A Framework for Improvement of Contractor Selection Procedures on Major Construction Project in Libya

By

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LIST OF CONTENTS

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LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The construction sector constitutes one of the most important sectors in the economy of any country. Contractor selection is a critical decision that is undertaken by client organisations and is central to the success of any construction project. For major construction projects, final contractor selection often follows the contractor selection stage. Contractor selection is a process which involves investigating, screening and determining whether candidate contractors have the technical and financial capability to be accepted to formally tender for construction work.

The process should be conducted prior to the award of contract, characterized by many factors such as: contactor's skills, experience on similar projects, track- record in the industry, and financial stability. Several models and approaches have been developed to assist client organisations in the contractor selection decision making process. This thesis evaluates the current state of knowledge in relation to contractor selection models.

The key features, strengths and limitations of each of these methods are critically evaluated. The key factors of particular interest to client organisations are assessed. This thesis reports on-going research which aims to develop improved contractor selection criteria and methods with specific application to make construction projects in the Libyan context.

The aim of this thesis is to build a framework for contractor selection process in the Libyan Construction Industry (LCI) and to find out the major obstacles constraining its operations which so far have not yet been taken into account by the Libyan researchers. However, to address that, a huge investigation has taken place about the current statues for contractor selection in Libya, as well as, in developed and well developed countries. To achieve that, both, theoretical and empirical research was carried out between 2010 and 2013 in Libya. The theoretical study concentrated on the sector of construction industry (Cl) and its key issues, whereas the empirical study focused and explored on the Libyan Construction Industry (LCI) as the context for the study.

Two case studies were utilized in this research. The case studies were used to provide more information about the current situation of the LCI and to identify the contractor selection procedures of construction projects in. Also, it assist the researcher to identify key research questions that can later be used in a questionnaire survey.

This research was implemented through the administration of a questionnaire survey based on research questions that are required for the building of a framework for contractor selection procedure and the identification of the challenges and obstacles that are facing the clients in the selection process. The development of the framework includes, but is not limited to, contractor selection criteria, decision makers, consultant, clients and sub-contractor. Therefore, the data collection is based on responses from the public and private sector (clients, consultants, contractors and others that are involved in and are knowledgeable about the contractor selection process in the Libyan construction projects). Mean and analysis of variance (independent T-test) were used to manipulate the data from the questionnaire within the SPSS v.20 software environment. The resulting framework was subjected to a validation procedure which involved a structured Delphi technique process based on a focus group consisting of experts who were selected to help with validation of the framework and establishing the extent to which the framework is practical, clear, applicable and comprehensive. This research uses an integrated approach that combines AHP (Analytic Hierarchy Process) method and TOPSIS (Technique for Order Performance by Similarity to Ideal Solution) method to evaluate and investigate the current existing practice of contractor selection in Libya. Also, the Delphi technique was used to establish a road map for contractor selection process. Twelve participants were selected to help with validation of the framework. Overall, this research found that the LCI was suffering from a total absence of contractor selection frameworks. This directly impacts on client satisfaction as well as government planning in the reconstruction of the country after the civil war in particular. To close this gap, this research was embarked upon to identify and explore the various contractor selection methods and frameworks that are utilized to support the guidance of contractor selection process toward success. As a consequence of this study, the Contractor Selection Process (CSP) is now very comprehensive and can now be a reference for any problem. Furthermore, this research will help decision makers and others involved to be more aware of and have a better understanding of the selection procedure in the LCI. This new understanding will help decision makers to make more efficacious decisions and to adopt good short and long term policies for contractor selection planning which can then be put into procedure. Even though this framework is built for the LCI, the research can be utilised in other countries that have a similar construction industry environment

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Othoman Elsayah.

DECLARATION

I hereby declare that this thesis is my own work and effort and that it has not been submitted anywhere for any award. Where other sources of information have been used, they have been acknowledged

Signature: ……………………………………….

Date: …………………………………………….

