trunk roads", *Project Management Journal*, 35, (4), pp. 57-65.

Bryman, A. (2006) “Integrating quantitative and qualitative research: how is it done*?” Qualitative Research SAGE Journal Publications* (London, Thousand Oaks, CA and New Delhi), 6, (10), pp 97-13.

Bryman, A. and Bell, E. (2011) *Business Research methods*. 2nd edn. oxford, UK.

Bryman, A. and Bell, E, (2007) *Business Research Methods.* USA: Oxford University Press,

Bubshait, A. A. and Al-Atiq, T. H. (1999) "ISO 9000 quality standards in construction", *Journal of Management in Engineering*, 15, (6), pp. 41–46.

Bureau of Statistics and Census Libya (2010) “General Census of Libyan Population”, Ministry of Planning, Statistics and Census department, Tripoli, Libya

Burns, R. B. (2000), *Introduction to Research Methods*. 4th edn. Sage Publication Ltd, London.

Chan, A. P. C. and Chan, E. H. W. (2012) “Applicability of procurement selection systems in Hong Kong”, Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, Available at: http://www2. ing.puc.cl/~icccon/abstracts/PDF/Track6/T6-P6.pdfl (Accessed: 10 March 2012).

Chan, A. P. C. (2000). “Evaluation of enhanced design and build system—A case study of a hospital project”, *Construction Management and Econoics,* 18, pp. 863–871.

Chan, A. P. C and Chan, D. W. M. (2002) "Benchmarking project construction time performance-the case of Hong Kong" *Project management-impresario of the construction industry,* held on 22nd - 23rd March 2002, in Hong Kong.

Chan, A. and Chan, A. (2004) "Key Performance Indicators for Measuring Construction Success", *Benchmarking: An International Journal*, 11, (2), pp. 203-221.

Chan, A. P. C., Yung, E. H. K., Lam, P. T. I., Tam, C. M. and Cheung, S. O. (2001) "Application of Delphi method in selection of procurement systems for construction projects", *Construction Management and Economics*, 19, (7), pp. 699-718.

Chan, D. W. M, and Kumaraswamy, M. M. (2002), "Compressing construction duration: Lesson learnedfrom Hong Kong building projects", *International journal of project management*, 20, (1), pp 23-35.

Chan, D. and Kumaraswamy, M. (1997) "A Comparative Study of Causes of Time Overruns in Hong Kong Construction Projects", *International Journal of Project Management,* 15, (1)**,** 55-63.

Chan, C. T. W. (2007) "Fuzzy procurement selection model for construction projects", *Construction Management and Economics,* 25, (6), pp. 611-618.

Chao, L. and Hsiao, C. S. (2012) “Fuzzy model for predicting project performance based on procurement experiences”, *Automation in Construction* 28, pp. 71–81

Chang, Y. C. and Ive, G. (2002) "Rethinking the multi-attribute utility approach based Procurement route selection technique", Construction Management and Economics, 20, (3), pp. 275-284.

Chen, W. and Hirschheim, R. (2004). A paradigmatic and methodological examination of information systems research from 1991 to 2001, *Information Systems Journal*, 14, pp. 197-235.

Cheng, J. and Proverbs, D. G. (2004) “The impact of strategic decisions on construction client satisfaction”, *20th Annual ARCOM Conference*, 1-3 September 2004, Heriot Watt University. Association of Researchers in Construction Management, Vol. 2, 931-8.

Cheng, E. W. L. and Li, H. (2004) "Contractor selection using the analytic network process", *Construction Management and Economics,* 22, (10), pp. 1021–1032.

Cherns, A. B and Bryant, D. T. (1984) “Studying the client's role in construction management”, *Journal of Construction Management and Economics*, 2, (2), pp. 177-184.

Cheung, S. O., LAM, T. I., Leung, M. Y. and Wan, Y. W. (2001) "An analytical hierarchy process based procurement selection method", 19, (4), pp. 427-437.

Cheung, S. O., Suen, H. C. H. and Cheung, K. K. W. (2004) "PPMS: A Web-based construction Project Performance Monitoring System", *Automation in Construction*, 13, (3), pp. 361-376.

Chinyio, E. Z., Olomolaiye, P. O., Kometa, S. T. and Harris, F. C. (1998) “A needs-based methodology for classifying construction clients and selecting contractors”. *Construction Management and Economics,* 17, (4), pp. 413-417.

Chua, D., Kog, Y. and Loh, P. (1999) “Critical success factors for different project objectives”, *Journal of Construction Engineering and Management*, 125, (3), pp. 142–150.

Civilengineeringlink (2011) *types of construction contracts*, Available at: http://www. civil engineeringlink.com/ (Accessed: 7 March 2011).

Clamp, H. and Cox, S. (1998) *Which Contract: Choosing Appropriate Building Contract.* 5th edn. RIBA Pub. Landon

Cohen, L., Manion, L. and Marrison, K. (1994) *Research Methods in Education.* London: Sage: Routledge Falmer

Cole, R. (2000) "Building environmental assessment methods: assessing construction practices", *Journal of Construction Management and Economics*, 18, (8), pp. 949–957.

Collins, A. and Baccarini, D. (2004) "Project Success - A Survey", *Journal of Construction Research*, 5, (2), pp. 211-231.

Collis, J & Hussey, R (2009), *Business Research: A practical guide for undergraduate and postgraduate students*. 3rd edn. London: Palgrave Macmillan.

Construction Excellence (2004), “Procurement Factsheet - Construction Excellence” Available at: www.constructingexcelllence.org.uk (Accessed: 15 March 2012).

Construction leader (2011) "Contract Type", Available at: http://www.pcl.com/Services-that-Deliver/Contract-Types/Pages/default.aspx (Accessed: 10 May 2011).

Cox, R. K. (1997) “Managing change orders and claims”, *Journal of Management in Engineering*, 13, (1), pp. 24-30.

Creswell, J. W. (2003) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 2nd edn. Sage, Thousand Oaks Cal, Sage Publications

Creswell, J. W. (2007) *Qualitative Inquiry and Research Design: Choosing Amongthe Five Approaches*. 2nd edn. Sage Publications, Thousand Oaks, Cal.: Sage Publications

Creswell, J W (2009), *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* Thousand Oaks, Cal.: Sage Publications.

Cruzbuy, (2013) “Scope of Work (SOW) Guide - UCSC Procurement Services”, Available at: http://cruzbuy.ucsc.edu/howto/SOWGuide.pdf. (Accessed at 30 June 2013)

Csehati, G. and Szabo, L (2014) “The relationship between success criteria and success factors in organisational event projects", *International Journal of Project Managment*, 32, (4), pp.613-624

Darren, R., Hale, P. E., Pramen, P., Shrestha, P. E., Edward, G., Jr, P. E. F. and Giovanni, C.Migliaccio, C. (2009) “Empirical Comparison of Design/Build and Design/Bid/Build Project" The Faculty of the Graduate School of The University of Texas at Austin Available at: www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA471763 (Accessed 5 :May(2013

Davis, P., Love, P. and Baccarini, D. (2008) “Building Procurement Methods”, *Research Project No: 2006-034-C-02*, *Procurement Method Tookit*, Cooperative Research Centre for Construction Innovation, Brisbane, Australia. Icon. Net Pty Ltd.

Davis, J. (1988) *Libyan Politics: Tribe and Revolution*, London, L. B. Tauris & Co Ltd.

Dawson, C. (2002), *Practical Research Methods.* New Delhi, UBS Publishers’ Distributors

De Vellis R. (2003) Scale development: theory and applications: theory and application. Thousand Okas, CA: Sage.

Den Hertog., Van der, A. W. and de Jong, M. W. (2010) "Capabilities for managing service innovation: towards a conceptual framework". *Journal of Service Management*, 21 (4), 490-514.

De Wit, A. (1988) “Measurement of project success”, *International Journal of Project Management*, 6, (3), pp. 164–170

Denzin and Lincoln, Y. S. (2007) *Strategies of Qualitative Inquiry.* Sage, 2007.

Dissanayaka S. M. and Kumaraswamy, M. (1999) “Evaluation of factors affecting time and cost performance in Hong Kong building projects”, *Engineering, Construction and Architectural Management*, 6, (3), pp.287 - 298

Doloi, H. (2013) “Empirical Analysis of Traditional Contracting and Relationship Agreements for Procuring Partners in Construction Projects” *J. Manage. Eng*, 29, (3), pp. 224–235

Easterby-Smith, M., Thorpe, R. and Lowe, A (1997) *Management Research: an Introduction*. 2nd edn. London, Sage.

Edmond, W. M., Albert, P. C., Daniel W. M. and Chan, M. (2008) “Determinants of Successful Design-Build Projects”, *Journal of Construction Engineering and Management*, 134, (5), pp. 333-341.

Education (2011) “Construction Contract and Delivery Method”, Available at: http://www. education.gov/ program/school approval/ccdm.htm (Accessed: 10 March 2011).

EL-Gayed, Y. (2013) “ Procurement Policy Development; The Case of Libya” . Available at: http// http://usir.salford.ac.uk/29205/1/phD_thesis.pdf (Accessed: 25-August-2015)

El-Hassia, A. (2005) *Libyan procurement police*. Unpublished PhD Thesis Salford University. UK.

El-Mahmudi, A. (1996) *The Islamic Cities in Libya: Planning and Architecture*. Peter Lang. Berlin

El-Mallalch, R. (1996) “The Economics of Rapid Growth” Middle East Journal, 1996: p.308.

EL-Wardani, M. A., Messner, J. I. and Horman, M. J. (2006) “Comparing procurement methods for design-build projects”, *Journal of Construction Engineering and Management*, 132, (3), pp. 230-238.

Engineeringtoolbox (2011) “ContractTypes” Available at http://www. Engineeringtoolbox. com (Accessed: 7 March 2011)

Enshassi, A, Mohamed, S and Abushaban, S. (2009) “Factors affecting the performance of construction projects in the Gaza strip”, *Journal of Civil Engineering and Management*, 15, (3), pp. 269–280.

Enshassi, A., Arain, F. and Al-Raee, S. (2010) “Causes of Variation Orders in Construction

Projects in the Gaza Strip", *Journal of Civil Engineering and Management,* 16, (4), pp. 540-541.

Eriksson, P.E and Westerberg, M. (2011) "Effects of cooperative procurement procedures on construction project performance: A conceptual framework", *International Journal of Project Management*, 29, (2), pp. 197–208.

Eriksson, P.E and Westerberg, M (2012) "Effects of procurement on construction project performance", Available at: Available at http://www. Engineeringtoolbox.com (Accessed: 7 March 2012)

Eriksson, P. E. (2008) "Achieving Suitable Coopetition in Buyer-Supplier Relationships: The Case of AstraZeneca", *Journal of Business to Business Marketing,* 15, (4)**,** pp. 425-454.

Fayad, M. (2000) *Government Expenditure and Growth in Libya*. Unpublished PhD thesis, Liverpool Business School, John Moores University,

Faniran, O. O., Oluwoye, J. O. and Lenard, D. (1994) "Effective Construction Planning", *Construction Management and Economics*, 12, (6), pp. 485-499.

Faridi, A.S. and El-Sayegh, S. M. (2006) "Significant factors causing delay in the UAE construction industry", *Construction Management and Economics,* 24, (11) pp. 1167-1176.

Financial Service and Treasury Bureau, (Fstb), (2011) "Tender Procedures for Government Procurement" Available at: www.fstb.gov.hk/tb/eng/procurement/espr-chapter3.pdf (Accessed 2 March 2011)

Fellows, R. and Liu, A. (2003), *Research Methods for Construction*. Blackwell Ltd, UK.

Field, A. (2005) *Discovering Statistics Using SPSS.* 2nd edn. SAGE Publications Ltd. Bath, UK.

Forsythe, P. (2007) "A Conceptual Framework for Studying Customer Satisfaction in Residential Construction", *Construction Management and Economics,* 25, (2), pp. 171-182.

Francom, T., Asmar, M., and Ariaratnam, S. (2014) "Using Alternative Project Delivery Methods to Enhance the Cost Performance of Trenchless Construction Projects", *Construction Research Congress* 2014: pp. 1219-1228

Frank, J. (1992) *Building Procurement Systems: A Guide to Building Project Management*. 2nd edn. Chartered Institute of Building, Ascot. UK.

Frey, J. H. and Fontana, A. (1991) "The group interview in social research" *Social Science Journal*, 28, (2), pp. 175–187, 2005.

Frimpong, Y., Oluwoye, J. and Crawford, L. (2003) "Causes of delay and cost overruns in the construction of ground water projects in developing countries; Ghana as a case study", *International Journal of Project Management*, 21, (5), pp. 321-326.

Furtrell, D. (1994) "The ten reasons why surveys fail", *Quality Progress*, 27, (4), pp. 65-69.

Gall, D. M., Walker, R. B. and Joyce, P. G. (1996) *Educational Research: an introduction*. 6th edn. White Plains, New York, Longman.

General People's Committee (1999) *Administrative Contracts Regulations*, General People's Committee, Libya

Gehrig, D. S. (2009) "Alternative Project Delivery Methods for Public Works Projects in California", available at: http://www.p2sl.berkeley.edu/.../Gehrig%202009%20/

Ghauri, P., Gronhaug-K and Krit. A, I (1995) *Research Methods In Business Studies*. Prints Hall, New York.

Gibson, G. E. and Walewski, J. (2001) "Project delivery methods and contracting approaches: Assessment and design-build implementation guidance" Research Rep. No. 2129-1, Available at: http://ftp.dot.state.tx.us (Accessed: 12 January 2012)

Gidado, K. I. (1996) “Project complexity: The focal point of construction production planning", *Journal of Construction Management and Economics*, 14, (3), pp. 213-225

Gidado, K. (2004) “Enhancing the prime contractor’s pre-construction planning”, *Journal of Construction Research,* 5, (1), pp. 87-106

Gill, J. and Johnson, P. (2002) *Research Methods for Managers*. 3rd edn. Paul Chapman, London.

Giurnaz A. (1985), *Economic of oil: A case of Libya*, Unpublished PhD Thesis, University of Keele.

Glenn, B (2009), Document analysis as a qualitative research method. *Qualitative Research Journal*, 9 (2), 27-40.

Gordon C. M. (1994) "Choosing appropriate construction contracting method", *Journal of Construction Engineering and Managemen, ASCE*, 120,(1), pp.196–210.

Gould, F. R. (2005) *Managing the construction process*, 3rd edn ., Prentice-Hall, Upper Saddle River, N. J.

Government of Libya (2004) decision No. (8) of the year 2004, regarding administrative contract regulation. Government Printers, Tripoli, Libya.

Government of Libya (1985) Law No. (9) of the year 1985 concerning formation of small and medium firms. Tripoli, Libya.

Government of Libya (1992) Law No. (9) of the year 1992, concerning the organization of economic activities and formation of partnership firms Tripoli, Libya.

Gransberg, D. D. and Shane, J. S. (2010) “Construction manager-at risk project delivery for highway programs—a synthesis of highway practice”, NCHRP Synthesis 402, National Cooperative Highway Research Program (NCHRP), Washington, DC.

Grifa, M. A. (2006) *The Construction Industry in Libya, with Particular Reference to Operations in Tripoli*, Doctor of Philosophy, Newcastle University. School of Architecture Planning and Landscape.

Grifflths, F. (1989)" Project contract strategy for 1992 and beyond ", *International Journal of Project Management*, 7, (2), pp.69-83

Griffith, A. and Headly, J. D. (1997) “Using a weighted score model as an aid to selecting procurement methods for small building works”, *Construction Management and Economics*, 15 (4), pp. 182-192.

Gudiene, N., Banaitis, A. and Banaitiene, N. (2013), ‘Evaluation of critical success factors for construction projects – an empirical study in Lithuania’, *International Journal of Strategic Property Management*, 17, (1), pp 21-31

Hair, J. F., Anderson, R. E. and Tatham, R. L. (1995) *Multivariate Data Analysis with Readings.* 2nd edn.

Hair, J. F., Anderson, R. E. and Tatham, R. L. and Black, W. (2006) *Multivariate Data Analysis with Readings.* 6th edn. NJ: Prentice-Hall, Upper Saddle River

Halaris, C., Kerridge, S., Bafoutsou. G. and Kerridge, S. (2003) “An Integrated System Supporting Virtual Consortia in the Construction Sector”, *Journal of Organizational Computing and Electronic Commerc*e, 13, (3) pp. 243-265.

Halpin, D. and Riggs, L. (1992) *Planning and Analysis of Construction Operations*. Chichester, Wiley.

Hall, B. and Howard, K. (2008). A Synergistic Approach: Conducting Mixed Methods Research With Typological and Systemic Design Considerations. *Journal of Mixed Methods Research*, 2, (3),pp. 248-269.

Hale, D., Shrestha, P., Gibson, G., Jr., and Migliaccio, G. (2009). ”Empirical Comparison of Design/Build and Design/Bid/Build Project Delivery Methods.” *Journal of Constraction Engineering and Management,* 135, (7), 579–587.

Hanna, A. S., Russell, J. S., Nordheim, E. V., and Bruggink, M. J. (1999) “Impact of change orders on labor efficiency for electrical construction”, *Journal of Construction Engineering andManagement,* 125(4), pp 224–232.

Hanson, D., Mbachu, J., Nkando, R. (2003) “Causes of client dissatisfaction in the South African building industry and ways of improvement: the contractors' perspectives”, in CIDB, South Africa.

Hassouna, R (2008) Viability of applying the public private partnership (PPP) strategy to the Libyan construction industry. In: Khosrowshahi, F (Ed.), *Proceedings 21st Annual ARCOM Conference,* 7-9 September 2008, London, UK. Association of Researchers in Construction Management, Vol. 2, pp. 1185–1194

Hartley, J. and Chesworth, K. (2000) “Qualitative and Quantitative Methods in Research on Essay Writing: No One Way”, *Journal of Further and Higher Education,* 24, (1), pp.15-25

Hashim, M., Yuet Li, M. C., Yin, N. C., Hooi, N. S., Heng, S. M. and Young, T. L. (2006) "Factors Influencing the Selection of Procurement Systems by Clients", *International Conference on Construction Indust*ry, 21st June – 25th June 2006, Padang, Indonesia, pp. 1-10.