LIST OF ABBREVIATIONS

Abbreviation	Character
AHP	Analytic Hierarchy Process
CCP	Contractor Selection Process
CDP	Criterion Decision Plus
CIA	Central Intelligence Agency
CSP	Contactor selection process
D&B	Design-Build Procurement Method
DM	Decision Makers
GDP	Gross Domestic Product
GNC	General National Congress
EMR	experience Modification Rating
HIB	Housing and Infrastructure Board
HRM	Human Resource Management
KMO	Kaiser-Meyer-Olkin
LCI	Libyan Construction Industry
LDW	Logical Decisions for Windows
MHU	Ministry of Housing and Utility
MPS	Management Procurement Systems
NIS	Negative Ideal Solution
NTC	National Transitional Council
SMS	Safety Management System
SPSS	Statistical Package for the Social Sciences
SMART	Simple Multi-Attribute Rating Technique
TOPSIS	Technique for Ordering Performance by Similarity to provide an Ideal Solution
TPS	Traditional procurement System
UNHDI	United Nation’s Human Development Index
UN	United Nations

CHAPTER ONE: INTRODUCTION

1.1 Aims of the chapter

This chapter aims to provide a brief introduction to the reader about the purpose and subject area of the research study. Further, the aims and objectives as well as the significance of the study of this research are also summarized and project problems are also identified. In this chapter an overview of the design of research methodology is also illustrated. Finally, an outline of the research and the thesis guide are shown at the end of this chapter.

1.2 Introduction

The history of the investigation in this study is dependent on feedback from previous and present experience of the research in the field of construction industry and its associated procedures and operations in Libya over the past two to three decades. Project success is the aim of any project owner. There are several factors that contribute to project success and one of the essential elements is contractor (bidder) evaluation, a process called the contractor selection process (Morote & Vila, 2012). Contractor selection is a critical activity that plays a major role towards the success of any construction project and it considers the most challenging decision for the client (Kog & Yaman, 2014). Selection process is a process that involves investigating, screening and deciding if candidate contractors (bidders) can be accepted as formal contractors (Jaskowski, et al., 2010). The process should be conducted prior to the award of contract and a contractor’s success is based on their skills, construction experience, financial stability, current workload, safety procedure and record and other criteria which usually depend on the decision maker. Construction contractors have a large influence upon projects and their successes. Consequently, it is quite critical to choose a qualified contractor in the procedure of construction management (Huang, 2011). A capable construction contractor is indispensable in proper procedure and completion of a construction project. However, the objective of the selection process is not only to ensure that the contractors' characteristics and capabilities match the requirements of the project under consideration but also the limitation of potential bidders. In such a case it is essential not only to judge whether the contractor fulfils the basic criteria, but also to what degree that criterion is fulfilled.

Cristóbal (2012) points out that contractor selection plays a vital role in the project performance. Appointing the suitable contractor for the right project is the most crucial challenge for any decision maker. The critical sources of delay are due to the fact that the project contractor does not have enough working capital, late advance payment, poor planning, poor site management and inadequate contractor experience (Tawil, et al., 2013). The selection of the contractor is one of the most significant issues affecting the success of a construction project and it is one of the most challenging decision-making aspects of a construction project (Kog & Yaman, 2014). In the other words, it means to attain the best outcome in the cost time quality triangle for construction project management.

Findings by researchers in civil engineering and construction at Libyan universities and elsewhere (Benkrima, 2001; Omar, 2003) revealed that delays in public projects in Libya are extensive and warrant further, rigorous investigation of the circumstances causing these problematic delays. New legislation has been implemented in Libya recently, for example the Ministry of Housing and Utilities in 2007 was established in 2006 under the legislation number (60) by Libyan General People's Committee.

According to Ali (2011), a contractor for a project has to be carefully selected taking into account the availability of knowledge, capability and experiences. This should be considered before the tendering stage in order to ensure that an appropriate contractor will be selected. A large number of projects have been delayed and failed in Libya because of a lack of efficiency and ability of the contractors. This may have been due to the absence of suitable selection criteria which allowed selection of appropriate contractor. This is considered as an essential issue in relation to the achievement of construction projects and would be taken into consideration. Delays in project completion time and increases in cost of construction projects have been closely related to specifications and contractors' qualification such as financial, technical, experience, contract type, variation between the contractor's bid price and the next lowest bidder's price which have been associated with the capability of contractor (Omran , et al., 2012).