Hashim, M. (1999) *The effects of procurement methods on performance of construction projects in Malaysia*. PhD thesis, Universitiy of Teknologi. Malaysia.

Hatush, Z., Skitmore and Martin R. (1997) Criteria for contractor selection. *Construction Management and Economics* 15 (1): pp. 19-38.

HIB, (2010) “The Annual monitoring and follow-up report of Libyan construction projects”, Organization of Implementation Housing and Utilities Projects, Management of follow-up and information, Tripoli, Libya pp. 30-45.

Hibberd, P. and Djebarni, R. (1998) "Criteria of choice for procurement methods", Available at: http://www.rics.org/site/scripts/download_info.aspx?fileID=2330& categoryID=450, (Accessed: 22 August 2010)

Hinzie, J. (1993) *Construction contracts,* McGraw-Hill, New York.

Holt, G. D. (1998) "which contractor selection methodology?” *International Journal of Project Management,* 16, (3), pp. 153-164.

Hogg, R.V., and Tanis, E. A. (2009) *Probability and Statistical Inference,* 8th edn, Prentice Hall, SOCR: Statistics Online Computational Resource tools, http://www.socr.ucla. edu/

Hosie, J. (2007) “Turnkey contracting under the FIDIC Silver Book: What do owners want? What do they get? Available at: http://www.mayerbrown.com/publications/ TurnKey-contracting-under-the-FIDIC-silver-BookWhat-do-owners-want-what-do-they-get-11-30-2007/(Accessed 5 May 2013).

Hussey, J and Hussey, R (1997), *Business Research: A practical guide for undergraduate and postgraduate students*. London: Palgrave.

Ibbs, W. (1997) “Quantitative Impacts of Project Changes”, *Journal of Construction Engineering and Management,* 123, (3), pp. 308–311.

Ibbs, C. W., Wong, C. K. and Kwak, Y. H. (2001) “Project change management system”, *Journal of Management in Engineering, ASCE*, 17, (3), pp. 159-165.

Ibbs, W. C., Kwak. Y. H., Ng. T. and Odabasi. M. A. (2003) “Project Delivery Systems and Project Change: Quantitative Analysis”, *Journal of Construction Engineering and Management,* 129, (4), pp. 382-387.

Irani, Z., Gunasekaran, A. and Peter, E. D. L. (2006) "Quantitative and qualitative approaches to information systems evaluation," *Eur. J. Oper. Res,* 173, (3), pp. 951-956.

Iyer, K. C. and Jha, K. N (2005) “Factors affecting cost performance: evidence from Indian construction projects”, *International Journal of Project Management*, 23, (4), pp. 283–295

Jin, X., Doloi, H. and Gao, S. (2007) “Relationship-based determinants of building project performance in China”, *Construction Management and Economics*, 25, (3), pp. 297–304.

Jing-min, N., Lechler, T. and Jun-long, J. (2010) “Success Criteria Framework for Real Estate Project”, *Management science and Engineering,* 4, (3), pp. 10-23.

Jin Lin, S., Ali, A., and Alias, A. (2015) “Analytic Hierarchy Process Decision-Making Framework for Procurement Strategy Selection in Building Maintenance Work”, *J. Perform. Constr. Facil*, 29, (2), pp, 0401- 4050

Josephson, P and Hammarlund, Y (1999) “The causes and costs of defects in construction A study of seven building projects”, *Automation in Construction*, 8, (6), 681-7.

Kabasakal, H. E., Sozen, Z. and Usdiken, B. (1989) "Organisational context, structural attributes and management systems in construction firms", *Journal of Construction Management and Economics*, 7, (4), pp. 347-356.

Kamala, A. M and Hindle, B. (2000) " Forces of Change and their Impact on Building Procurement Systems in use in Tanzania" *2nd International Conference on Construction in Developing Countries*, Rotterdam, (Netherlands), available at: http://www.irb.fraunhofer.de/bauforschung/baufolit.jsp?s=building+procurement+syste

Kasperson, R E., Renn, O., Slovic, P, Brown, H S., Emel, J., Goble, R and Ratick, S. (1988), “The social amplification of risk: a conceptual framework”, *Risk Analysis*, 8, (2), 177-187.

Kate, M. (2010) "Contract Types: An Overview of the Legal Requirements and Issues" *CRS Report for Congress.*

Kish, L. (1965) *Survey Sampling*. New York: Wiley

Koelmans, R. G. (2004) “Project success and performance evaluation", *International Platinum Conference ‘Platinum Adding Value’,* The South African Institute of Mining and Metallurgy, 2004, pp. 229–236.

Kometa, S. T., Olomolaiye, P. O. and Frank , C. H. (1995) “An evaluation of client’s needs and responsibilities in the construction process”, *Engineeing, Construction and Architectural Management,* 2, (1), pp. 57-76

Konchar, M., and Sanvido, V. (1998) “Comparison of U.S. project delivery system", *Jornal of Construction Engineering and Management"*, 124, (6), pp 435 – 444.

Kothari, C. R. (1985) *Research Methodology- Methods and Techniques.* Wiley Eastern Limited, New Delhi.

Krima, N. (2005) *Assessing the effectiveness of Libyan supervisors in dealing with construction delays* , PhD thesis, Salford .UK.

Krima, N., Wood, G., Aouad, G. and Hatush, Z. (2007) “Assessing the performance of libyan supervising engineers”, *Construction Management and Economics,* (25) pp. 509–518. .

Kumar, R. (2005) *Research Methodology-A Step-by-Step Guide for Beginners*. 2nd edn. Pearson Education, Singapore.

Kumaraswamy, M. M. and Dissanayaka, S. M. (1998) “Linking procurement systems to project priorities”, *Building Research and Information*, 26, (4) pp. 223–238.

Labovitz, S. (1975) “Comment on the Henkel's paper: the interplay between measurement and statistics”. Pacific Sociological Review, 18, 27-35

Lai, I. K. W. and Lam, F. K. S. (2010) “Perception of various performance criteria by stakeholders in the construction sector in Hong Kong” *Construction Management and Economics*, 28, (4), pp. 377–391.

Lam, K., Hu, T., NG, T., Skitmore, M. and Cheung, S. O. (2001) "A Fuzzy Neural Network Approach for Contractor Prequalification", *Construction Management and Economics*, 19 (2)**,** 175-188.

Laryea, S. (2011) "Quality of tender documents: case studies from the UK", *Construction Management and Economics*, 29, (3), 275-286.

Laufer, A. (1992) "A micro view of the project planning process", *Journal of Construction Management and Economics*, 10, (1), pp. 31-43.

Laufer, A., Tucker R. L., Shapira, A., Shenhar, A. J. (1994) “The multiplicity concept in construction project planning”, *Journal of Construction Management and Economics*, 12, (1), pp. 53-65.

Lawrence, N. W. (1997). Social research methods: Qualitative and quantitative approaches, 3rd ed. Allyn and Bacon, MA

Ledbetter, W. B. (1994) "Quality performance on successful project", *Journal of Construction Engineering and Management*, 120, (1), pp. 34–46.

Lee, S. H. (2006) *The prerequisites for developing turn-key system*, Construction & Economy Research Institute of Korea, Seoul, Korea.

Lee, H. S. (2007) “Analysing characteristics of design-build delivery system in Korea using system dynamics modelling” *Korea Institute of Construction Engineering and Management*, 8, (5), pp.119–132.

Libyan Public Committee of Monitoring and Follow-up (LPCOMF), (2009) “The report on executive status of construction projects", Contract Management, Tripoli, pp.15-40

Lim, C. and Mohamed, M. Z. (1999) “Criteria of project success: an exploratory re-examination”, *International Journal of Project Management*, 17, (4), pp. 243–248

Lim, E. H. and Ling, F. Y. Y. (2002) “Model for predicting clients’ contribution to project success”, *Engineering, Construction and Architectural Managemen*t, 9, (5/6), pp. 388-395.

Liv (Liverpol university) (2011) "*Unit 3: Review of traditional construction models and a comparison of product development processes with other industries".* Available at: http://www.liv.ac.uk/~halim/Section one unit 3.pdf (Accessed: 1 January 2011).

Ling, F., Chan, S., Chong, E., and Ee, L. (2004). “Predicting Performance of Design-Build and Design-Bid-Build Projects.” *J. Constr. Eng. Manage.*, 130, (1), 75–83.

Ling, F. Y. Y. (2004) “Key determinants of performance of design-bid-build projects in Singapore”, *Building Research and Information*, 32, (2), pp. 128–139.

Ling, F. Y. Y., Low, S. P., Wang, S. Q. and Lim, H. H. (2009) "Key project management practices affecting Singaporean firms project performance in China". *International Journal of Project Management*, 27, (1), 59–71.

Loosemore, M., Hall, K. and Dainty, A. (1996) Innovation and courage in Construction Management research, *Proceedings of the 12th Annual Conference of ARCOM*, pp 418-427

Lo, S-C and Chao, Y. (2007) “Efficiency Assessment of Road Project Delivery Models,” *AIP Conference Proceedings*, vol. 963, Aip, pp. 1016–1019, available at: http://www.aip.org/link/APCPCS/v963/i2/p1016/s1&Agg=doi>.

Long, D. N., Stephen O. O. and Do, T. X. L. (2004) “A Study on ProjectSuccess Factors in Large Construction Projects in Vietnam”, *Engineering, Construction and Architectural Management*, 11, (6), pp. 404 – 406

Love, P., Mistry, D., and Davis, P. (2010) "Price Competitive Alliance Projects: Identification of Success Factors for Public Clients", *Journal of Construction Engineering Management*, 136, (9), 947–956.

Love, P.E.D., Skitmore, M. and Earl, G. (1998) "Selecting a suitable procurement method for a building project", *Construction Management and Economics*, 16, (2), pp. 221-233.

Love (2002) "Influence of Project Type and Procurement Method on Rework Costs in Building Construction Projects", *Journal of Construction Engineering and Management*, 128, (1), pp. 18-29.

Love, P., Davis, P., Baccarini, D., Wilson, G. and Lopez, R. (2008) "Procurement selection in the public sector: A tale of two states. In: Clients Driving Innovation", *Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation* , Gold Coast, Australia ", pp. 1-11.

Love, P., Edwards, D., Irani, Z., and Sharif, A. (2012). "Participatory Action Research Approach to Public Sector Procurement Selection." *J. Constr. Eng. Manage*, 138, (3), pp, 311–322

Luu, D. T., Thomas Ng, S. and Chen, S. E. (2003) "A case-based procurement advisory system for construction", *Advances in Engineering Software*, 34, (7), pp. 429-438.

Luu, D. T., Thomas Ng, S. and Chen, S. E. (2005) "Formulating procurement selection criteria through case-based reasoning approach", *Journal of Computing in Civil Engineering*, 19, (3), pp. 269-276.

Macal, C. M. (2005) "Model Verification and Validation", *Workshop on "Threat Anticipation: Social Science Methods and Models*, the University of Chicago and Argonne National Laboratory. Availableat:Available at: http://jtac.uchicago.edu/conferences/05/resources/V&V_macal_pres.pdf, (Accessed: 12 December 2012).

Mahdi, I. M. and Alreshaid, K. (2005) "Decision support system for selecting the proper project delivery method using analytical hierarchy process (AHP)", *International Journal of Project Management*, 23, (7), 564–572

Mahon, C. (2011) "Key procurement selection criteria of Auckland interior fitout clients: An empirical study" *A Report for Industry Project CONS 7819*, Available at: http:// unitec.researchbank.ac.nz (Accessed 2 July 2013)

Maloney, W. (2002) "Construction Product/Service and Customer Satisfaction", *Journal of Construction Engineering and Management*, 128, (6)**,** pp. 522-529.

Mante, J., Ndekugri, I., Ankrah, N. and Hammond, F. (2012) "The influence of procurement methods on dispute resolution mechanism choice in construction", *28th Annual ARCOM Conference*, 3rd - 5th *September 2012*, Edinburgh, UK, Association of Researchers in Construction Management, pp 979-988.

Manavazhi, M. R. and Adhikari, D. K. (2002) "Material and equipment procurement delays in highway projects in Nepal", *International Journal of Project Management*, 20, (8), pp. 627–632.

Mansfield, N. K., Ugwu, O. O. and Doran, T. (1994) "Causes of Delay and Cost Overruns in Nigerian Construction Projects", *Journal of Project Management*, 12, (4), pp. 254-260.

Maricopa (2011) "A Primer on Construction Delivery Methods"Available at:http://www.gc .maricopa.edu/adminsvcs/oct_05/insert.pdf (accessed: 5-April 2011).

Masterman, J. W. E. (2002) *Introduction to Building Procurement Systems*. 2nd edn. E & FN Spon, London,

Masterman, J. W. E. and Gameson, R. N. (2010) "Client characteristics and needs in relation to their selection of building procurement system", *Hong Kong University*

(HKU), available at: http://www.irbnet.de/daten/iconda/CIB12576.pdf, (accessed: 3 June 2012).

Masurier, J. L., Wilkinson, S. and Shestakova, Y. (2006) "An analysis of the alliancing procurement method for reconstruction following an earthquake", *Proceedings of the 8th U.S. National Conference on Earthquake Engineering, pp. 1.*

Maxwell, J. A. and Kaplan, B. (1994) "Qualitative Research Methods for Evaluating Computer Information Systems", Evaluating Health Care Information Systems: Methods and Applications. pp. 45–68

Memon, A. H., Abdul Rahman, I., Abdullah, M. R., Abdu Azis, A. A. and Rakyat, M. A. (2010) " Factors Affecting Construction Cost Performance in Project Management Projects Case of MARA Large Projects", *International Journal of Sustainable Construction Engineering and Technology*, 2, (2), pp.4-45.

Mezher, T. and Tawil, W. (1998) "Causes of delays in the construction industry in Lebanon", *Engineering Construction and Architectural Management*, 5, (3), pp. 352-260.

Migliaccio, G., Gibson, G., and O'Connor, J. (2009) "Procurement of Design-Build Services: Two-Phase Selection for Highway Projects", *J. Manage. Eng*, 25, (1), pp. 29–39

Migliaccio, G., Gibson, Jr., G., and O'Connor, J. (2006) Design-Build Procurement Process Model for Delivering Highways in Texas. Computing in Civil Engineering (2006): pp. 1-8

Min, J. N., Lechler, T. G. and Long, j. j. (2010) "Success Criteria Framework for Real Estate Project", *Management Science and Engineerin*g, 4, (3), pp. 10-23.

Minchin, R., Jr., Li, X., Issa, R., and Vargas, G. (2013). "Comparison of Cost and Time Performance of Design-Build and Design-Bid-Build Delivery Systems in Florida." *J. Constr. Eng. Manage.*, 139(10), 04013007Ministry of Housing, (1985) Laws and Legislations Concerning the Responsibility of the Ministry of Housing. Volume One. Tripoli, Al-Tuna Al-Arrabia Establishment for Publishing and Distribution.

Mohsini, R. and Davidson, C. H. (1991)"Building procurement-key to improved performance", *Building Research and Information*, 19, (2), pp. 106-113.

Mohsini, R. A., Sirpal, R. and Davidsonb, C. H. (1995) "A comparative analysis of construction management and traditional building processes", *Building Research and Information*, 25, (3), pp. 285-290.

Molenaar, K. R. and Songer, A.D. (1998) "Model for public sector design–build project selection", *Journal of Construction Engineering and Management*, 124, (6), 467–79.

Molenaar, K., Sobin, N., Gransberg, D., Tamera McCuen, T. L., Sinem. K. S. and Horman, M. (2009) "Sustainable, High Performance Projects and Project Delivery Methods", The Charles Pankow Foundation and The Design-Build Institute of America.

Molenaar, K. R., Songer, A. D. and Mouji, B. (1999) "Public-sector design/build evolution and performance", *Journal of Management in Engineering* 15, (2), pp.54–62.

Molenaar, K. and Songer, A. (1998). "Model for Public Sector Design-Build Project Selection." *J. Constr. Eng. Manage.*, 124(6), 467–479.

Moore, D., McCabe, G., Duckworth, W., and Sclove, S. (2003) *The Practice of business statistics*. Freeman, New York.

Morledge, R., Smith, A. and Kashiwagi, D. T. (2006) *Building Procurement*. London: Blackwell publishing ltd

Moser, C. A. and Kaltron, G. (1986) *Survey Methods in Social Investigation*. 2nd edn. Gower. Aldershot

Munns, A. K. and Bjeirmi, B. F. (1996) "The role of project management in achieving project success", *International Journal of Project Management*, 14, (2), pp. 81-87.

Murdoch, J. and Hugh, W. (2008) *Construction Contracts Law and Management.* 4th edn. Publisher: Taylor and Francis, Simultaneously published in the USA and Canada

Myers, M. D. and Klein, H. K. (1999) "A set of principles for conducting and evaluating interpretive field studies in information systems", *MIS Quarterly*, 23, (1), pp. 67–93

Nachmias, C. and Nachmias, D (1996) *Research Methods in the Social Sciences* Frankfort: Hodder Arnold.

Naoum, S., Fong, D. and Walker, G. (2004) "Critical success factors of project management", *Proceedings of International Symposium on Globalisation and Construction: "Meeting the Challenges, Reaping the Benefits". 17th -19th November 2004*, Asian Institute of Technology Conference Centre, Bangkok, Thailand.

Naoum, S. and Egbu, C. (2015) "Critical review of procurement method research in construction journals", *Procedia Economics and Finance*, 21, (1), pp. 6-13

Naoum, S.G. (1991) "Procurement and project performance: A comparison of management and traditional contracting". *CIOB, Occasional Paper No. 45.*

National Economic Development Office (NEDO) (1986) Faster Building for Commerce, London.