It can be said that implementing a contractor selection process and the identification and recognition of criteria for competent contractors is essential for making progress with current redevelopment plans in Libya.

From the above, it is clear that contractor selection is an important factor that affects construction success. These factors, if not properly managed, will lead to construction project failures. However, in the coming years, Libya will be largely engaged in comprehensive plans for redeveloping large parts of the country. The programme includes, but is not limited to, building developments, infrastructure constructions, airport reconstructions, and highways new developments all of which need contributions from well developed countries, in the field of the investment and construction performance. Therefore, to help the improvement in construction project achievements, this research will focus on one of the most important factors of project success which is establishing a framework for contractor selection procedure in the LCI. This framework will be used to select local and international contractors in general construction projects such as infrastructure projects, building, air ports etc. in both private and public sectors.

Thus, this study investigates and assesses the current practice of contractor selection in the LCI. A model for contractor selection that could be utilised for contractor's selection in the LCI is developed. The main focus of this research is how to select a contractor who can satisfactorily reach the client's needs in terms of time, cost and quality. For this purpose, a contractor selection criteria model has been built using Analytic Hierarchy Process (AHP) and Technique of Order Preference by Similarity to Ideal Solution (TOPSIS) software. This investigation revolves around achievement in the contractor selection process and improvement of the image of the LCI.

1.3 Problem statement of contactor selection in Libya

Identification of the problem motivating the study should be the first step in design and development research (Ellis and Yair 2010).

According to Ali (2011), the success of any construction project is considered a complementary procedure. If any participating body is wrongly chosen, that will certainly influence the achievement of the completion project. In Libya, a large number of projects have been failed because of a lack of competence and ability of the contractors. This may have been due to the absence of appropriate selection criteria which allowed selection of "the wrong" contractor. Krima (2009) confirmed that one of the main factors that causes delay in construction projects and their ranking as a whole is lack of or bad application of modern planning techniques by the contractor.

Omran et al (2012), published a paper in which they evaluated the critical success factors for construction projects in Libya and found that contractor's experience, cash flow, effective site management and cost control are considered as important factors which impact on the success of a construction project in a study which set out to analyse and quantify delay factors affecting construction projects in Libya.

Abubaker et al (2008), published a paper in which they assessed the critical success factors for construction projects project planning on Libyan construction projects and found that out of the 120 projects reported by respondents, a clear majority (83, i.e. 69%) suffered some delay and only 37 (31%) finished within time. The standard level of contractor selection criteria in Libya is still inadequate as a number of significant factors are not presently taken into account by decision makers. Such factors include the ineffective planning and scheduling of projects by contractor and poor qualification of the contractor's technical staff, difficulties in financing projects by contractor, incorrect construction methods implemented by contractor, shortage of equipment, low level of equipment-operator's skill, equipment breakdowns, poor selection of sub-contractor and conflicts in sub-contractors schedule in execution of project.

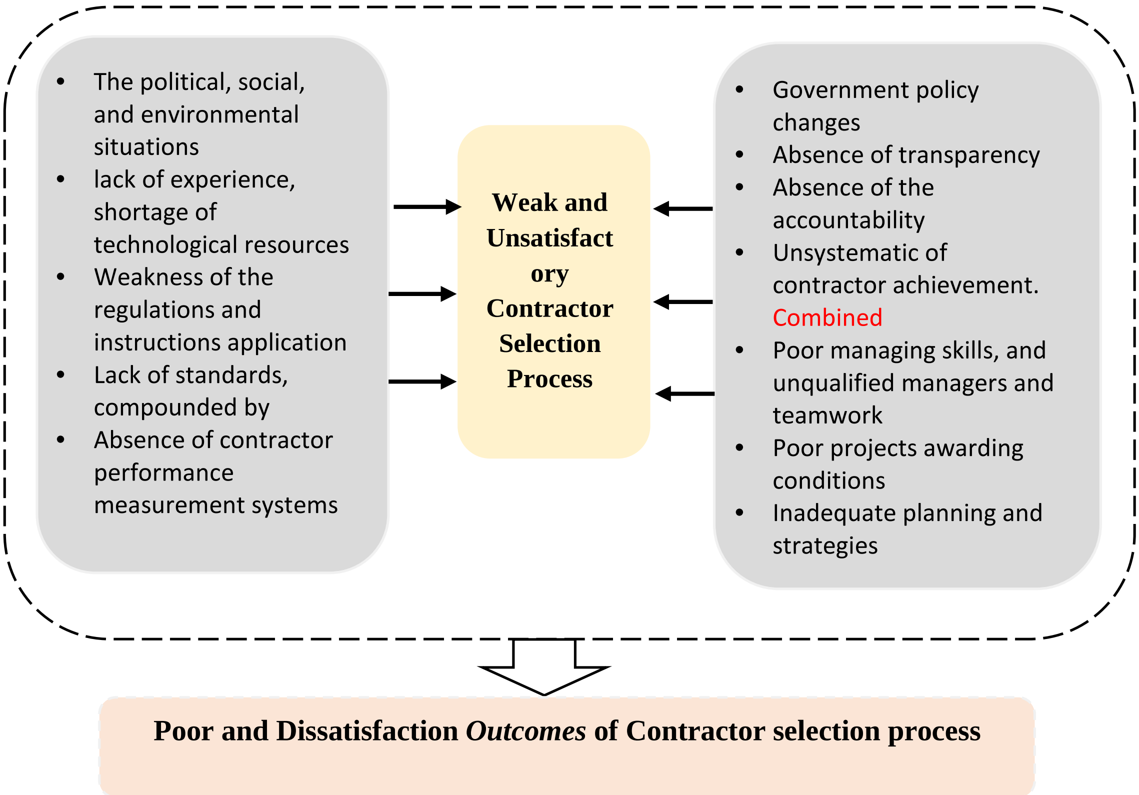

Figure 1-1 Problem background

To improve and enhance the operations of the Libyan construction industry, it is necessary to understand what the key factors are affecting the construction industry and its associated operations. From above studies, it is clear that there is insufficiency in both private and public construction sectors and contractor selection is considered one of the most important factors that impacts on construction project success in the LCI. Thus, it clear that a framework and special tools need to be developed which will help stakeholders to select a qualified contractor from amongst the possible candidates who are able meet the project’s needs.

1.4 Research question

Draper (2004) defines the research question as ‘the broad question which is set at the start of a study'. The centrality of the research question to the whole research process is outlined. The question needs to be clear and well-articulated so that there is no doubt about what the researcher wants to know.

According to Kowalczyk (2015)a research question is an answerable inquiry into a specific concern or issue. It is the initial step in a research project. The 'initial step' means after you have an idea of what you want to study, the research question is the first active step in the research project.

In this study, the process of developing the research questions was based on a review of the literature related to the contractor selection process in the construction industry during the course of this study. In addition, the questions were improved through discussion with construction industry specialists and finally revised throughout all phases of the research process in order to meet the purposes of the study. At the end of this process, the study attempts to answer the following key questions. Therefore, this research will study and provide a solution to the most important problems facing the process of CSP in Libya these are:

- How could clients select the most capable contractor for finishing a particular project within specific budget and time frame in the term of given contractors attributes?
- Is there any specific system for contractor selection process in the LCI?
- What are the most important factors that influence CSP in the Libyan market?
- What are the best tools, methods and models that can be used for CSP?