Natkin, K. H. (1994) "Legal aspect of design/build", *AIAA J*, 83, (9), pp. 125–127.

Ndekugri, I and Turner, A. (1994) "Building procurement of design and build approach", *Journal of Construction Engineering and Mana*, 120, (2), pp. 70–80.

Neale, R. H. and Neale, D. E. (1989) *Construction planning*. Thomas Telford, London

Ness, K. (2012) "Conflict in construction: constructive conflict" avilable at Available at: http://www.academia.edu/246338/Conflict_in_construction_constructive_conflict_, (Acssesed 6 April 2013)

Ng, S. T. and Skitmore, R. M. (1999) "Client and Consultant Perspectives of Prequalification Criteria", *Building and Environment*, 34, (5), pp. 607-621

Ngab, A. S. (2011) "Libya-The construction industry – an overview", Avialable at Available at: http://enpub.fulton.asu.edu/cement/cbm_CI/CBMI_Separate_Articles/ Article%2021.pdf, (Accessed: 30 August 2011)

Nikou Goftar, V., El Asmar, M., and Bingham, E. (2014) "A Meta-analysis of Literature Comparing Project Performance between Design-Build (DB) and Design-Bid-Build (DBB) Delivery Systems", *Construction Research Congress* 2014: pp. 1389-1398

Nogowi, A. (1998) "Is construction procurement a key to sustainable development?" *Building Research and Information*, 26, (6), pp. 340-350.

Ochieng. C. O. and Bruno D. Zumbo (2001) "Examination of a variable ordering index in linear regression models: An assessment of the relative Pratt index in Likert data", available at: http://educ.ubc.ca/faculty/zumbo/ins2001/pratt.pdf (accessed: 25 September 2012)

Organization of Development administrative buildings (ODAC), (2010) "The Annual monitoring and follow-up report of Libyan construction projects", Organization of Developments Administrative Buildings, Management of Follow-up and Information, Tripoli, Libya pp, 30-45.

Odeh, A. M. and Battaineh, H. T. (2002) "Causes of construction delay: Traditional contracts", *International Journal of Project Management* 20, (1), pp. 67-73.

OGC, B. P. (2011) "Common Causes of Project Failure", Available at http:// www.swan.ac.uk/media/cp0015.pdf (Accessed: 5 October 2011).

Ogunsemi, D. R. and Aje, I. O. (2006) "A Model for Contractors' Selection in Nigeria", *Journal of Financial Management of Property and Construction*, 11, (1), pp. 33-43.

Ojo, S.O., Adeyemi, A.Y. and Fagbenle, O. I. (2006) “The performance of traditional contract procurement on housing projects in Nigeria”, *Civil Engineering Dimension,* 8, (2), p. 81-86.

Ola, Lædre., Tore I. H. and Ole J. K. (2006) "Procurement Routes in Public Building and Construction Projects", *Journal of Construction Engineering and Management*, 132, (7), p. 689–696.

Oladapo, A. A., (2007) “A quantitative assessment of the cost and time impact of variation orders on construction projects", *Journal of Engineering, Design and Technology*, 5, (1), pp.35 – 48.

Olupolola, F. O., Emmanuel, O. O., Adeniyi, M. B. and Kamaldeen, A. A. (2010) “ Factors affecting the time performance of building project”, *The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors Held at Dauphine University, Paris, 2nd -3rd September 2010*

Omran, A., Alnor, M. A. Gebril, A. O. (2012) “An Evaluation of the Critical Success Factors for Construction Projects in Libya”, *Journal of Economic Behaviou, vol 2, 2012*

Oppenheim, A. N. (1992) *Questionnaire Design, Interviewing and Attitude Measurement*, Pinter, London.

Oyedele, O., Jaiyeoba, E. B., Fadeyi, M. (2003) “Design Factors influencing Quality of Building Projects in Nigeria: Consultants' Perception”, *The Australian Journal of Construction Economics and Building*, 3, (2), pp. 25-32

Owuor. C. O. (2001) “implication of using Likert data in multiple regressions”, Available at:https://circle.ubc.ca/bitstream/handle/2429/13778/ubc_2001-715140.pdf?sequence=1 (Accessed: 20 June 2012)

Palaneeswaran, E. and Kumaraswamy, M. M. (2000) “Contractor Selection for Design and Build projects”, *Journal of, Construction Engineering and Management,* 126, (5), pp. 331-339.

Pallant, J. (2010) *A step by step guide to data analysis using the SPSS program*. 4th edn. UK.

Panas, A. and Pantouvakis, J. P (2010) Evaluating Research Methodology in Construction Productivity Studies, *The Built & Human Environment Review*, 3, (1), pp 63-85

Park, M., Ji, S., Lee, H. and Kim, W. (2009) “Strategies for Design-Build in Korea Using System Dynamics Modeling”, *Journal of Construction Engineering and Management,* 135, (11), pp. 1125–1137.

Patton, M. Q. (1990), *Qualitative Evaluation and Research Techniques*. 2nd edn . Sage, Newbury Park, California.

Perkins, R. A. (2009) "Sources of Changes in Design-Build Contracts for a Governmental Owner", *Journal of Construction Engineering and Management*, 135, (7), pp. 588-593.

Pheng, L. S and Chuan, Q. T. (2006) "Environmental factors and work performance of project managers in the construction", *International Journal of Project Management,* 24, (1), pp.24-37

Pinto J. K. and Slevin D. P. (1998) “Critical Success factors Across the Project Lift Cycle”, Project Management Journal 19, (3), pp. 67-75

Pishdad-Bozorgi, P. and de la Garza, J. (2012) “Comparative Analysis of Design-Bid-Build and Design-Build from the Standpoint of Claims”, Construction Research Congress 2012: pp. 21-30

Polat, G., Okay, F. and Eray, E. (2014) "Factors Affecting Cost Overruns in Micro-scaled Construction Companies" Selected papers from Creative Construction Conference, Volumes 85, pp. 428-435

Poon, J., Potts, K. and Cooper, P. (2000) "Practitioners' opinions on a new construction process model" In: *Construction and Building Research (COBRA) Conference*, University of *Greenwich, Greenwich, 30 August - 1 September 2000*. pp. 368-378.

Popic, Z. and Moselhi, O. (2014) "Project Delivery Systems Selection for Capital Projects Using the Analytical Hierarchy Process and the Analytical Network Process", *Construction Research Congress* 2014: pp. 1339-1348

Pramen, P., Shrestha, P. E., James, T. O., Connor, P.E., Edward, G. and Gibson Jr, P. E. F (2012) "Performance Comparison of Large Design-Build and Design-Bid-Build Highway Projects", *Journal of Construction Engineering and Management,* 138 (1), pp. 1-13.

Public Project Authority (PPA), (2010) "Report on the implementation of buildings and infrastructures projects", Public Project Authorities, Management of Follow-up and Information, Tripoli.

Puspasari, T. R. (2005) *Factors causing the poor performance of construction project,* Masters thesis, Universiti Technologi Malaysia, Faculty of Civil Engineering, Available at: http://eprints.utm.my/3723/ (Accessed: 3 July 2012).

Rahman, M. and Kumaraswamy, M. (2004) "Potential for Implementing Relational Contracting and Joint Risk Management", *Journal of Management in Engineering*, 20, (4), pp.178- 189.

Ralph, A. O and Iyagba, R. (2012) "Factors Affecting Contractor Performance: A Comparative Study of Non Value-Adding Activities in Nigeria and Indonesia", *Journal of Emerging Trends in Economics and Management Sciences*, 3, (5), pp. 467-474

Ratnasabapathy, S. Rameezdeen, R. and Gamage, I. (2006), "macro level factors affecting the construction procurement selection: A multi criteria model," *The Joint International Conference on Construction, Culture, Innovation and Management (CCIM)*, 26th -29th Nov 2006 Dubai, UAE pp. 581–591.

Rdsu (2012) "Qualitative research methods", available at: http://www.projects.exeter.ac.uk/Rdsu (Accesssed: 14 July-2012)

Rea L. M. and Parker, P. A. (1997) *Designing and Conducting Survey Research*. 2nd edn. San Francisco, Cal.: Jossey-Bass Publishers.

Richarad, F. and Anite, L. (2008) *Research Methods for Construction.* 3rd edn. Wiley-Blackwell

Riecke Smith, V., Castro-Lacouture, D., and Oberle, R. (2009) "Effects of the Regulatory Environment on Construction Project Delivery Method Selection", *Construction Research Congress* 2009: pp. 211-218

Robson, C. (2002) *Real World Research: A Research For Social Scientists and Practitioner- Researchers*. 2nd edn. Blackwell, Oxford

Robson, W. (1997) *Strategic management and information systems*: *An integrated approach*. 2nd edn. Anonymous England: Financial Times Professional Limited

Rodriguez, J. (2011) *Construction Contract Ty*pe, available at:http://www.About.com/ (accessed: 5 March 2011).

Roer-Strier, D. and Kurman, J. (2009) "Combining Qualitative and Quantitative Methods to Study Perceptions of Immigrant Youth", *Journal of Cross-Cultural Psychology*, 40, (6), p. 988-995.

Root, D. and Hancock, M. (1996) "Familiarity and procurement preference: Putting the brake on the adoption of new procurement methods" *Economic Management of*

Innovation: Productivity and Qualityin Construction, Proc., of CIB W55, Civil Engineering Institute of Croatia, Zagreb, Croatia, pp. 523–534.

Rosmayati, M., Abdul Razak, H., Zulaiha, A. and Noor, M. M. N. (2010) "Decision Support Systems (DSS) in Construction Tendering Processes", *International Journal of Computer Science,* 7, (2), pp. 35-45.

Rossman, G. B. and Rallis, S. F. (1998) *Learning in the field: An Introduction to Qualitative Research*. 3rd edn, Sage, Thousand Oaks, CA.

Rowley, J (2012) Conducting research interviews. *Management Research Review,* 35, (3/4), pp. 260-271.

Rowlinson, S and McDermott, P (1999), *Procurement Systems: A Guide to Best Practicein in Construction*.1st edn. Eand F. N Spon, London, UK

Rubin, H J & Rubin, I S (2011), *Qualitative Interviewing: The art of hearing data.* Thousand Oaks, Cal.: Sage Publications.

Rwelamila, P. D. (2011) "Selection of procurement systems: Why have we failed the test?" Dept. of Construction Economics and Management, Univ. of Cape Town, Cape Town, South Africa, available at: http//www.ing.puc.cl/~icccon/abstracts/ PDF/ Track5/T5-P12.pdf/ (Accessed: 15 March 2011).

Rwelamila, P. and Edries, R. (2007) "Project Procurement Competence and Knowledge Base of Civil Engineering Consultants: An Empirical Study", *Journal of, Management in Engineering,* 3, (4), pp. 182-192.

Sambasivan, M and Soon, Y. W. (2006) 'Causes and effects of delays in Malaysian construction industry', *International Journal of Project Management,* 25, (2007) 517–526

Sapsford and Jupp. (2006) *Data collection and analysis.* 2nd edn.

Sargent, R. G. (1998) "Verification and Validation of Simulation Models". *proceeding of the 30th Winter Simulation Conference, USA.*

Saunders, M., Lewis, P. and Thornhill, A. (2007) *Research methods for business students*. 3rd edition, Pearson Education Limited, Essex

Sekeran, U. (2000) *Research Methods For Business: A skillBuilding Approach.* 3rd edn. John Wiley and Sons, Inc, USA.

Seng, N. W. and Yusof, A. M. (2006) "The success factors of design and build procurement method: a literature visit", *Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference*, pp. 1-11.

Sexton, M. (2003). A supple approach to exposing and challenging assumptions and 292 path dependencies in research, International Postgraduate Research Conference Available at: http://www. researchs.cpm.salford.ac.uk/bf2003/sextonkeynote.Pdf Last. (Accessed on 25 August 2015

Shapiro, B., Hankinson, S. and Knutson (2013) "Design/Build and Turnkey contracts – pros and cons)", Available at: http://www.shk.ca/docs/Design_Build Turnkey Contracts Prosand Cons.pdf (Accessed: 21 March 2012)

Shamas, R. T. And Stephen, O. O. (2010) "Beyond the 'iron triangle': Stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects", *International Journal of Project Management,* 28, (3), pp. 228-236

Shen, L.Y., Tam, V., (2002) "Implementation of environmental managementin the Hong Kong construction industry", *International Journal of Project Management*, 20, (7), pp. 535–543.

Shrestha, P., O'Connor, J., and Gibson, G., Jr. (2012), "Performance Comparison of Large Design-Build and Design-Bid-Build Highway Projects." *J. Constr. Eng. Manage.*, 138(1), 1–13

Siva, J. and London, K. (2012), "Client Decision-Making to Support Innovations on Megaprojects", *AEC International Conference*, Available at: http://innovationinaec 2012.pcc.usp.br/proceedings/- (accessed, March 2013)

Sincich, T., Levine, D. M., and Stephan, D. (2002) *Practical statistics by example using Microsoft Excil and Minitab*, 2nd edn., Prentice Hall, Upper Saddle River, NJ

Singh, D. and Tiong, R. L. K., (2006) "Contractor selection criteria: investigation of opinions of Singapore construction practitioners", *Journal of Construction Engineering & Management*, 132, (9), pp. 998–1008.

Skitmore, R. M. and Marsden, D. E. (1988) "Which procurement system? Towards a universal procurement selection technique", *Construction Management and Economics*, 6, (1), pp 71–89.

Smith, R. C (1986) *Estimating and tendering for building work*. Longman: London.

Smith, E M (2005), Telephone interviewing in healthcare research: a summary of the evidence. *Nurse Researcher*, 12, (3), pp. 32-41.

Soetanto, R., Proverbs, D. G. and Holt, G. D. (2001) "Achieving quality construction projects based on harmonious working relationships: clients' and architects' perceptions of contractor performance", *International Journal of Quality and Reliability Management*, 18, (4/5), pp. 528-48.

Songer A. D. and Molenaar K.R. (1997) "Project Characteristics for Successful Public-Sector Design – Build", *Journal of Construction Engineering and Managemen*t ASCE, 123, (1), pp. 34-40

Songer, A., Molenaar, K. R. and Robinson, G. (2011) "Selection Factors and Success Criteria for Design- Build in the U.S and UK" Avialable at: Available at: http:// www.colorado.edu/engineering/civil/db/papers/usuk/ (Accessed:15 March 2011).

Spratt, C., Walker, R. and Robinson, B. (2004) "Mixed research methods", Available at: http://www.col.org/SiteCollectionDocuments/A5.pdf (Accessed 2 may 2012).

Squires, W. R. and Murphy, M. J. (1983) "The impact of fast-track construction management on subcontractor", *law and contemporary problemes*, 46, (1), pp. 55-67.

Sultan, S. S. (2013) *Power Quality Programme Awareness: Framework for Develo*ping Countries, Doctor of Philosophy, Brunel University. School of Engineering and Design, available at: http://bura.brunel.ac.uk/handle/2438/7452

Sundar, S. B. (2012) "Efficient procurement management in UK construction projects", *International Journal of Marketing and Technology*, 2, (4), pp. 230-238.

Sunders, M., Lewis, P. and Thornhill, A. (2009) *Research methods for business student*. 5nd edn.

Tabachnick, B. G. and Fidell, L, S. (2006) *Using Multivariate Statistics* 5th edn

Takim, R.and Akintoye, A. (2002) "Performance indicators for successful construction project performance" 19th Annual ARCOM Conference, September 2013, London pp. 2–4. Avilable at: Available at: http//www.arcom.ac.uk/-docs/.../ar2002-545-555_Takim_and_Akintoye.pdf

Takim, R., Akintoye, A. and Kelly, J. (2003) "Performance measurement system in Construction", *19th Annual ARCOM Conference, September 2013*, *London* pp. 3-5. Avilableat:Available at: http//*www.arcom.ac.uk/-.../ar2003-432_Takim_Akintoye_ and_Kelly.pdf*,

Tang, W., Duffield, C. F. and Young, D. M. (2006) "Partnering Mechanism in Construction: An empirical Study on the Chinese construction Industry", *Journal of Construction Engineering and Management*, 132, (3), pp. 217-229.

Tanur, J. M. (1982) "*Advances in methods for large-scale surveys and experiments: behavioral and social science research: A national resource*," D. C.: National Academy Press, Washington, Tech. Rep. Part II

Tatum, C. B., Vanegas, J. A. and Willians, J. M. (1986) *Constructability Improvement During Conceptual Planning*, The Construction Industry Institute, Austin, TX.

Tawiah, P. A and Russell, A. D (2005) "Influence of procurement mode on innovation potential" *6th Construction Specialty Conference, June 2nd -4th June 2006, Toronto, Ontario, Canada*, pp. 1–11.

Tavakol, M. and Dennick, R. (2011) "Making sense of Cronbach's alpha", *International Journal of Medical Education*, Vol. 2, pp. 53-55

Terril, M. A. (1998) *Legal aspects of the design-build method of construction delivery*, Master of Science in Construction Engineering and Project Management, The University of Texas at Austin. Faculty of the Graduate School, available at: http://archive.org/details/legalaspectsofde00terr (Accessed at 15 March 2012)

Thanh, L. D., Thomas, N. and Chen, E. (2003) "Parameters governing the selection of procurement system an empirical survey", *Engineering Construction and Architectural Management* , 10, (3), 209-218.

Thomas, N. S., Luu, D. T. and Chen, S. E. (2002) "Decision criteria and their subjectivity in construction procurement system", *The Australian Journal of construction Economics and building*, 2, (1), pp. 70-80.

Thomas, N. S., Luu, D. T., Chen, S. E. and Lam, K. C. (2002) "Fuzzy membership function of procurement selection criteria", *The Australian Journal of construction Economics and building*, 20, (3), pp. 285-296.