1.5 The context and scope of the study

As stated previously, the main aim of this research is to build a framework for CSP in the LCI and its associated procedures and operations; also to recognize those major obstacles constraining its practice and operations. Libya falls into three main geographical regions Tripolitania in the west (Tripoli), Fezzan (Sebha) in the southwest and Cyrenaica (Benghazi) in the east. Tripoli city, which is the capital of the country, is in the centre of this region (www.photius.com, 2004). Originally, it was planned to conduct this study in all three regions but, due to some compelling circumstances such as security factors (civil war), as well as technical, geographical, time and financial limitations and operational indicators of the LCI, the research is focused on the public and private LCI in west and southwest regions, with priority given to the city of Tripoli as the central operation of the research. The reasons for selecting Tripoli as the context of the research are discussed in section (7.2.3). Also, the researcher has wide knowledge and familiarities with the city and its associated departments. To concentrate the research on a specific area helps to facilitate the management of the research in terms of effort and time. This selection offers an appropriate context in which the experimental study could be carried out. Thus, the role of the city in national, facilities, social and economic activities, and the accessibility and variety of data and availability of their sources, made Tripoli the best context for investigating the CSP and its related procedures, obstacles and operations. In summary, the scope of this research is about the development of contractor selection criteria in Libya.

1.6 The research problem in the context of the Libyan political crisis

The construction industry is considered one of the most important economic activities that contribute towards the economic growth of the Libya nation (Omran, et al., 2012). The impacts of the conflict on Libya's economy have significant ramifications on Libyan economic reconstruction. As in most post-civil war countries, enormous difficulties such as economic, political, and social challenges which are being faced by the government in the aftermath of civil war (Vandewalle, 2011). However, the construction industry plays a significant role in the country's economy growth with the vast majority of the labour force in the LCI being foreign and considered a substantial part of the construction. The country also faces another problem with the loss of those foreign employees force. Owing to the conflict and violence increased, the majority of the experts including engineers, project managers' consultant from foreign companies fled the country (Sahar , 2012). For example, Turkey's share of the Libyan construction market was 14.1%, with contractors working on 529 projects valued at $27 billion before the civil war. Most of construction sites were attacked and looted at the outbreak of the conflict, forcing companies to abandon sites and machinery (White , 2011). Additionally, China's Ministry of Commerce reported that more than 75 Chinese companies have invested in more than 50 construction projects in the LCI, of which the vast majority was in the civil construction sector (i.e. housing development, railway construction, oil services and communications). As the unrest spread, Chinese companies suspended their operations one after the other and many construction sites were looted and abandoned. Although China's role as a contractor has limited its exposure to direct losses in the unrest, some Chinese assets like Sinopec refineries were raided and destroyed while supplies have been disrupted. Losses therefore include, but are not limited to, disrupted employment of the workers, abandonment and looting of the construction sites, disruption of operations, disruption of trade between China and Libya and evacuation costs of the Chinese expatriates. According to an EXIM Bank official, losses in Libya, which have been far more than in any other country, accounted for US$ 18.8 billion as of April 2011, while "nobody knows how much we have lost in total because of the North African turmoil" (Belligoli, 2012).

Another report revealed that the Libyan crisis will affect so many sectors and activities especially the on-going progress with the developing level in the Libyan construction industry (Ali, et al., 2011). In reality, construction will be the biggest sector to be affected. This is due to the fact that all companies come from overseas and they are the main players within the construction sector. In fact, this crisis firstly affects the country because progress has slowed and later after settling the unrest, the country should pay fines and are involved with many sanctions such as legal action. Secondly, the companies are affected because their businesses are currently depressed and many workers who come from abroad are presently jobless. However, the current unrest will involve many periods of crises and will also experience several stages.

Another problem that has been determined occurred in the LCI in 2011 when civil war started in Libya as all the Turkish contractors immediately left the Libyan market as it was no longer safe to perform any work and many construction contractors lost a huge volume of work and money (Özorhon & Demirkesen, 2014).

As result, this conflict has further strongly impacted on the LCI due to demolision and abandonment of projects, causing huge financially demanding compensation claims to the Government, which increases the damage to the Libyan economy battered by the civil war. This is combined with an absence of accountability among official contractors as the weakness of the government. Thi has led to a decrease in the quality of construction, so as to cause reputable companies to refrain from participation in the reconstruction of the country, which in turn has led to cost overturn. Therefore, the increasing disarray among the Libyan construction industries markets has exerberated the need for new CSP and made it even more pressing.

1.7 Client needs

In the construction industry it looks very simple when we talk about Client. That simplicity hides the invisible intricate concept of the nature of the client where there is a lack of system and difference of interest and where one will hardly ever find a relationship between any single members in the construction industry yet those clients have had a great influence in the construction industry (Crichton, 2013).

The most important things for the contractor about the client are the client experience, client past performance, financial stability, the reputation of the client and the capability of the client representative (Egemen & Mohamed, 2006).

According to Al-Barrak (2004), lack of experience is one of the main failure factors of any project in the construction industry. Not only does the contractor have to have the relevant experience, but clients should also aim to employ a highly qualified working team in the company. The working team must also have good experience in the same line of work, which will make it possible for management to maximise the usage of the company’s resources. Not only does the working team have experience, but the owners should also have experience in the line of work for two reasons. First, the owner would not be cheated from anyone inside or outside the company. Secondly, if the owner does not have experience, he may not appreciate any improvement or any fresh ideas, which could bring good income in the future. Most of the decisions which cause contractor failures are taken by the management.

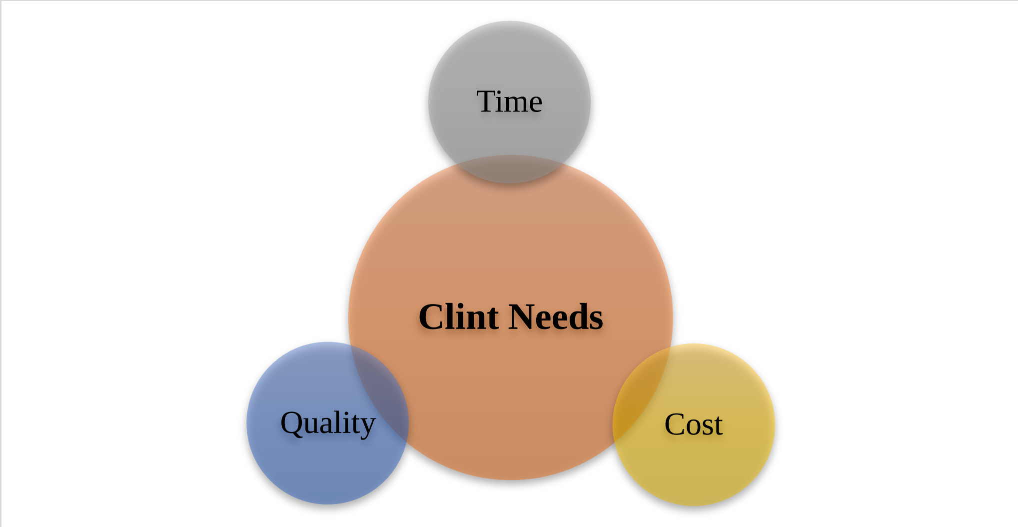

Figure 1-2 Showing client needs

1.8 Research Aims

The quality of citizens' life is enhanced by public construction projects such as infrastructure, public utilities and is vital to the economic growth of the Libyan nation as it is for any nation in that the physical development of construction projects such as buildings, roads, and bridges is the measure of their economic growth, according to Alzahrani and Emsley (2013). Consequently, success and failure of delivered construction project has a direct effect on people's satisfaction (Omran, et al., 2012). The key factor for this weakness of construction performance is a result of absence of competence and ability of the contractors so it is an urgent and serious issue to investigate (Eriksson, 2013). Thus, the Libyan government has been delivering unprofitable construction projects originally designed to improve citizens' quality of life, however, the maturity of these projects are facing and suffering from delay and failures.

Consequently, this research is aimed at developing a framework for contractor selection process (CSP) for the Libyan construction industry (LCI). The framework will enable the assessment of the effectiveness of the current contractor selection practices in Libya, together with the provision of a 'good practice' toolkit for future construction projects. The framework also contributes towards improving construction success and to eliminate contractors who are not responsive, responsible and competent. Further, it provides the opportunity for improved contractor selection procedure in construction projects in Libya. In additional, it enhances and assures bidding opportunities for ‘eligible’ contractors. Additionally, it helps to avoid and minimize risks of contractor failure and improve client satisfaction. Also it aids comparison of CSP between public and private sectors in the LCI. Finally, as a basis for designing a framework for contractor selection, using the TOPSIS and AHP methods, it can determine the best and the worst ideal solutions. This is very significant for the decision makers to discover weak points in the bidder as they can then improve upon them.