Thwala, W. D and Mathonsi, M. D. (2012) "Selection of procurement systems in the South African construction industry: an Exploratory Study", *Acta Commercii, Independent Research Journal in the Management Science*, 12, (1), pp. 13-26

Titannewyork (2011) "*construction management advantages"*, available at: http://www.titannewyork.com/ (accessed: 10-March 2011).

Tiwari, P. (2001) "Housing and development objectives in India", *Habitat International*, 25, (2), pp. 229-253.

Tookey, J., Murray, M., Hardcastle, C. and Langford, D. (2001) "construction procurement routes: Re-defining the contours of construction procurement", *Engineering Construction and Architectural Management*, 8, (1), pp. 20–30.

Trigunarsyah, B. (2004) "Project owners' role in improving constructability of construction projects: an example analysis for Indonesia", *Construction Management and Economics*, 22, (8), pp. 861–876

Tripp-Reimer, T. (1985) *Combining qualitative and quantitative methodologies*. In M. M. Leininger (Ed.), *Qualitative research methods in nursing* (pp. 180). Orlando, FL: Grune and Stratton.

Tucker, R. L. (1986) "Management of Construction Productivity", *Journal of Management in Engineering, ASCE*, 2, (3), pp. 148-156.

Tukel, O. I. and Rom, W. O. (2001) "An empirical investigation of project evaluation criteria" *International Journal of Operations and Production Management*, 21, (3), pp. 400–416.

Tumi, A. S., Omran, A. and Pakir, A. H. (2009) "Causes of delay in construction industry in Libya", available at: http://www.itchannel.ro/faa/265_pdfsam_ICEA_FAA_2009 .pdf (accessed: 12-May 2011)

Turin, D. A. (1980). "What do we mean by building", *Habitat International*, 5, (3/4), pp. 271-288.

Turina, N., Radujkovic. M. and Pusic, D. C. (2008) "Design and build in comparison with the traditional procurement and possibility of its application in the Croatian construction industry", *8th International Conference: Organization, Technology and Management in Construction, 17th -20th of Septmber 2008 Umag, Hrvatska*, Avialable at:Available at: http://bib.irb.hr/datoteka/362416.65-Turina_ Radujkovic _Car-Pusic.pdf (Accessed: 2 April 2011).

Veld, J. I. T. and Peeters, W. A. (1989) "Keeping large projects under control: the importance of contract type selection", *International Journal of Project Management,* 7, (3), pp. 155-162.

Walker, D. H. T. and Vines, M. W. (2000) "Australian multi-unit residential project construction time performance factors" *Engineering, Construction and Architectural Management,* 7, (3), pp. 278-284.

Wells, J. (1986) "The Construction Industry in Developing Countries: A Strategy for Development", Unpublished PhD thesis.London, University of Wales.U.K.

Weisheng, L., Steve, R., Anita M. M. L. and Poon. S. W. (2011) "Procurement Perspectives from Chinese International Construction Companies" Working Paper Proceedings, Engineering Project Organizations Conference, Estes Park, Colorado, 9th -11th August 2011.

Williams, P., Ashill, N. J., Naumann, E. and Jackson, E. (2015) "Relationship quality and satisfaction: Customer-perceived success factors for on-time projects Paul", International Journal of Project Management

Winch, G. M. and Kelsey, J. M. (2005) "What do construction project planners do?" *International Journal of Project Management*, 23, (2), pp. 141 - 149.

World Bank (1960) "The Economic Development of Libya Baltimore", *the International Bank for Reconstruction and Development.*

World Bank (1988) "The Construction Industry in Development: Issues and Options". Washington, D. C.

Wustenhagen, R and Menichetti, E. (2012) "Strategic choices for renewable energy investment: conceptual framework and opportunities for further research". *Energy Policy*, 40, pp. 1-10.

Xia, B., Chan, A., and Yeung, J. (2011) "Developing a Fuzzy Multicriteria Decision-Making Model for Selecting Design-Build Operational Variations" *journal of Construction Engineering and Management*, 137, (12), pp 1176–1184.

Xiao, H and Proverbs, D. G. (2003) "Cost certainty and time certainty: an international investigation", *In:* Greenwood, D J (Ed.), *19th Annual ARCOM Conference*, 3rd -5th September 2003, University of Brighton. Association of Researchers in Construction Management, Vol. 1, pp. 23-32.

Yang, L. R. (2007) "Exploring the links between technology usage and project outcomes", *Journal of Construction Management and Economics*, 25, (10), pp. 1041–1051.

Yasamis, F., David, A. and Jamshid, M. (2002) "Assessing contractor quality performance" *Construction Management and Economics,* 20, (3), pp.211–223.

Yin, R K (2003), *Case Study Research: Design and methods*. 3rd edn. Thousand Oaks, Cal: Sage Publications

Polat, G., Okay, F. and Eray, E. (2014) "Factors Affecting Cost Overruns in Micro-scaled Construction Companies", Procedia Engineering, Selected papers from Creative Construction Conference, Volume 85, pp. 425-435

Appendix A: Initial survey questionnaire, main survey and cover letter

INITIAL QUESTIONAIRE TO INVESTIGATE THE MOST COMMON PROCURMENT METHODS TO DELIVER LIBYAN CONSTRUCTION PROJECTS

Section A: General Information

Please check ☒ one box in each column for each function relevant to you.

1. Please indicate your years of experience of working in construction and civil engineering projects.

Less than 5	5-10	11-15	16-20	21-25	More than 25
❑	❑	❑	❑	❑	❑

2. Please indicate the type of projects that you are involved with.

Buildings	Roads	Bridges	Sewerage and water supply	Airports	Others (please specify)
❑	❑	❑	❑	❑	

3. Please indicate which of the following best describes your job.

Project manager for client	❑	Project manager for contractor	❑
Site engineer	❑	Quantity surveyor	❑
Design engineer	❑	General supervisor	❑
Architecture engineer	❑	Other (please specify)________________________________	

4. Please indicate which of the following best describe your academic degree.

BSc	❑	PhD	❑
MSc	❑	Other please (specify)	

Section B: The types of Libyan construction procurement

5. From your past experience which of the following types of construction procurement have been used to deliver construction projects in Libya in the last 10 years?

Traditional method	❑	Construction management method	❑
Design & Build method	❑	Other please (specify)	

6. Please indicate from the following the extent of use of the most common procurement type.

(60% – 69%)	(69% – 70%)	(71% – 80%)	(81% – 90%)	(91% – 100%)
❑	❑	❑	❑	❑

8. Please indicate the criteria by which the most common procurement methods have ensured successful project delivery

1- Complete project on time, cost and good quality	6- Complete project on time
2- Complete project on time and cost	7- Complete project on cost
3- Complete project on time and good quality	8- Complete project on good quality
4- Complete project on cost and good quality	

9. Please indicate from the following the level of understanding of using the most common procurement type.

Very low level	Low level	Moderate	High level	Very high level
❑	❑	❑	❑	❑

10. Please indicate from the following the main problems that associated with using the most common procurement type.

Time overruns	❑	Poor quality	❑
Cost overruns	❑	Other please (specify)	

11. From your past experience indicate from the following the level of project performance would you give to the Libyan construction projects.				
Very poor	Poor	Neutral	Good	Excellent
❑	❑	❑	❑	❑

12. Please indicate from the scale 1 to 5 the level for which each the following performance criteria have a source project unsatisfaction.					
	Low level				High level
	1	2	3	4	5
1- Time	❑	❑	❑	❑	❑
2- cost	❑	❑	❑	❑	❑
3- Quality	❑	❑	❑	❑	❑
4- Health and safety	❑	❑	❑	❑	❑
5- Environment/Social	❑	❑	❑	❑	❑
6- Others (please specify) ______________________ ______________________ ______________________ ______________________ ______________________	❑	❑	❑	❑	❑

School of Engineering and Design
University of Brunel

Cover letter for main questionnaire survey

Dear ………

ASSISTANCE FOR RESEARCH SURVEY ON THE IMPACT OF CONSTRUCTION PROCUREMNT METHODS HAVE ON PROJECT PERFORMANCE

The aim of this study is to investigate the influnce procurement method selection criteria have on project performance. To achieve these aims, I would be most grateful if you could encourage a member(s) of staff with relevant experience of construction project delivery to participate in the survey. You may make multiple copies of this questionnaire in case of multiple respondents. In addition, to answers to specific questions, views on any other matters relevant to the aims of the study are most welcome. There are no correct or incorrect responses, only much-needed expert opinion.

The main aim of the questionnaire is to gather and assess your views on the impact of construction procurement method on project performance. The questionnaire consists of two parts. **Section A** seeks to collect information on your personal experience and background in working in engineering construction field. **Sections B** asks of your opinions on the criteria for selection DBB method of procurement and DB method of procurement in the projects that you are involved with. In addition, it concerns your opinions on the degree of frequency of projects completed on or before schedule, on or below budget and to the required quality in the same projects that you are involved with.

We would very much appreciate if you could please spare some few minutes to complete the questionnaire. All information received will be treated as strictly confidential and will not be disclosed in any way.

We do appreciate that the questionnaire will take some of your valuable time but without your kind and expert input the research objectives aimed cannot be realised. To this end, we would like to thank you very much for your valued and kind consideration. Please return the completed questionnaire to the e-mail addresses below or I can collect it in person on 5/1/2012. If there is difficulty in sending it by email, please do not hesitate to contact me.

Alaeddin Ghadamsi
PhD Student
School of Engineering and Design
Brunel University
Tel: 00447411743043
00218913179225
E-mail: mepgamg@brunel.ac.uk or
Alla_Nafa@yahoo.com

A QUESTIONNAIRE TO INVESTIGATE THE INFLUNCE OF PROCUREMENT METHODS HAVE ON PROJECT PERFORMANCE

Section A: General Information

Please check ☒ one box in each column for each function relevant to you.

1. Please indicate your years of experience of working in construction and civil engineering projects

Less than 5	5-10	11-15	16-20	21-25	More than 25
❑	❑	❑	❑	❑	❑

2- Which of the following best describes the nature of your organisation's activities?

Buildings	❑	Civil work	❑
Roads	❑	Contract management	❑
Airports	❑	Other (please specify) ____________ ____________	

3. Please indicate which of the following best describes your job in this organization.

Project manager for client	❑	Project manager for contractor	❑
Site engineer	❑	Quantity surveyor	❑
Design engineer	❑	General supervisor	❑
Architecture engineer	❑	Other (please specify) ____________ ____________	

4. Please give an indication of the size of your organisation in terms of annual turnover (£).

Less than 3m	❑	11m-20m	❑	31m-40m	❑
3m-10m	❑	21m-30m	❑	More than 40m	❑

Section B: The impact of construction procurement method on project performance

5. Please indicate on scale of 1 to 5 (1 indicates "low frequency" and 5 indicates "high frequency") the frequency by which each the following factors below has been the reason for poor project performance as experienced in traditional procurement method.

	Low frequency				High frequency
	1	2	3	4	5
1- Poor contract management	❑	❑	❑	❑	❑
2- Improper planning and design	❑	❑	❑	❑	❑
3- Inadequate contractor experience	❑	❑	❑	❑	❑
4- Slow decision making by client	❑	❑	❑	❑	❑
5- Inappropriate contract type	❑	❑	❑	❑	❑
6- Inappropriate payment method	❑	❑	❑	❑	❑
7- Delay in delivery of materials to the site	❑	❑	❑	❑	❑
8- Conflict among project participants	❑	❑	❑	❑	❑
9- Construction mistakes and defective work	❑	❑	❑	❑	❑
10- Poor skills and experience of labour	❑	❑	❑	❑	❑
11- Lack of coordination between clients and contractors	❑	❑	❑	❑	❑
12- Difficulty of project site	❑	❑	❑	❑	❑
13- Unavailability of resources as planned through the project duration	❑	❑	❑	❑	❑
14- Poor leadership skills for project manager	❑	❑	❑	❑	❑

15- Others (please specify) _________________________ _________________________ _________________________ _________________________ _________________________	❑	❑	❑	❑	❑

6. Please indicate on scale of 1 to 5 (1 indicates “low frequency” and 5 indicates “high frequency”) the frequency by which each the following factors below has been the reason for poor project performance as experienced in design and build procurement method.

	Low frequency				High frequency
	1	2	3	4	5
1- Poor contract management	❑	❑	❑	❑	❑
2- Improper planning and design	❑	❑	❑	❑	❑
3- Inadequate contractor experience	❑	❑	❑	❑	❑
4- Slow decision making by client	❑	❑	❑	❑	❑
5- Inappropriate contract type	❑	❑	❑	❑	❑
6- Inappropriate payment method	❑	❑	❑	❑	❑
7- Delay in delivery of materials to the site	❑	❑	❑	❑	❑
8- Conflict among project participants	❑	❑	❑	❑	❑
9- Construction mistakes and defective work	❑	❑	❑	❑	❑
10- Poor skills and experience of labour	❑	❑	❑	❑	❑
11- Lack of coordination between clients and contractors	❑	❑	❑	❑	❑
12- Difficulty of project site	❑	❑	❑	❑	❑
13- Unavailability of resources as planned through the project duration	❑	❑	❑	❑	❑
14- Poor leadership skills for project manager	❑	❑	❑	❑	❑
15- Others (please specify) _________________________ _________________________ _________________________ _________________________ _________________________	❑	❑	❑	❑	❑

7. For project procured using DBB indicate the level of effect with which each the following statement on project performance in term of time, cost and quality for the projects that you are involved with (1=very low effect, 5=very high effect)

Project performance	Time					Cost					Quality				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1- Poor contract management	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
2- Improper planning and design	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
3- Inadequate contractor experience	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
4- Slow decision making by client	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
5- Inappropriate contract type	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
6- Inappropriate payment method	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

7- Delay in delivery of materials to the site	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
8- Conflict among project participants	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
9- Construction mistakes and defective work	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
10- Poor skills and experience of labour	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
11- Lack of coordination between clients and contractors	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
12- Difficulty of project site	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
13- Unavailability of resources as planned through the project duration	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
14- Poor leadership skills for project manager	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

8. For project procured using DB indicate the level of effect with which each the following statement on project performance in term of time, cost and quality for the projects that you are involved with (1=very low effect, 5=very high effect)

Project performance	Time					Cost					Quality				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1- Poor contract management	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
2- Improper planning and design	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
3- Inadequate contractor experience	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
4- Slow decision making by client	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
5- Inappropriate contract type	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
6- Inappropriate payment method	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
7- Delay in delivery of materials to the site	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
8- Conflict among project participants	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
9- Construction mistakes and defective work	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

10- Poor skills and experience of labour	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
11- Lack of coordination between clients and contractors	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
12- Difficulty of project site	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
13- Unavailability of resources as planned through the project duration	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
14- Poor leadership skills for project manager	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

9. Please indicate the extent of your agreement or disagreement with which each of the following statement below is the reason for selecting the most common procurement type

	Strongly disagree				Strongly agree
	1	2	3	4	5
1-Lack of client experience and knowledge with the other types of construction procurement.	❑	❑	❑	❑	❑
2-Rush decision-making by client without adequate study on the nature of the project	❑	❑	❑	❑	❑
3- Client refusing to try and use the other types of construction procurement	❑	❑	❑	❑	❑
4- External pressure (political- economical)	❑	❑	❑	❑	❑
5- Others (please specify) ______________ ______________ ______________	❑	❑	❑	❑	❑

10. Please indicate the extent of involvement of the role of each project parties following to achieving good project performance as experienced on project procured by DBB method.

	Low involvement				High involvement
	1	2	3	4	5
1- Project client	❑	❑	❑	❑	❑
2- Project contractor	❑	❑	❑	❑	❑
3- Project consultant	❑	❑	❑	❑	❑
4- Others (please specify) ______________ ______________ ______________	❑	❑	❑	❑	❑

11. Please indicate the extent of involvement of the role of each project parties following to achieving good project performance as experienced on project procured by DB method.

	Low involvement				High involvement
	1	2	3	4	5
1- Project client	❑	❑	❑	❑	❑
2- Project contractor	❑	❑	❑	❑	❑
3- Project consultant	❑	❑	❑	❑	❑
4- Others (please specify)	❑	❑	❑	❑	❑

______________________ ______________________ ______________________					

12. Please indicate the extent of your agreement or disagreement on the suitability of each of the following contract types for DBB method.

	Strongly disagree				Strongly agree
	1	2	3	4	5
1-Bill of quantity	❑	❑	❑	❑	❑
2- Lump sum	❑	❑	❑	❑	❑
3- Cost plus	❑	❑	❑	❑	❑

13. Please indicate the extent of your agreement or disagreement on the suitability of each of the following contract types for DB procurement method.

	Strongly disagree				Strongly agree
	1	2	3	4	5
1-Bill of quantity	❑	❑	❑	❑	❑
2- Lump sum	❑	❑	❑	❑	❑
3- Cost plus	❑	❑	❑	❑	❑

14. For project procured using DBB indicates on scale of 1 to 5 the frequency of using the following types of tendering below for the projects that you are involved with. 1 represents “not frequent” and 5 represents “most frequent”.

	Very low frequency				Very high frequen
	1	2	3	4	5
1- Open tender	❑	❑	❑	❑	❑
2- Selective tender	❑	❑	❑	❑	❑
3- Negotiation tender	❑	❑	❑	❑	❑

15. For project procured using DB indicates on scale of 1 to 5 the frequency of using the following types of tendering below for the projects that you are involved with. 1 represents “not frequent” and 5 represents “most frequent”.

	Very low frequency				Very high frequen
	1	2	3	4	5
1- Open tender	❑	❑	❑	❑	❑
2- Selective tender	❑	❑	❑	❑	❑
3- Negotiation tender	❑	❑	❑	❑	❑

16. Indicate on a scale of 1 to 5 your level of agreement with each of the following variables as experienced on projects procured under DBB method. 1 represents “strongly disagree” and 5 represents “strongly agree”.

	Strongly disagree				Strongly agree
	1	2	3	4	5
1-High price competition	❑	❑	❑	❑	❑
2- Clarity of scope definition	❑	❑	❑	❑	❑
3- Complexity of design	❑	❑	❑	❑	❑
4- High level of quality required	❑	❑	❑	❑	❑
5- Clear definition of	❑	❑	❑	❑	❑

parties responsibilities					
6- Client involvement in the project	❑	❑	❑	❑	❑
7- Controllable project variation	❑	❑	❑	❑	❑
8- High degree of certainty on project cost.	❑	❑	❑	❑	❑
9- High degree of certainty on project duration	❑	❑	❑	❑	❑
10- Ease of organizing and reviewing project activates	❑	❑	❑	❑	❑
11- Desiring efficient project planning and design	❑	❑	❑	❑	❑
12- Project functionality	❑	❑	❑	❑	❑
13- Others (please specify) ____________ ____________ ____________ ____________	❑	❑	❑	❑	❑

17. For project procured using DBB indicates on scale of 1 to 5 the frequency by which each following outcomes had been experienced. 1 represents “very low frequency” and 5 represents “very high frequency”.

	Very low frequency				Very high frequency
	1	2	3	4	5
1- Project completed on or before schedule	❑	❑	❑	❑	❑
2- Project completed on or below budget	❑	❑	❑	❑	❑
3- Project completed at high quality	❑	❑	❑	❑	❑

18. Indicate on a scale of 1 to 5 your level of agreement with each of the following variables as experienced on projects procured under DB method. 1 represents “strongly disagree” and 5 represents “strongly agree”.

	Strongly disagree				Strongly agree
	1	2	3	4	5
1-Quick delivery of construction processes	❑	❑	❑	❑	❑
2- Quick project commencement	❑	❑	❑	❑	❑
3- Effective communication between project parties	❑	❑	❑	❑	❑
4- Flexibility in design and construction changes	❑	❑	❑	❑	❑
5- Single point of responsibility	❑	❑	❑	❑	❑
6- Low level of conflict amongst project parties	❑	❑	❑	❑	❑
7- Complexity of design	❑	❑	❑	❑	❑
8- Transfer of risks to the contractor	❑	❑	❑	❑	❑
9- Desiring reduced project cost	❑	❑	❑	❑	❑
10- Desiring reduced project time	❑	❑	❑	❑	❑

11- Competence and experienced contractor.	❑	❑	❑	❑	❑
12- Collaborative working relationship between project team	❑	❑	❑	❑	❑
13- Desiring efficient project plan	❑	❑	❑	❑	❑
14- Others (please specify) ____________ ____________ ____________ ____________					

19. For project procured using DB indicate on scale of 1 to 5 the frequency by which each following outcomes had been experienced. 1 represents "very low frequency" and 5 represents "very high frequency".

	Very low frequency				Very high frequency
	1	2	3	4	5
1- Project completed on or before schedule	❑	❑	❑	❑	❑
2- Project completed on or below budget	❑	❑	❑	❑	❑
3- Project completed at high quality	❑	❑	❑	❑	❑

20. For purposes of the above, follow-up and relaying the research findings to interested participants, could you please provide us with the following information? (This is optional).

Name of Respondent ____

Position within organisation: ____

Name of organisation: ____

Address: ____

Telephone: ____

E-mail ____

Appendix B: Interview procurement selection criteria and PP

Section A: general information

Name of respondent: ………………………………………………………………………………..

Position within organisation: …………………………………………………………………..

Name of the organisation: ………………………………………………………………………

Years of experience: ……………………………………………………………………………

Address: ………………………………………………………………………………………..

Telephone no: …………………………………………………………………………………..

Email: ……………………………………………………………………………………………..

Section B: Explaining how construction procurement method affects PP
1) Traditional Procurement Method (DBB)

Q1- Do you think that the contractor were selected based on competitive basis? Yes/No
…………………………………………………………………………………………………

Q2- If Yes or No to Q1, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q3- Do you think that the project scope was very clear and well defined? Yes/No
…………………………………………………………………………………………………

Q4- If Yes or No to Q3, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q5 Do you think, that the quality parameters (quality of materials, workmanship and equipment) were adequate and high efficiency? Yes/No
…………………………………………………………………………………………………

Q6- If Yes or No to Q5, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q7- Do you think that the project team and contractors were capable to handling complex projects in terms of design?? Yes/No
…………………………………………………………………………………………………

Q8- If Yes or No to Q7, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q9- Do you think, that the project parties were committed to their responsibilities in the project? Yes/No

………………………………………………………………………………………………

Q10- If Yes or No to Q9, please explains how this affected PP.
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

Q11- Do you think that the client was highly involved in the project? Yes/No
………………………………………………………………………………………………

Q12- If Yes or No to Q11, please explains how this affected PP.
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

Q13- Do you think that the changes in the project in terms of design and specification were controlled? Yes/No
………………………………………………………………………………………………

Q14- If Yes to Q13, please specify how this is so.
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

Q15- Explain how the certainty of knowing project time and cost in advance affected PP?
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

Q16- Do you think that the project was well managed and organized? Yes/No
………………………………………………………………………………………………

Q17- If Yes or No to Q16, please explains how this affected PP?
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

Q18- Do you think that the functional and physical requirements of the project positively affected PP? Yes/No
………………………………………………………………………………………………

Q19- If Yes or No to Q18, please specify how this is so.
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

2) Design and Build Procurement Method (DB)

Q1) Do you think that the overlapping of the design and construction processes helped to speeding up project delivery? Yes/No
………………………………………………………………………………………………

Q2) If Yes or No to Q1, please explains how this affected PP.
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

Q3) Do you think that the overlapping of the design and construction processes helped to start the project early in the site? Yes/No
………………………………………………………………………………………………

Q4) If Yes or No to Q3, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q5) Do you think that the communication between project parties was effective? Yes/No
…………………………………………………………………………………………………

Q6) If Yes or No to Q5, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q7) Do you think that, there was flexibility in the designs and construction changes during construction process? Yes/No
…………………………………………………………………………………………………

Q8) If Yes or No to Q7, please explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q9) Do you think the conflicts between project team were reduced during construction project ? Yes/No
…………………………………………………………………………………………………

Q10) If Yes or No to Q9, please explains how reducing conflicts affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q11) Do you think that bearing the contractor the whole project responsibilities caused negative effect on PP? Yes/No
…………………………………………………………………………………………………

Q12- If Yes or No to Q11, please explain how this is so.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q13) Do you think that the contractor was experienced enough to carry out the project properly? Yes/No
…………………………………………………………………………………………………

Q14) If Yes or No to Q13, explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q16) Do you think that the overlapping between the construction phase and design phase helped to minimizing project duration and reducing project cost? Yes/No
…………………………………………………………………………………………………

Q17) If Yes or No to Q16, explains how this affected PP.
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q18) To what extent do you think that the collaborative working relationship between project team affected PP? Please rank the extant on scale of 1-5 (1=very low extent and 5= very high extent)
…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

Q19) Do you think that the project planning was efficient?
……………………………………………………………………………………………

Q20) If Yes or No to Q18, explains how this affected PP.
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

Section C: General questions

Q1) From your point of view, please indicate the factors besides procurement that do you think are responsible for poor project performance.
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

Q2) what are the reasons that prevent public clients in Libya from complying with the *Administrative Contracts Regulation* when choosing contractors in recent years?
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

Appendix C: Descriptive analysis, Test of Reliability and one way ANOVA test

Descriptive analysis

- Summary of the Descriptive Analysis (Range Minimum, Maximum, Mean, Standard Deviation, Skewness and Kurtosis) for DBB projects;
- Summary of the Descriptive Analysis (Range Minimum, Maximum, Mean, Standard Deviation , skewness and kurtosis) for DB projects
- Summary of frequency and percentage of distributions of respondents (DBB projects)
- Summary of frequency and percentage of distributions of respondents (DB projects)

Reliablity Test

- Test of reliability for factors responsible for poor PP
- Test of reliability for factors behind selection of improper PMs
- Test of reliability for factors responsible for poor PP
- Test of reliability for project parties' involvement
- Test of reliability for the types of tenders used
- Test of reliability for the types of contracts used

One way between ANOVA Test

- One way ANOVA test for factors responsible for PP (DBB)
- One way ANOVA test for factors responsible for PP (DB)
- One way ANOVA test for factors behind selection of the most common PMs
- One way ANOVA test for (project parties involvement, types of contracts used and types of tenders used) DB
- ANOVA test for (project parties involvement, types of contracts used and types of tenders used) DBB

Summary of the Descriptive Analysis (Range Minimum, Maximum, Mean, Standard Deviation, Skewness and Kurtosis) for DBB projects

		N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Factors responsible for poor performance	Factor 1	126	4	1	5	3.71	.959	-.712	.216	-.510	.428
	Factor 2	126	4	1	5	4.15	.918	-1.000	.216	.255	.428
	Factor 3	126	3	2	5	3.90	.889	-.488	.216	-.998	.428
	Factor 4	126	4	1	5	3.64	.874	-.325	.216	-.649	.428
	Factor 5	126	4	1	5	3.35	.882	-.090	.216	-.245	.428
	Factor 6	126	4	1	5	3.30	.934	.021	.216	-.618	.428
	Factor 7	126	4	1	5	3.38	1.000	-.391	.216	-.911	.428
	Factor 8	126	4	1	5	3.44	.943	-.093	.216	-.931	.428
	Factor 9	126	4	1	5	3.32	.941	-.025	.216	-.669	.428
	Factor 10	126	4	1	5	3.62	.864	-.769	.216	.230	.428
	Factor 11	126	4	1	5	3.52	.994	-.343	.216	-.387	.428
	Factor 12	126	4	1	5	3.40	.969	-.222	.216	-.797	.428
	Factor 13	126	4	1	5	3.37	.941	-.227	.216	-.701	.428
	Factor 14	126	4	1	5	3.54	.916	-.668	.216	-.117	.428
The involvement of project parties	Client	126	3	2	5	4.24	.950	-1.010	.216	.282	.428
	Contractor	126	2	3	5	4.40	.716	-.757	.216	-.696	.428
	Consultant	126	3	2	5	4.27	.774	-.931	.216	.578	.428
Types of contracts used	BOQ	126	4	1	5	4.63	.688	-.640	.216	1.000	.428
	Lump sum	126	4	1	5	2.88	.952	.129	.216	.281	.428
	Cost plus	126	4	1	5	1.95	.978	1.000	.216	1.000	.428
Types of tendering used	Open	126	4	1	5	2.83	1.000	.312	.216	-.985	.428
	selective	126	4	1	5	3.66	.991	-.499	.216	-.836	.428
	Direct order	126	4	1	5	3.05	1.000	-.104	.216	-1.000	.428
DBB procurement criteria	Criterion 1	126	3	2	5	3.27	.858	.047	.216	-1.020	.428

		N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
	Criterion 2	126	3	2	5	3.85	.913	-.400	.216	-.629	.428
	Criterion 3	126	3	2	5	3.28	.882	.346	.216	-.513	.428
	Criterion 4	126	3	2	5	3.64	.992	-.130	.216	-1.000	.428
	Criterion 5	126	4	1	5	3.95	.918	-.551	.216	.237	.428
	Criterion 6	126	3	2	5	3.59	.982	-.222	.216	-.940	.428
	Criterion 7	126	4	1	5	3.25	.958	.091	.216	-1.002	.428
	Criterion 8	126	4	1	5	3.83	.921	-.525	.216	-.578	.428
	Criterion 9	126	3	2	5	3.81	.930	-.449	.216	-1.000	.428
	Criterion 10	126	4	1	5	3.84	.876	-.588	.216	.052	.428
	Criterion 11	126	3	2	5	3.87	.870	-.325	.216	-.611	.428
	Criterion 12	126	3	2	5	3.20	.890	.106	.216	-.750	.428

Summary of the Descriptive Analysis (Range Minimum, Maximum, Mean, Standard Deviation, skewness and Kurtosis) for DB projects

		N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Factors responsible for poor performance	*Factor 1*	*126*	*4*	*1*	*5*	*3.73*	*.998*	-.693	.216	-.658	.428
	Factor 2	126	2	3	5	4.17	.787	-.305	.216	-1.000	.428
	Factor 3	126	3	2	5	3.95	.879	-.491	.219	-1.025	.428
	Factor 4	126	3	2	5	3.86	.919	-.471	.218	-1.002	.428
	Factor 5	126	3	2	5	3.59	.923	-.199	.216	-.766	.428
	Factor 6	126	3	2	5	3.26	.990	.084	.218	-1.000	.428
	Factor 7	126	3	2	5	3.55	.893	-.228	.218	-1.145	.428
	Factor 8	126	3	2	5	3.41	.858	.143	.223	-1.054	.428
	Factor 9	126	3	2	5	3.95	.906	-.011	.220	-.820	.428

		N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
	Factor 10	126	3	2	5	3.69	.882	-.371	.219	-.491	.428
	Factor 11	126	3	2	5	3.48	.862	-.053	.219	-1.001	.428
	Factor 12	126	3	2	5	3.58	.958	-.252	.218	-.860	.428
	Factor 13	126	3	2	5	3.54	.861	-.219	.218	-.578	.428
	Factor 14	126	4	1	5	3.69	.993	-.531	.216	-.694	.428
The involvement of project parties	Client	126	4	1	5	3.02	.820	-.030	.216	-.172	.428
	Contractor	126	2	3	5	4.55	.627	-1.000	.216	.089	.428
	Consultant	126	3	2	5	3.10	.987	.412	.216	-.808	.428
Types of contracts used	BOQ	126	3	1	4	2.63	.640	-.055	.216	-.162	.428
	Lump sum	126	4	1	5	2.29	.961	.192	.216	-1.012	.428
	Cost plus	126	4	1	5	2.36	1.000	.494	.216	-.966	.428
Types of tendering used	Open	126	4	1	5	3.77	.901	-.469	.216	-.337	.428
	selective	126	4	1	5	2.39	1.000	.540	.216	-.852	.428
	Direct order	126	4	1	5	3.72	1.000	-.657	.216	-.645	.428
DB procurement criteria	Criterion 1	126	3	2	5	3.63	.948	-.239	.216	-.821	.428
	Criterion 2	126	3	2	5	3.59	.964	-.216	.216	-.884	.428
	Criterion 3	126	4	1	5	3.72	.891	-.337	.216	-.741	.428
	Criterion 4	126	3	2	5	3.66	.969	-.235	.216	-.896	.428
	Criterion 5	126	2	3	5	4.15	.700	-.322	.216	-.920	.428
	Criterion 6	126	3	2	5	3.34	.994	.072	.216	-1.000	.428
	Criterion 7	126	4	1	5	3.00	.980	.110	.216	-.752	.428
	Criterion 8	126	3	2	5	3.74	.897	-.322	.216	-.633	.428
	Criterion 9	126	3	2	5	3.29	.881	.089	.216	-.670	.428
	Criterion 10	126	3	2	5	3.44	.865	.038	.216	-.630	.428

		N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
	Criterion 11	126	4	1	5	3.64	.875	-.294	.216	-.673	.428
	Criterion 12	126	4	1	5	3.94	.779	-.674	.216	.948	.428
	Criterion 13	126	3	2	5	3.79	.930	-.503	.216	-.514	.428

Summary of the Descriptive Analysis (Range Minimum, Maximum, Mean, Standard Deviation, skewness and Kurtosis) for factors behind selection the common PMs

		N	Range	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Factors behind selection improper PMs	Factor 1	126	4	1	5	3.68	.972	-.492	.216	-.727	.428
	Factor 2	126	4	1	5	4.07	.887	-1.002	.216	1.000	.428
	Factor 3	126	3	2	5	3.82	.709	-.544	.216	.548	.428
	Factor 4	126	4	1	5	4.46	.918	-1.000	.216	.449	.428

Summary of frequency and percentage of distributions of respondents (DBB projects)

Factors responsible for poor performance	Very low frequency		low frequency		Moderate		High frequency		Very high frequency		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Factor 1	3	2.4	16	12.7	22	17.5	37	29.4	48	38.1	126	100
Factor 2	3	2.4	8	6.3	23	18.5	25	19.8	67	53.2	126	100
Factor 3	16	12.7	0	0	27	21.4	36	28.6	47	37.3	126	100
Factor 4	2	1.6	13	10.3	39	31.5	38	30.2	34	27	126	100
Factor 5	6	4.8	14	11.1	57	45.2	28	22.2	21	16.7	126	100
Factor 6	11	8.7	30	23.8	44	34.9	29	23	12	9.5	126	100
Factor 7	12	9.5	22	17.5	25	19.8	40	31.7	27	21.4	126	100
Factor 8	3	2.4	25	19.8	38	30.2	34	27	26	20.6	126	100
Factor 9	3	2.4	25	19.8	44	34.9	37	29.4	17	13.5	126	100
Factor 10	5	4	13	10.3	26	20.6	60	47.6	22	17.5	126	100
Factor 11	3	2.4	17	13.5	38	30.2	48	38.1	20	15.9	126	100