1.9 Research Objectives

This study is aimed to develop a framework whereby contractor selection process will be improved, and more specifically, to meet the aim of this research, particular objectives should be accomplished. These objectives are interrelated with the study aim and related with questions of study which should be answered to provide required data and information to achieve the main aim. The key elements and aspects which represent the research scope and domain, such as construction project issues and current practised CSP determine the research objectives which are proposed and listed below:

- Identify the problem areas associated with contractor selection in Libya
- Investigate the existing CSP from developed and developing countries and identify the attributes that can be used to evaluate contractors
- Investigate the existing models and tools from developed and developing countries and identify the attributes that can be used to select contractors in LCI.
- Develop an evaluation framework for contractor selection in construction projects in Libya
- Validate the framework and devise a roadmap for its implementation by consulting practitioners from the LCI
- Establish a comprehensive system for helping contractor selection in construction projects in Libya.

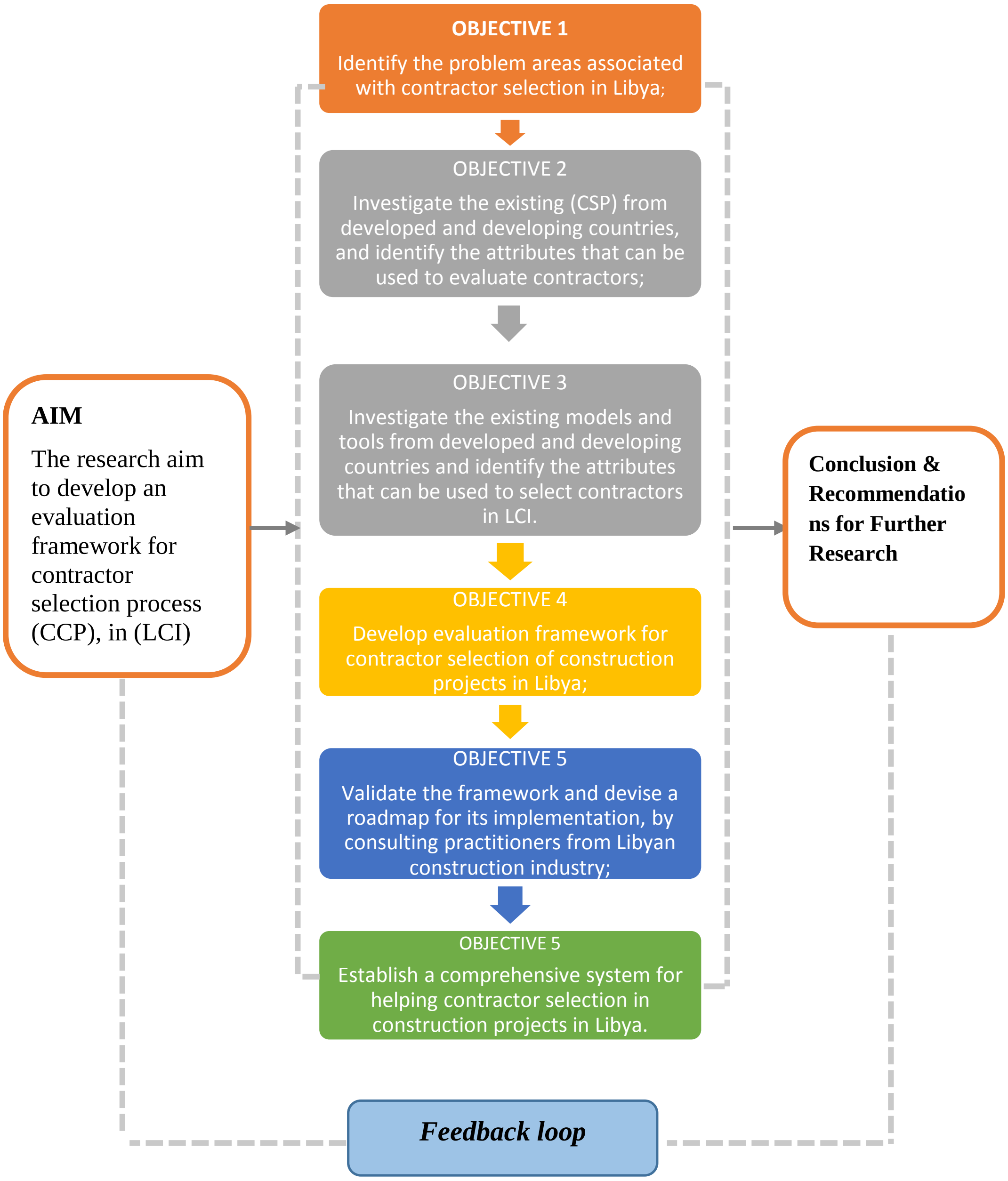

Figure 1-3 Methodological Model for the Research

1.10 Research method instrument

The aim of this study is to investigate and build the framework of contractor selection for the LCI. To reach this aim, fundamental data about the current practice of the LCI needs to be collected. To attain this aim, a questionnaire survey is to be conducted; then the questionnaire is to be supported with the second survey "Delphi survey" and case study.

Phase One: The literature review phase is recognised as the most critical stage of study as it is purposed to investigate and comprehend the nature of the problem and identify the research aim and objectives seeking to build the theoretical framework for the research questions. It also includes the investigation of contractor selection methodologies, approaches and toolkits currently being used in the construction industries of developed and developing countries. The purpose of investigating previous research is to provide enough knowledge and information regarding concepts of CSP in terms of their procedures in public and the private sector and to identify key factors which can help the researcher to build a framework for contractor selection process in the LCI.