Factor 12	6	4.8	23	18.3	36	28.6	36	28.6	25	19.8	126	100
Factor 13	6	4.6	23	18.3	37	29.3	39	31.3	21	16.7	126	100
Factor 14	7	5.6	15	11.9	28	22.2	55	43.7	21	16.7	126	100
The involvement of project parties	**Very low involvement**		**Low involvement**		**Moderate**		**High involvement**		**Very high involvement**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Client	0	0	11	8.7	12	9.5	39	31	64	50.8	126	100
Contractor	0	0	0	0	17	13.5	42	33.3	67	53.2	126	100
Consultants	0	0	4	3.2	13	10.3	54	42.9	55	43.7	126	100
Types of contracts used	**Strongly disagree**		**Disagree**		**Moderate**		**Agree**		**High agree**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
BOQ	1	0.8	1	.8	6	4.8	27	21.4	91	72.2	126	100
Lump sum	10	7.9	27	21.4	65	51.6	16	12.7	8	6.3	126	100
Cost plus	56	44.4	41	32.5	17	13.5	3	2.4	9	7.1	126	100
Types of tendering used	**Very low frequency**		**low frequency**		**Moderate**		**High frequency**		**Very high frequency**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Open	17	13.5	44	34.9	25	19.8	24	19	16	12.7	126	100
selective	4	3.2	23	18.3	21	16.7	42	33.3	36	28.6	126	100
Direct order	27	21.4	13	10.3	39	31	21	16.7	26	20.6	126	100
DBB procurement criteria	**Strongly disagree**		**Disagree**		**Moderate**		**Agree**		**High agree**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Criterion 1	0	0	23	18.3	42	33.3	36	28.6	25	19.8	126	100
Criterion 2	0	0	11	8.7	30	23.8	52	41.3	33	26.2	126	100
Criterion 3	0	0	23	18.3	58	46.6	32	25.4	13	10.3	126	100
Criterion 4	0	0	18	14.3	38	30.2	41	32.5	29	23	126	100
Criterion 5	4	3.2	11	8.7	19	15.1	45	35.7	47	37.3	126	100
Criterion 6	0	0	22	17.3	31	24.6	50	39.7	23	18.3	126	100
Criterion 7	7	5.6	44	34.9	24	19	39	31	12	9.5	126	100
Criterion 8	2	1.6	18	14.3	21	16.7	45	35.7	40	31.7	126	100
Criterion 9	0	0	19	15.1	27	21.4	31	24.6	49	38.9	126	100
Criterion 10	3	2.4	13	10.3	21	16.7	53	42.1	36	28.6	126	100
Criterion 11	0	0	8	6.3	33	26.2	53	42.1	32	25.4	126	100
Criterion 12	0	0	13	10.3	51	40.5	41	32.5	21	16.7	126	100

Summary of Frequency and Percentage of Distributions of Respondents (DB projects)

Factors responsible for poor performance	Very low frequency		low frequency		Moderate		High frequency		Very high frequency		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Factor 1	75.6	20	15.9	16	12.7	40	31.7	43	34.1	126	126	100
Factor 2	0	0	0	0	30	23.8	45	35.7	51	40.5	126	100
Factor 3	14	11.2	0	0	30	23.8	32	25.4	50	39.6	126	100
Factor 4	0	0	20	15.87	25	19.8	36	28.57	45	35.7	126	100
Factor 5	0	0	18	14.3	36	28.6	52	41.3	20	15.9	126	100
Factor 6	0	0	27	21.4	41	32.5	38	30.15	20	15.87	126	100
Factor 7	29	23.0	23	18.25	49	38.9	25	19.85	0	0	126	100
Factor 8	0	0	24	19	45	35.7	32	25.4	25	19.8	126	100
Factor 9	0	0	25	19.8	42	33.3	46	36.5	13	10.3	126	100
Factor 10	0	0	15	11.9	31	24.6	59	46.0	21	46.8	126	100
Factor 11	0	0	27	21.4	34	26.9	43	33.3	22	16.7	126	100
Factor 12	0	0	22	17	31	24.6	53	42.0	20	15.8	126	100
Factor 13	0	0	17	13.5	39	30.9	55	43.6	15	11.9	126	100
Factor 14	5	4	18	14.3	27	21.4	37	29.4	39	31.0	126	100
The involvement of project parties	**Strongly disagree**		**Disagree**		**Moderate**		**Agree**		**High agree**		**Total**	
	Very low involvement		**Low involvement**		**Moderate**		**High involvement**		**Very high involvement**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Client	3	2.4	29	23	60	47.6	31	24.6	3	2.4	126	100
Contractor	0	0	0	0	9	7.1	39	31	78	61.9	126	100
Consultants	0	0	28	22.2	54	42.9	24	19	20	15.9	126	100
Types of contracts used	**Strongly disagree**		**Disagree**		**Moderate**		**Agree**		**High agree**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
BOQ	41	32.5	35	27.8	20	15.9	24	19	6	4.7	126	100
Lump sum	41	32.5	35	27.8	20	15.8	24	19	6	4.8	126	100
Cost plus	4	3.2	7	5.6	43	34.1	32	25.4	40	31.7	126	100
Types of tendering	**Very low frequency**		**low frequency**		**Moderate**		**High frequency**		**Very high frequency**		**Total**	

used	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Open	42	33.3	31	24.6	25	19.8	18	14.3	10	7.9	126	100
selective	7	5.6	18	14.3	21	16.6	37	29.4	43	34.1	126	100
Direct order	27	20.6	10	7.9	33	26.8	18.2	14.3	38	30.2	126	100
DBB procurement criteria	**Strongly disagree**		**Disagree**		**Moderate**		**Agree**		**High agree**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Criterion 1	0	0	17	13.5	34	27	50	39.6	25	19.8	126	100
Criterion 2	0	0	20	15.8	33	26.2	50	39.7	23	1.8.3	126	100
Criterion 3	2	1.6	12	9.5	40	31.7	33	26.2	39	31.0	126	100
Criterion 4	0	0	16	12.7	36	28.6	46	36.5	28	22.2	126	100
Criterion 5	0	0	0	0	20	15.9	59	46.8	47	37.3	126	100
Criterion 6	0	0	22	17.5	44	34.9	36	28.6	24	19	126	100
Criterion 7	16	12.7	33	26.1	39	31.0	26	20.6	12	9.5	0	0
Criterion 8	0	0	11	8.7	33	26.2	53	42.1	29	23	126	100
Criterion 9	0	0	18	14.3	50	39.7	43	34.1	15	11.9	126	100
Criterion 10	0	0	15	11.9	49	38.9	46	36.5	16	12.7	126	100
Criterion 11	2	1.6	14	11.1	39	31.0	38	30.2	33	26.2	126	100
Criterion 12	1	0.8	2	1.6	24	19.0	64	50.8	35	27.8	126	100
Criterion 13	0	0	15	11.9	24	19	58	46	29	23	126	100

Summary of frequency and percentage of distributions of respondents

Factors behind selection improper PMs	**Strongly disagree**		**Disagree**		**Moderate**		**Agree**		**High agree**		**Total**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Factor 1	3	2.4	7	5.6	18	14.3	61	48.4	37	29.4	126	100
Factor 2	4	3.2	9	7.1	13	10.3	48	38.1	52	41.3	126	100
Factor 3	0	0	6	4.8	27	21.4	77	61.1	16	12.7	126	100
Factor 4	3	2.4	5	4	4	3.2	33	26.2	81	64.3	126	100

Test of reliability for factors responsible for poor PP

DBB procurement method		DB procurement method	
Factors	**Cronbach's alpha**	**Factors**	**Cronbach's alpha**
Poor contract management	0.819	Poor contract management	0.737
Improper planning and design	0.815	Improper planning and design	0.736
Inadequate contractor experience	0.824	Inadequate contractor experience	0.739
Slow decision-making by client	0.821	Slow decision-making by client	0.727
Inappropriate contract type	0.837	Inappropriate contract type	0.754
Inappropriate payment method	0.838	Inappropriate payment method	0.725
Delay in materials delivery to site	0.819	Delay in materials delivery to site	0.753
Conflict among project participants	0.813	Conflict among project participants	0.733
Construction mistakes and defective work	0.816	Construction mistakes and defective work	0.753
Poor skills and experience of labour	0.812	Poor skills and experience of labour	0.750
Lack of coordination between clients and contractors	0.813	Lack of coordination between clients and contractors	0.726
Difficulty of project site	0.836	Difficulty of project site	0.752
Unavailability of resources as planned through the project duration	0.814	Unavailability of resources as planned through the project duration	0.748
Poor leadership skills for project manager	0.815	Poor leadership skills for project manager	0.728
Overall Cronbach's α	**0.843**	**Overall Cronbach's α**	**0.756**

Test of reliability for factors behind selection of improper PMs

DBB procurement method		DB procurement method	
Factors	**Cronbach's alpha**	**Factors**	**Cronbach's alpha**
Lack of client experience and knowledge with the modern PMs	0.723	Lack of client experience and knowledge with the modern PMs.	0.722
Rushed decision-making by client	0.701	Rushed decision-making by client	0.740
Client reluctance to try and use the modern PMs	0.735	Client reluctance to try and use the modern PMs	0.722
External pressure (political-economic)	0.714	External pressure (political-economic)	0.730
Overall Cronbach's α	**0.742**	**Overall Cronbach's α**	**0.745**

Test of reliability for project parties' involvement

DBB procurement method		DB procurement method	
Project parties' involvements	**Cronbach's alpha**	**Project parties' involvements**	**Cronbach's alpha**
Client involvement	0.782	Client involvement	0.763
Contractor involvement	0.782	Contractor involvement	0.792
Consultant involvement	0.743	Consultant involvement	0.725
Overall Cronbach's α	**0.790**	**Overall Cronbach's α**	**0.766**

Test of reliability for the types of tenders used

DBB procurement method		DB procurement method	
Types of tenders used	**Cronbach's alpha**	**Types of tenders used**	**Cronbach's alpha**
Open tender	0.773	Open tender	0.742
Selective tender	0.760	Selective tender	0.761
Direct order	0.773	Direct order	0.725
Overall Cronbach's α	**0.778**	**Overall Cronbach's α**	**0.765**

Reliability test for the types of contracts used

DBB procurement method		DB procurement method	
Types of contracts	**Cronbach's alpha**	**Types of contracts**	**Cronbach's alpha**
Suitability of BOQ with DBB procurement	0.780	Suitability of BOQ with DB procurement	0.770
Suitability of Lump Sum with DBB procurement	0.754	Suitability of Lump Sum with DB procurement	0.753
Suitability of Cost Plus with DBB procurement	0.776	Suitability of Cost Plus with DB procurement	0.724
Overall Cronbach's α	**0.790**	**Overall Cronbach's α**	**0.777**

One way ANOVA test for (project parties involvement, types of contracts used and types of tenders used) DBB

ANOVA test for project parties' involvement		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Client Involvement in project	Between Groups	2.882	2	1.441	1.612	.204
	Within Groups	109.975	123	.894		
	Total	112.857	125			
Contractor involvement in project	Between Groups	1.594	2	.797	1.567	.213
	Within Groups	62.565	123	.509		
	Total	64.159	125			
Consultant involvement in project	Between Groups	2.017	2	1.009	1.704	.186
	Within Groups	72.808	123	.592		
	Total	74.825	125			
ANOVA test for types of contracts used		**Sum of Squares**	**df**	**Mean Square**	**F**	**P Value Sig**
Suitability of BOQ with DBB method	Between Groups	.128	2	.064	.133	.876
	Within Groups	59.079	123	.480		
	Total	59.206	125			
Suitability of Lump Sum with DBB method	Between Groups	2.756	2	1.378	1.534	.220
	Within Groups	110.458	123	.898		
	Total	113.214	125			
Suitability of Cost Plus with DBB method	Between Groups	10.893	2	1.202	1.420	.225
	Within Groups	154.821	123	.785		
	Total	165.714	125			
ANOVA test for types of tenders used		**Sum of Squares**	**df**	**Mean Square**	**F**	**P Value Sig**
The frequency of using the open tender for DBB method	Between Groups	9.167	2	.064	.133	.870
	Within Groups	186.991	123	.480		
	Total	196.159	125			
The frequency of using the selective tender for DBB method	Between Groups	4.999	2	2.500	1.860	.160
	Within Groups	165.326	123	1.344		
	Total	170.325	125			
The frequency of using the direct order for DBB method	Between Groups	.003	2	.001	.001	.999
	Within Groups	245.711	123	1.998		
	Total	245.714	125			

One way ANOVA test for (project parties involvement, types of contracts used and types of tenders used) DB

ANOVA test for project parties' involvement		**Sum of Squares**	**df**	**Mean Square**	**F**	**P Value Sig**
Client Involvement in project	Between Groups	8.785	2	4.393	2.007	.139
	Within Groups	267.023	122	2.189		
	Total	275.808	124			
Contractor involvement in project	Between Groups	10.893	2	1.202	1.420	.225
	Within Groups	154.821	123	.785		
	Total	165.714	125			

		Sum of Squares	df	Mean Square	F	P Value Sig
Consultant involvement in project	Between Groups Within Groups Total	6.152 203.792 209.944	2 123 125	3.076 1.657	1.857	.161
ANOVA test for types of contracts used		**Sum of Squares**	**df**	**Mean Square**	**F**	**P Value Sig**
Suitability of BOQ with DBB method	Between Groups Within Groups Total	1.740 157.975 159.714	2 123 125	.870 1.284	.677	.510
Suitability of Lump Sum with DBB method	Between Groups Within Groups Total	3.042 191.887 194.929	2 123 125	1.521 1.560	.975	.380
Suitability of Cost Plus with DBB method	Between Groups Within Groups Total	2.756 110.458 113.214	2 123 125	1.378 .898	1.534	.220
ANOVA test for types of tenders used		**Sum of Squares**	**df**	**Mean Square**	**F**	**P Value Sig**
The frequency of using the open tender for DBB method	Between Groups Within Groups Total	6.152 203.792 209.944	2 123 125	3.076 1.657	1.857	.161
The frequency of using the selective tender for DBB method	Between Groups Within Groups Total	5.872 183.406 189.278	2 123 125	2.936 1.491	1.969	.144
The frequency of using the direct order for DBB method	Between Groups Within Groups Total	8.785 267.023 275.808	2 122 124	4.393 2.189	2.007	.139

One way ANOVA test for factors behind selection of the most common PMs

factors behind selection of the most common PMs		Sum of Squares	df	Mean Square	F	P Value Sig
Lack of client knowledge and experience with the other types of construction procurement	Between Groups Within Groups Total	.518 162.783 163.302	2 123 125	.259 1.323	.196	.822
Rushed decision making by client	Between Groups Within Groups Total	3.228 133.129 136.357	2 123 125	1.614 1.082	1.491	.229
Client reluctance to try and use modern procurement	Between Groups Within Groups Total	.381 62.421 62.802	2 123 125	.190 .507	.375	.688
External pressure (political-economical)	Between Groups Within Groups Total	1.235 104.067 105.302	2 123 125	.617 .846	.730	.484

One way ANOVA test for factor responsible for poor performance (DBB)

factor responsible for poor performance		Sum of Squares	df	Mean Square	F	P value (Sig)
Poor contract management	Between Groups	5.316	2	2.658	2.124	.124
	Within Groups	153.898	123	1.251		
	Total	159.214	125			
Improper planing and design	Between Groups	6.334	2	3.167	2.787	.066
	Within Groups	139.800	123	1.137		
	Total	146.135	125			
Inadequate contractor experience	Between Groups	1.979	2	.990	.902	.408
	Within Groups	134.878	123	1.097		
	Total	136.857	125			
Slow decision making by client	Between Groups	2.882	2	1.441	1.371	.258
	Within Groups	129.253	123	1.051		
	Total	132.135	125			
Inappropriate contract type	Between Groups	4.931	2	2.465	2.338	.101
	Within Groups	129.704	123	1.055		
	Total	134.635	125			
Inappropriate payment method	Between Groups	5.316	2	2.658	2.124	.124
	Within Groups	153.898	123	1.251		
	Total	159.214	125			
Delay in delivery of materials to the site	Between Groups	4.117	2	2.058	1.294	.278
	Within Groups	195.598	123	1.590		
	Total	199.714	125			
Conflict among project participants	Between Groups	.268	2	.134	.109	.896
	Within Groups	150.724	123	1.225		
	Total	150.992	125			
Construction mistakes and defective work	Between Groups	.148	2	.074	.070	.932
	Within Groups	129.154	123	1.050		
	Total	129.302	125			
Poor skills and experience of labour	Between Groups	1.954	2	.977	.946	.391
	Within Groups	126.975	123	1.032		
	Total	128.929	125			
Lack of coordination between clients and contractors	Between Groups	2.447	2	1.223	1.243	.292
	Within Groups	121.022	123	.984		
	Total	123.468	125			
Difficulty of project site	Between Groups	.995	2	.497	.379	.685
	Within Groups	161.362	123	1.312		
	Total	162.357	125			
Unavailability of resources as planned through the project duration	Between Groups	1.585	2	.793	.643	.527
	Within Groups	151.621	123	1.233		
	Total	153.206	125			
Poor leadership skills for project manager	Between Groups	3.941	2	1.971	1.715	.184
	Within Groups	141.360	123	1.149		
	Total	145.302	125			

One way ANOVA test for factors responsible for PP (DB)

factor responsible for poor performance		Sum of Squares	df	Mean Square	F	P value (Sig)
Poor contract management	Between Groups	3.239	2	1.619	1.051	.353
	Within Groups	189.586	123	1.541		
	Total	192.825	125			
Improper planing and design	Between Groups	.385	2	.192	.307	.736
	Within Groups	77.115	123	.627		
	Total	77.500	125			
Inadequate contractor experience	Between Groups	.593	2	.296	.273	.761
	Within Groups	129.112	119	1.085		
	Total	129.705	121			
Slow decision making by client	Between Groups	2.383	2	1.191	1.019	.364
	Within Groups	140.268	120	1.169		
	Total	142.650	122			
Inappropriate contract type	Between Groups	.290	2	.145	.168	.846
	Within Groups	106.249	123	.864		
	Total	106.540	125			
Inappropriate payment method	Between Groups	5.316	2	2.658	2.124	.124
	Within Groups	153.898	123	1.251		
	Total	159.214	125			
Delay in delivery of materials to the site	Between Groups	5.571	2	2.785	2.594	.079
	Within Groups	128.836	120	1.074		
	Total	134.407	122			
Conflict among project participants	Between Groups	.454	2	.227	.220	.803
	Within Groups	118.834	115	1.033		
	Total	119.288	117			
Construction mistakes and defective work	Between Groups	1.330	2	.665	.807	.449
	Within Groups	97.183	118	.824		
	Total	98.512	120			
Poor skills and experience of labour	Between Groups	.059	2	.030	.037	.963
	Within Groups	94.105	119	.791		
	Total	94.164	121			
Lack of coordination between clients and contractors	Between Groups	.376	2	.188	.180	.835
	Within Groups	124.051	119	1.042		
	Total	124.426	121			
Difficulty of project site	Between Groups	3.484	2	1.742	1.926	.150
	Within Groups	108.533	120	.904		
	Total	112.016	122			
Unavailability of resources as planned through the project duration	Between Groups	.301	2	.150	.200	.819
	Within Groups	90.203	120	.752		
	Total	90.504	122			
Poor leadership skills for project manager	Between Groups	.064	2	.032	.023	.977
	Within Groups	170.864	123	1.389		
	Total	170.929	125			

Appendix D: Correlation test results

(i) Correlation between DBB procurement criteria and project performance for clients group
(ii) Correlation between DBB procurement criteria and project performance for contractors group
(iii) Correlation between DBB procurement criteria and project performance for consultants group
(iv) Correlation between DBB procurement criteria and project performance for overall group
(v) Correlation between DB procurement criteria and project performance for clients group
(vi) Correlation between DB procurement criteria and project performance for contractors group
(vii) Correlation between DB procurement criteria and project performance for consultants group
(viii) Correlation between DB procurement criteria and project performance for overall group

(i) Correlation between DBB selection criteria and PP criteria (clients)

Procurement criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
High price competition	Correlation Coefficient	.267*	.272*	-.218
	Sig. (2-tailed)	.041	.037	.097
	N	59	59	59
Clarity of scope definition	Correlation Coefficient	.118	-.046	.035
	Sig. (2-tailed)	.375	.729	.791
	N	59	59	59
Complexity of project design	Correlation Coefficient	.329*	.105	.057
	Sig. (2-tailed)	.011	.427	.669
	N	59	59	59
High quality Level of project quality	Correlation Coefficient	-.130	-.031	.343**
	Sig. (2-tailed)	.327	.817	.008
	N	59	59	59
Clear definition of project parties responsibility	Correlation Coefficient	-.100	.135	.271*
	Sig. (2-tailed)	.453	.307	.038
	N	59	59	59
Client involvement in the project	Correlation Coefficient	.005	.319*	.142
	Sig. (2-tailed)	.969	.014	.283
	N	59	59	59
Controllable project variations	Correlation Coefficient	-.150	.041	.286*
	Sig. (2-tailed)	.256	.760	.028
	N	59	59	59
Cost certainty	Correlation Coefficient	-.090	.074	.196
	Sig. (2-tailed)	.497	.580	.136
	N	59	59	59
Time certainty	Correlation Coefficient	.027	.275*	-.069
	Sig. (2-tailed)	.838	.035	.603
	N	59	59	59
Ease of organizing and reviewing project activates.	Correlation Coefficient	.247	.227	-.183
	Sig. (2-tailed)	.060	.084	.166
	N	59	59	59
Desiring efficient project planning	Correlation Coefficient	.080	.223	-.061
	Sig. (2-tailed)	.548	.089	.647
	N	59	59	59
Project functionality	Correlation Coefficient	.685**	.179	.290*
	Sig. (2-tailed)	.000	.174	.042
	N	59	59	59

(ii) Correlation between DBB selection criteria and PP criteria (contractors)

Procurement criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
High price competition	Correlation Coefficient	.164	.072	.067
	Sig. (2-tailed)	.306	.653	.679
	N	41	41	41
Clarity of scope definition	Correlation Coefficient	.063	-.139	.112
	Sig. (2-tailed)	.694	.384	.486
	N	41	41	41
Complexity of project design	Correlation Coefficient	.194	.161	-.001
	Sig. (2-tailed)	.223	.314	.997
	N	41	41	41
High quality Level of project quality	Correlation Coefficient	-.281	-.381*	.096
	Sig. (2-tailed)	.075	.014	.551
	N	41	41	41
Clear definition of project parties responsibility	Correlation Coefficient	-.318*	.001	-.075
	Sig. (2-tailed)	.043	.993	.643
	N	41	41	41
Client involvement in the project	Correlation Coefficient	.328*	.262	.009
	Sig. (2-tailed)	.037	.098	.958
	N	41	41	41
controllable project variations	Correlation Coefficient	.096	.084	.437**
	Sig. (2-tailed)	.551	.600	.004
	N	41	41	41
Cost certainty	Correlation Coefficient	.071	.121	-.126
	Sig. (2-tailed)	.660	.453	.431
	N	41	41	41
Time certainty	Correlation Coefficient	-.101	-.074	-.283
	Sig. (2-tailed)	.529	.645	.073
	N	41	41	41
Ease of organizing and reviewing project activates.	Correlation Coefficient	.132	-.037	-.058
	Sig. (2-tailed)	.410	.819	.717
	N	41	41	41
Desiring efficient project planning	Correlation Coefficient	-.077	-.047	.025
	Sig. (2-tailed)	.632	.772	.877
	N	41	41	41
Project functionality	Correlation Coefficient	.638**	.227	.051
	Sig. (2-tailed)	.000	.154	.753
	N	41	41	41

(iii) Correlation between DBB selection criteria and PP criteria (consultants)

Procurement criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
High price competition	Correlation Coefficient	-.225	.132	-.162
	Sig. (2-tailed)	.269	.520	.429
	N	26	26	26
Clarity of scope definition	Correlation Coefficient	-.201	-.068	-.042
	Sig. (2-tailed)	.325	.740	.840
	N	26	26	26
Complexity of project design	Correlation Coefficient	-.216	-.135	.488*
	Sig. (2-tailed)	.290	.512	.012
	N	26	26	26
High quality Level of project quality	Correlation Coefficient	-.239	-.491*	.675**
	Sig. (2-tailed)	.239	.011	.000
	N	26	26	26
Clear definition of project parties responsibility	Correlation Coefficient	.011	.154	.363
	Sig. (2-tailed)	.957	.454	.068
	N	26	26	26
Client involvement in the project	Correlation Coefficient	.155	.231	.194
	Sig. (2-tailed)	.451	.257	.343
	N	26	26	26
controllable project variations	Correlation Coefficient	.043	-.066	.536**
	Sig. (2-tailed)	.834	.750	.004
	N	26	26	26
Cost certainty	Correlation Coefficient	.189	.245	.253
	Sig. (2-tailed)	.356	.228	.213
	N	26	26	26
Time certainty	Correlation Coefficient	.246	.239	.134
	Sig. (2-tailed)	.226	.239	.514
	N	26	26	26
Ease of organizing and reviewing project activates.	Correlation Coefficient	.214	.055	.378
	Sig. (2-tailed)	.294	.789	.057
	N	26	26	26
Desiring efficient project planning	Correlation Coefficient	.136	-.040	.412*
	Sig. (2-tailed)	.507	.847	.036
	N	26	26	26
Project functionality	Correlation Coefficient	.686**	.105	.131
	Sig. (2-tailed)	.000	.611	.522
	N	26	26	26

(iv) Correlation between DBB selection criteria and PP criteria (overall group)

Procurement criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
High price competition	Correlation Coefficient	-.112	-.055	-.121
	Sig. (2-tailed)	.212	.544	.176
	N	126	126	126
Clarity of scope definition	Correlation Coefficient	.021	-.029	.027
	Sig. (2-tailed)	.815	.748	.765
	N	126	126	126
Complexity of project design	Correlation Coefficient	.176*	.073	.122
	Sig. (2-tailed)	.048	.418	.173
	N	126	126	126
High quality Level of project quality	Correlation Coefficient	-.201*	-.345**	.322**
	Sig. (2-tailed)	.024	.006	.000
	N	126	126	126
Clear definition of project parties responsibility	Correlation Coefficient	-.135	.115	.152
	Sig. (2-tailed)	.131	.200	.089
	N	126	126	126
Client involvement in the project	Correlation Coefficient	.141	.371**	.105
	Sig. (2-tailed)	.116	.008	.240
	N	126	126	126
Controllable project variations	Correlation Coefficient	-.035	.044	.374**
	Sig. (2-tailed)	.694	.625	.000
	N	126	126	126
Cost certainty	Correlation Coefficient	.009	.134	.094
	Sig. (2-tailed)	.918	.136	.296
	N	126	126	126
Time certainty	Correlation Coefficient	.028	.188*	-.117
	Sig. (2-tailed)	.753	.039	.192
	N	126	126	126
Ease of organizing and reviewing project activates.	Correlation Coefficient	.203*	.103	-.047
	Sig. (2-tailed)	.023	.250	.605
	N	126	126	126
Desiring efficient project planning	Correlation Coefficient	.035	.073	.054
	Sig. (2-tailed)	.697	.418	.548
	N	126	126	126
Project functionality	Correlation Coefficient	.671**	-.088	.177*
	Sig. (2-tailed)	.000	.328	.048
	N	126	126	126

(v) Correlation between DB selection criteria and PP criteria (clients)

Procurement Criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
Quick delivery of construction processes	Correlation Coefficient	.510**	.517**	.061
	Sig. (2-tailed)	.000	.000	.645
	N	59	59	59
Quick project commencement	Correlation Coefficient	.473**	.152	-.213
	Sig. (2-tailed)	.000	.252	.106
	N	59	59	59
Effective communication between project parties	Correlation Coefficient	.377**	.406**	.142
	Sig. (2-tailed)	.003	.001	.284
	N	59	59	59
Flexibility in design & construction changes	Correlation Coefficient	-.317*	.179	-.169
	Sig. (2-tailed)	.014	.176	.202
	N	59	59	59
Single point of responsibility	Correlation Coefficient	.259*	.265*	-.239
	Sig. (2-tailed)	.047	.042	.068
	N	59	59	59
Less conflict amongst project team	Correlation Coefficient	.005	.097	.020
	Sig. (2-tailed)	.973	.465	.880
	N	59	59	59
Complexity of design	Correlation Coefficient	-.171	.026	.339**
	Sig. (2-tailed)	.196	.846	.009
	N	59	59	59
Transfer of risks to the contractor	Correlation Coefficient	.169	.110	-.048
	Sig. (2-tailed)	.201	.409	.717
	N	59	59	59
Desiring reduced project cost	Correlation Coefficient	.054	-.168	-.286*
	Sig. (2-tailed)	.684	.203	.028
	N	59	59	59
Desiring reduced project time	Correlation Coefficient	.304*	.125	-.082
	Sig. (2-tailed)	.019	.345	.539
	N	59	59	59
Level of competence and experienced contractor	Correlation Coefficient	.028	.047	.127
	Sig. (2-tailed)	.834	.725	.339
	N	59	59	59
Collaborative working relationship between	Correlation Coefficient	.148	.196	.172
	Sig. (2-tailed)	.264	.137	.192
	N	59	59	59
Desiring efficient project planning	Correlation Coefficient	.129	.186	.144
	Sig. (2-tailed)	.331	.158	.276
	N	59	59	59

(vi) Correlation between DB selection criteria and PP criteria (contractors)

Procurement Criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
Quick delivery of construction processes	Correlation Coefficient	.355*	.168	.158
	Sig. (2-tailed)	.023	.292	.325
	N	41	41	41
Quick project commencement	Correlation Coefficient	.084	-.131	-.051
	Sig. (2-tailed)	.602	.414	.752
	N	41	41	41
Effective communication between project parties	Correlation Coefficient	.354*	-.083	.034
	Sig. (2-tailed)	.023	.607	.833
	N	41	41	41
Flexibility in design & construction changes	Correlation Coefficient	.289	.177	.341*
	Sig. (2-tailed)	.066	.267	.029
	N	41	41	41
Single point of responsibility	Correlation Coefficient	-.034	-.039	-.021
	Sig. (2-tailed)	.834	.809	.899
	N	41	41	41
Less conflict amongst project team	Correlation Coefficient	.249	.083	.341
	Sig. (2-tailed)	.116	.605	.023
	N	41	41	41
Complexity of design	Correlation Coefficient	.295	.199	.243
	Sig. (2-tailed)	.061	.211	.126
	N	41	41	41
Transfer of risks to the contractor	Correlation Coefficient	.168	.130	.192
	Sig. (2-tailed)	.294	.418	.229
	N	41	41	41
Desiring reduced project cost	Correlation Coefficient	.060	.120	.190
	Sig. (2-tailed)	.710	.400	.300
	N	41	41	41
Desiring reduced project time	Correlation Coefficient	.430**	.267	.137
	Sig. (2-tailed)	.005	.092	.394
	N	41	41	41
Level of competence and experienced contractor	Correlation Coefficient	.448**	.260	.241
	Sig. (2-tailed)	.003	.098	.128
	N	41	41	41
Collaborative working relationship between	Correlation Coefficient	.435**	-.083	.034
	Sig. (2-tailed)	.005	.607	.833
	N	41	41	41
Desiring efficient project planning	Correlation Coefficient	.408**	.387*	.241
	Sig. (2-tailed)	.008	.013	.128
	N	41	41	41

(vii) Correlation between DB selection criteria and PP criteria (consultants)

Procurement Criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
Quick delivery of construction processes	Correlation Coefficient	-.115	-.150	.034
	Sig. (2-tailed)	.577	.464	.871
	N	26	26	26
Quick project commencement	Correlation Coefficient	.000	-.131	.346
	Sig. (2-tailed)	.999	.522	.083
	N	26	26	26
Effective communication between project parties	Correlation Coefficient	-.160	.065	-.258
	Sig. (2-tailed)	.436	.751	.203
	N	26	26	26
Flexibility in design & construction changes	Correlation Coefficient	.191	-.203	.118
	Sig. (2-tailed)	.351	.319	.565
	N	26	26	26
Single point of responsibility	Correlation Coefficient	.177	-.258	-.008
	Sig. (2-tailed)	.388	.203	.967
	N	26	26	26
Less conflict amongst project team	Correlation Coefficient	.089	-.021	.105
	Sig. (2-tailed)	.666	.921	.609
	N	26	26	26
Complexity of design	Correlation Coefficient	-.345	-.275	.162
	Sig. (2-tailed)	.084	.173	.428
	N	26	26	26
Transfer of risks to the contractor	Correlation Coefficient	.026	-.029	.128
	Sig. (2-tailed)	.900	.888	.534
	N	26	26	26
Desiring reduced project cost	Correlation Coefficient	.018	.102	-.424*
	Sig. (2-tailed)	.929	.619	.031
	N	26	26	26
Desiring reduced project time	Correlation Coefficient	-.675**	-.321	.008
	Sig. (2-tailed)	.000	.110	.970
	N	26	26	26
Level of competence and experienced contractor	Correlation Coefficient	.015	-.265	.528**
	Sig. (2-tailed)	.943	.191	.006
	N	26	26	26
Collaborative working relationship between	Correlation Coefficient	.161	-.117	-.110
	Sig. (2-tailed)	.433	.570	.594
	N	26	26	26
Desiring efficient project planning	Correlation Coefficient	.118	-.071	-.135
	Sig. (2-tailed)	.566	.729	.510
	N	26	26	26

(viii) Correlation between DB selection criteria and PP criteria (overall group)

Procurement Criteria		C.P on schedule (Time)	C.P on Budget (Cost)	C.P at Quality (Quality)
Quick delivery of construction processes	Correlation Coefficient	.399**	.324*	.094
	Sig. (2-tailed)	.001	.001	.293
	N	126	126	126
Quick project commencement	Correlation Coefficient	.369**	.030	-.056
	Sig. (2-tailed)	.002	.735	.535
	N	126	126	126
Effective communication between project parties	Correlation Coefficient	.375**	.397**	.078
	Sig. (2-tailed)	.002	.009	.388
	N	126	126	126
Flexibility in design & construction changes	Correlation Coefficient	.249**	.082	-.014
	Sig. (2-tailed)	.005	.360	.881
	N	126	126	126
Single point of responsibility	Correlation Coefficient	.134	.028	-.128
	Sig. (2-tailed)	.134	.752	.153
	N	126	126	126
Less conflict amongst project team	Correlation Coefficient	.082	.063	.144
	Sig. (2-tailed)	.363	.482	.108
	N	126	126	126
Complexity of design	Correlation Coefficient	-.186*	-.080	.248**
	Sig. (2-tailed)	.037	.371	.005
	N	126	126	126
Transfer of risks to the contractor	Correlation Coefficient	.005	.013	-.016
	Sig. (2-tailed)	.956	.884	.856
	N	126	126	126
Desiring reduced project cost	Correlation Coefficient	.136	.024	.190*
	Sig. (2-tailed)	.129	.789	.033
	N	126	126	126
Desiring reduced project time	Correlation Coefficient	.231**	.091	-.163
	Sig. (2-tailed)	.006	.308	.069
	N	126	126	126
Level of competence and experienced contractor	Correlation Coefficient	.163	.114	-.050
	Sig. (2-tailed)	.068	.204	.581
	N	126	126	126
Collaborative working relationship between	Correlation Coefficient	.333**	.165	.114
	Sig. (2-tailed)	.003	.064	.205
	N	126	126	126
Desiring efficient project planning	Correlation Coefficient	.201*	.176*	.161
	Sig. (2-tailed)	.024	.049	.072
	N	126	126	126

Appendix E: Multiple regression coefficients

(i) DBB procurement selection criteria with significant contribution to the PP in terms of time
(ii) DBB procurement selection criteria with significant contribution to the PP in terms of cost
(iii) DBB procurement selection criteria with significant contribution to the PP in terms of quality
(iv) DB procurement selection criteria with significant contribution to the PP in terms of time
(v) DB procurement selection criteria with significant contribution to the PP in terms of cost
(vi) DB procurement selection criteria with significant contribution to the PP in terms of quality

(a) **DBB selection criteria with significant contribution to the PP in terms of time**

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Beta			Tolerance	VIF
1	(Constant)	-.239		-.799	.426		
	1-High price competition	.124	.131	2.477	.015	.993	1.00
	2- Clarity of scope definition	.118	.116	2.05	.045	.814	1.221
	3- Complexity of design	.020	.021	.336	.738	.752	1.330
	4- High quality Level required	-.072	-.073	-1.164	.247	.727	1.376
	5- Clear definition of project party's responsibilities	.018	.017	.205	.838	.419	2.389
	6- Client involvement in the project	.194	.209	3.839	.000	.933	1.072
	7- Controllable project variation	.023	.029	.449	.654	.682	1.466
	8- Cost certainty	.029	.031	.368	.713	.413	2.424
	9- Time certainty	-.034	-.035	-.362	.718	.301	3.320
	10- Ease of organizing and reviewing project activates.	.131	.128	1.234	.220	.264	3.789
	11- Desiring efficient project planning	.115	.096	1.969	.033	.993	1.007
	12- Project functionality	1.684	.816	15.302	.000	.9771	1.030

(ii) DBB selection criteria with significant contribution to the PP in terms of cost

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Beta			Tolerance	VIF
1	(Constant)	.810		1.818	.072		
	1-High price competition	-.028	-.030	-.326	.745	.905	1.105
	2- Clarity of scope definition	.033	.031	.309	.758	.753	1.328
	3- Complexity of design	.052	.054	.570	.570	.744	1.344
	4- High quality Level required	.254	.288	2.927	.004	.802	1.247
	5- Clear definition of project party's responsibilities	.236	.235	2.539	.012	.778	1.285
	6- Client involvement in the project	.189	.212	2.488	.014	.922	1.085
	7- Controllable project variation	-.002	-.003	-.027	.979	.414	2.418
	8- Cost certainty	.258	.276	1.999	.049	.814	1.221
	9- Time certainty	.252	.271	1.796	.075	.301	3.318
	10- Ease of organizing and reviewing project activates.	.273	.278	2.135	.035	1.00	1.00
	11- Desiring efficient project planning	-.009	-.008	-.067	.947	.451	2.216
	12- Project functionality	.422	.213	2.549	.012	.954	1.048

(iii) DBB selection criteria with significant contribution to the PP in terms of quality

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig. Tolerance	Collinearity Statistics	
		B	Beta			Tolerance	VIF
1	(Constant)	2.409		5.724	.000		
	1-High price competition	.214	.191	2.36	.020	.957	1.045
	2- Clarity of scope definition	-.222	.198	-2.35	0.324	.905	1.105
	3- Complexity of design	.173	.096	1.989	.049	.814	1.221
	4- High quality Level required	.298	.225	3.15	.002	.963	1.038
	5- Clear definition of project party's responsibilities	.108	.088	.720	.473	.434	2.302
	6- Client involvement in the project	.110	.101	.956	.341	.414	2.418
	7- Controllable project variation	.281	.298	3.694	.000	.964	1.037
	8- Cost certainty	.00	.00	.001	.999	.414	2.418
	9- Time certainty	-.114	-.099	-.680	.498	.301	3.318
	10- Ease of organizing and reviewing project activates.	.231	.192	2.37	.019	.96	1.042
	11- Desiring efficient project planning	.178	.127	1.06	.291	.451	2.216
	12- Project functionality	.063	.026	.296	.768	.843	1.186

(iv) DB selection criteria with significant contribution to the PP in terms of time

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Beta			Tolerance	VIF
1	(Constant)	-.064		-.083	.934		
	13-Quick delivery of construction processes	.047	.046	.381	.704	.450	2.225
	14- Quick project commencement	.229	.230	2.807	.010	.975	1.026
	15- Effective communication between project parties	.172	.188	2.075	.040	.804	1.245
	16- Flexibility in design and construction changes	.084	.085	.737	.463	.495	2.019
	17Single point of responsibility	-.065	-.047	-.469	.640	.657	1.521
	18- Less conflict between project parties	-.158	-.164	-1.643	.103	.671	1.490
	19- complexity of design	.178	.213	2.51	.013	.917	1.091
	20- Transfer of risks to the contractor	.124	.116	1.160	.249	.664	1.506
	21- Desiring reduced project cost	-.139	-.127	-1.076	.284	.475	2.104
	22- Desiring reduced project time	.154	.139	1.117	.267	.430	2.328
	23- Level of competent and experienced contractor.	.056	.060	.632	.529	.734	1.363
	24- Collaborative working relationship between project team	.276	.202	2.179	.031	.763	1.310
	25- Desiring efficient project planning	.022	.022	.192	.848	.524	1.910

(v) DB selection criteria with significant contribution to the PP in terms of cost

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Beta			Tolerance	VIF
1	(Constant)	1.414		1.901	.060		
	13-Quick delivery of construction processes	.069	.076	.584	.561	.450	2.225
	14- Quick project commencement	.042	.047	.448	.655	.698	1.432
	15- Effective communication between project parties	.224	.272	2.763	.009	.694	1.441
	16- Flexibility in design and construction changes	-.041	-.046	-.375	.709	.495	2.019
	17Single point of responsibility	-.098	-.080	-.745	.458	.657	1.521
	18- Less conflict between project parties	-.112	-.129	-1.214	.227	.671	1.490
	19- complexity of design	-.121	-.161	-1.612	.110	.752	1.329
	20- Transfer of risks to the contractor	.108	.112	1.050	.296	.664	1.506
	21- Desiring reduced project cost	-.078	-.079	-.631	.529	.475	2.104
	22- Desiring reduced project time	.027	.027	.203	.840	.430	2.328
	23- Level of competent and experienced contractor.	-.006	-.007	-.068	.946	.734	1.363
	24- Collaborative working relationship between project team	.191	.156	1.190	.237	.441	2.265
	25- Desiring efficient project planning	.003	.003	.027	.978	.524	1.910

(vii) DB selection criteria with significant contribution to the PP in terms of quality

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Beta			Tolerance	VIF
1	(Constant)	2.971		3.878	.000		
	13-Quick delivery of construction processes	.087	.093	.715	.476	.450	2.225
	14- Quick project commencement	.150	.176	2.000	.047	.902	1.109
	15- Effective communication between project parties	.149	.175	1.931	.049	.901	1.109
	16- Flexibility in design and construction changes	-.053	-.058	-.465	.643	.495	2.019
	17Single point of responsibility	-.213	-.167	-1.989	.049	.90	1.11
	18- Less conflict between project parties	.062	.069	.655	.514	.671	1.490
	19- complexity of design	.194	.250	2.919	.004	.998	1.002
	20- Transfer of risks to the contractor	-.029	-.029	-.271	.787	.664	1.506
	21- Desiring reduced project cost	-.113	-.112	-.888	.377	.475	2.104
	22- Desiring reduced project time	.005	.005	.037	.971	.430	2.328
	23- Level of competent and experienced contractor.	-.117	-.136	-1.338	.184	.734	1.363
	24- Collaborative working relationship between project team	.003	.003	.020	.984	.441	2.265
	25- Desiring efficient project planning	.091	.095	.790	.431	.524	1.910

Appendix F: Interview questionnaire for validation of the model

School of Engineering and Design
University of Brunel

VALIDATION OF A MODEL FOR INVESTIGATING THE IMPACT OF CONSTRUCTION PROCUREMENT METHOD ON PROJECT PERFORMANCE

The aim of this questionnaire is to gather information via case study based on recent construction projects under taken in Libya. Personal interviews with project managers, site engineers and general superisors who were highly involved in these projects will be conducted to collect these data. This information will be used to validate a model of investigating the impact of procurement method selection criteria on project performance. The questionnaire is in two parts. **Section A** seeks to collect general information about project, while **Section B** asks respondents who were involved in construction projects to indicate the extent of the influnce of procurement selection criteria that have been used in the design of the model on the performance of these projects. The interviews also aim to identify if there are other procurement criteria influence project performance. There are no correct or incorrect responses, only your much-needed opinions.

We would like to thank you in advance for your valued and kind consideration. If you would like any further information about the research, please let me know.

Alaeddin Ghadamsi
PhD Student
School of Engineering and Design
Brunel University
Tel: 00447411743043
00218913179225
E-mail: mepgamg@brunel.ac.uk or
Alla_Nafa@yahoo.com

Questionnaire on a Case Study of a project procured by traditional method (DBB)

Section A: General information about the project

Project type: …………………………………………………………………. ……….

Project contract type: ………………………………………………………………

Type of project tender: ………………………………………………………………..

Respondents years of experience: ………………………………………………….

Respondents role on the project: ……………………………………………………

Section B: The impact of DBB procurement method on project performance

Q1) Please rank this project on the level of price competition at the time of procurement selection. Use a scale of 1 to 5, where 1 “indicates low price competition” and 5 indicates “high price competition”.	1❑	❑	❑	❑	5❑
Q2) Please rank this project on the level of its scope definition at the time of procurement selection. Use a scale of 1 to 5, where 1 indicates “poorly scope defined” and 5 indicates” well defined scope”	1❑	❑	❑	❑	5❑
Q3) Please rank this project on the level of design complexity at the time of procurement selection. Use a scale of 1 to 5, where 1 indicates “low complexity of design” and 5 indicates “high complexity of design”.	1❑	❑	❑	❑	5❑
Q4) Please rank this project on the quality required level of the project at the time of procurement selection. Use a scale of 1 to 5, where 1 indicates “low level of quality” and 5 indicates “highly level of quality”.	1❑	❑	❑	❑	5❑
Q5) Please rank this project on clarity of project parties’ responsibilities at the time of procurement selection. Use a scale of 1 to 5, where, 1 indicates “unclear definition of responsibility” and 5 “clear definition of responsibilities”.	1❑	❑	❑	❑	5❑
Q6) Please rank this project on the level of involvement of project client during construction processes. Use a scale of 1 to 5, where 1 indicates “low involvement” and 5 indicates “highly involvement”.	1❑	❑	❑	❑	5❑
Q7) Please rank this project on the level of accessibility to controllable variation during construction processes. Use a scale of 1 to 5, where 1 indicates “low accessibility” and 5 “indicate highly	1❑	❑	❑	❑	5❑

accessibility".					
Q8) Please rank this project on the level of certainty on project cost at the time of procurement selection. Use a scale of 1 to 5, where 1 indicates "low degree of certainty" and 5 indicates "highly degree of certainty".	1❑	❑	❑	❑	5❑
Q9) Please rank this project on the level of certainty on project duration at the time of procurement selection. Use a scale of 1 to 5, where 1 indicates "low degree of certainty" and 5 "indicates highly degree of certainty"	1❑	❑	❑	❑	5❑
Q10) Please rank this project on the level of accessibility of organizing and reviewing construction work during construction processes. Use a scale of 1 to 5 where 1 indicates "low accessibility" and 5 indicates "high accessibility"	1❑	❑	❑	❑	5❑
Q11) Please rank this project on the level of accessibility to project plan and design at the time of procurement selection. Use a scale of 1 to 5 where 1 indicates "low accessibility" and 5 "highly accessibility"	1❑	❑	❑	❑	5❑
Q12) Please rank this project on the level of project functionality during construction processes. Use a scale of 1 to 5 where 1 indicates "unclear project functionality" and 5 indicate clear project functionality".	1❑	❑	❑	❑	5❑
Q13) Please indicate any other procurement issue that effect the performance of this project …… …… …… …… …… …… …… ……………………………………					

Questionnaire on a Case Study of a project procured by design and build procurement method (DB)

Section A: General information about the project

Project type: ………………………………………………………………. ……….

Project contract type: ………………………………………………………………

Type of project tender: ……………………………………………………………..

Respondents years of experience: ………………………………………………….

Respondents role on the project: ……………………………………………………

Section B: The impact of DB procurement method on project performance

Q1) Please rank this project on the rate delivery of construction processes during construction processes. Use a scale of 1 to 5, where 1 indicates" slow delivery" and 5 indicates" quick delivery".	1❑	❑	❑	❑	5❑
Q2) Please rank this project on the speed project commencement during construction processes. Use a scale of 1 to 5 where 1 indicates "slow commencement" and 5 indicates "quick commencement".	1❑	❑	❑	❑	5❑
Q3) Please rank this project on the level of communication between project parties during construction processes. Use a scale of 1 to 5, where 1 indicates "ineffective communication" and 5 indicates "effective communication".	1❑	❑	❑	❑	5❑
Q4) Please rank this project on the level of flexibility of design change at the time of procurement selection. Use a scale of 1 to 5 where 1 indicates "low level of flexibility" and 5 indicates "high level of flexibility".	1❑	❑	❑	❑	5❑
Q5) Please rank this project on the level of responsibility of the contractor during construction processes. Use a scale of 1 to 5, where 1 indicates "low level of responsibility" and 5 indicates "high level of responsibility".	1❑	❑	❑	❑	5❑
Q6) Please rank this project on the level of conflict between project parties during construction processes. Use a scale of 1 to 5 where 1 indicates "low level of conflict" and 5 indicates "high level of conflict".	1❑	❑	❑	❑	5❑
Q7) Please rank this project on the level of design complexity at the time of procurement selection. Use a scale of 1 to 5 where 1 indicates "low complexity" and 5 indicates "highly complexity".	1❑	❑	❑	❑	5❑

Q8) Please rank this project on the extent of risk transfer to the contractor at the time of procurement selection. Use a scale of 1 to 5 where 1 indicates “low level of risk transfer” and 5 indicates “highly level of risk transfer”.	1❑	❑	❑	❑	5❑
Q9) Please rank this project on the level of desiring reduced project cost at the time of procurement selection. Use a scale of 1 to 5 where 1 indicates “low possibility” and 5 indicates “high possibility”.	1❑	❑	❑	❑	5❑
Q10) Please rank this project on the level of possibility to minimize project duration at the time of procurement selection. Use a scale of 1 to 5, where 1 indicates “low possibility” and 5 indicates “high possibility”	1❑	❑	❑	❑	5❑
Q11) Please rank this project on the level of experience and efficiency of the contractor during construction processes. Use a scale of 1 to 5 where 1 indicates “low experience and efficiency” and 5 indicate “high experience and efficiency”.	1❑	❑	❑	❑	5❑
Q12) Please rank this project on the level of relationship between project team during construction processes. Use a scale of 1 to 5 where “low relationship” and 5 indicates “high relationship”.	1❑	❑	❑	❑	5❑
Q13) Please rank this project on the level of accessibility to project plan and design at the time of procurement selection. Use a scale of 1 to 5 where 1 indicates “low accessibility” and 5 indicates “highly accessibility”.	1❑	❑	❑	❑	5❑
Q14) Please indicate any other procurement criteria effect the performance of the project ……… ……… ……… ……… ……… ……… ……… ……………………………………					

Appendix G: Chi-square probabilities

df	0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01	0.005
1	---	---	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952

Appendix H: Critical value of Chi-square

df	0.250	0.100	0.050	0.025	0.010	0.005	0.001
1	1.32330	2.70554	3.84146	5.02389	6.63490	7.87944	10.828
2	2.77259	4.60517	5.99147	7.37776	9.21034	10.5966	13.816
3	4.10835	6.25139	7.81473	9.34840	11.3449	12.8381	16.266
4	5.38527	7.77944	9.48773	1.1433	13.2767	14.8602	18.467
5	6.62568	9.23635	11.0705	12.8325	15.0863	16.7496	20.515
6	7.84080	10.6446	12.5916	14.4494	16.8119	18.5476	22.458
7	9.03715	12.0170	14.0671	16.0128	18.4753	20.2777	24.322
8	10.2188	13.3616	15.5073	17.5346	20.0902	21.9550	26.125
9	11.3887	14.6837	16.9190	19.0228	21.6660	23.5893	27.877
10	12.5489	15.9871	18.3070	20.4831	23.2093	25.1882	29.588
11	13.7007	17.2750	19.6751	21.9200	24.7250	26.7569	31.264
12	14.8454	18.5494	21.0261	23.3367	26.2170	28.2995	32.909
13	15.9839	19.8119	22.3621	24.7356	27.6883	29.8194	34.528
14	17.1770	21.0642	23.6848	26.1190	29.1413	31.3193	36.123
15	18.2451	22.3072	24.9958	27.4884	30.5779	32.8013	37.697
16	19.3688	23.5418	26.2962	28.8454	31.9999	34.2672	39.252
17	20.4887	24.7690	27.5871	30.1910	33.4087	35.7185	40.790
18	21.6049	25.9894	28.8693	31.5264	34.8053	37.1564	42.312
19	22.7178	27.2036	30.1435	32.8523	36.1908	38.5822	43.820
20	23.8277	28.4120	31.4104	34.1696	37.5662	39.9968	45.315
21	24.9348	29.6151	32.6705	35.4789	38.9321	41.4010	46.797
22	26.0393	30.8133	33.9244	36.7807	40.2894	42.7956	48.268
23	27.1413	32.0069	35.1725	38.0757	41.6384	44.1813	49.728
24	28.2412	33.1963	36.4151	39.3641	42.9798	45.5585	51.179
25	29.3389	34.3816	37.6525	40.6465	44.3141	46.9278	52.620
26	30.4345	35.5631	38.8852	41.9232	45.6417	48.2899	54.052
27	31.5284	36.7412	40.1133	43.1944	46.9630	49.6449	55.476
28	32.6205	37.9159	41.3372	44.4607	48.2782	50.9933	56.892
29	33.7109	39.0875	42.5569	45.7222	49.5879	52.3356	58.302
30	34.7998	40.2560	43.7729	46.9792	50.8922	53.6720	59.703
40	45.6160	51.8050	65.7585	59.3417	63.6907	66.7659	73.402
50	56.3336	63.1671	67.5048	71.4202	76.1539	79.4900	86.661
60	66.9814	74.3970	79.0819	83.2976	88.3794	91.9517	99.607
70	77.5766	85.5271	90.5312	95.0231	100.425	104.215	112.317
80	88.1303	96.5782	101.879	106.629	112.329	116.321	124.839
90	98.6499	107.565	113.145	118.136	124.116	128.299	137.208
100	109.141	118.498	124.342	129.561	135.807	140.169	149.449