Phase Two: The case study and pilot study phase took place to design the questionnaire. The case studies are conducted to help the researcher identify the weak points and give the opportunity to collect more knowledge and information about the current practice of CSC. In addition, twelve copies of the survey were distributed to the experts to improve and enhance the questionnaire. The pilot study is conducted to investigate the precision of questions being asked and to establish suitable questions to provide the required information and reach to the final questionnaire.

Phase Three: This stage deals with the task of data collection to answer the questionnaire and also concentrated on perceptions, opinions and suggestions about the current practise. The questionnaire also investigates problematic areas, the pre-qualification process and contractor selection criteria. Furthermore, the questionnaire briefly investigates the effect of the social factors and the procurement systems in the contractor selection process. The data will also be tested for validity and reliability utilizing proper statistic methods such as, Cronbach's alpha. This method is considered one of the most common methods to be used by researchers to conduct the validity and reliability. All the Statistical Product and Service Solutions (SPSS v20) software data will be utilized for analysing data.

Phase Four: The main purpose of this phase is to fulfil the research questions and moreover to determine the criteria and procedure that can be implemented for contractor selection in the Libyan construction projects. Many different statistical analyses will be used to analyse the collected data. These will include descriptive statistics tests to investigate and assess the opinions of the perceptions. In order to test whether there is a difference in the views between the public and private sector an independent samples t –test also will be used. Effective statistic tests, e.g., Factor analysis, Cronbach's Alpha and Kaiser-Meyer Olkin measure (KMO) will be used to assess the sub-criteria of the main criteria.

Phase Five: The final phase of the research was divided into three main steps. The first step is developing and improving practical framework for CSP. The second stage is validation of the framework using a Delphi survey. The main idea of using this method is to allow experts to rank the main criteria, express their point of view (validate) on the suggested framework and establish a road map for the framework. About 75% of the experts will be selected from government sectors and 25% of the expert will be selected from private sectors. The third task is conclusion and recommendations. Some of recommendations will be based on pooled ideas from the stakeholders' surveys, experts and the researcher's observations in the field. Figure (5.5) shows the research design instrument chart and more detail is illustrated as follows:

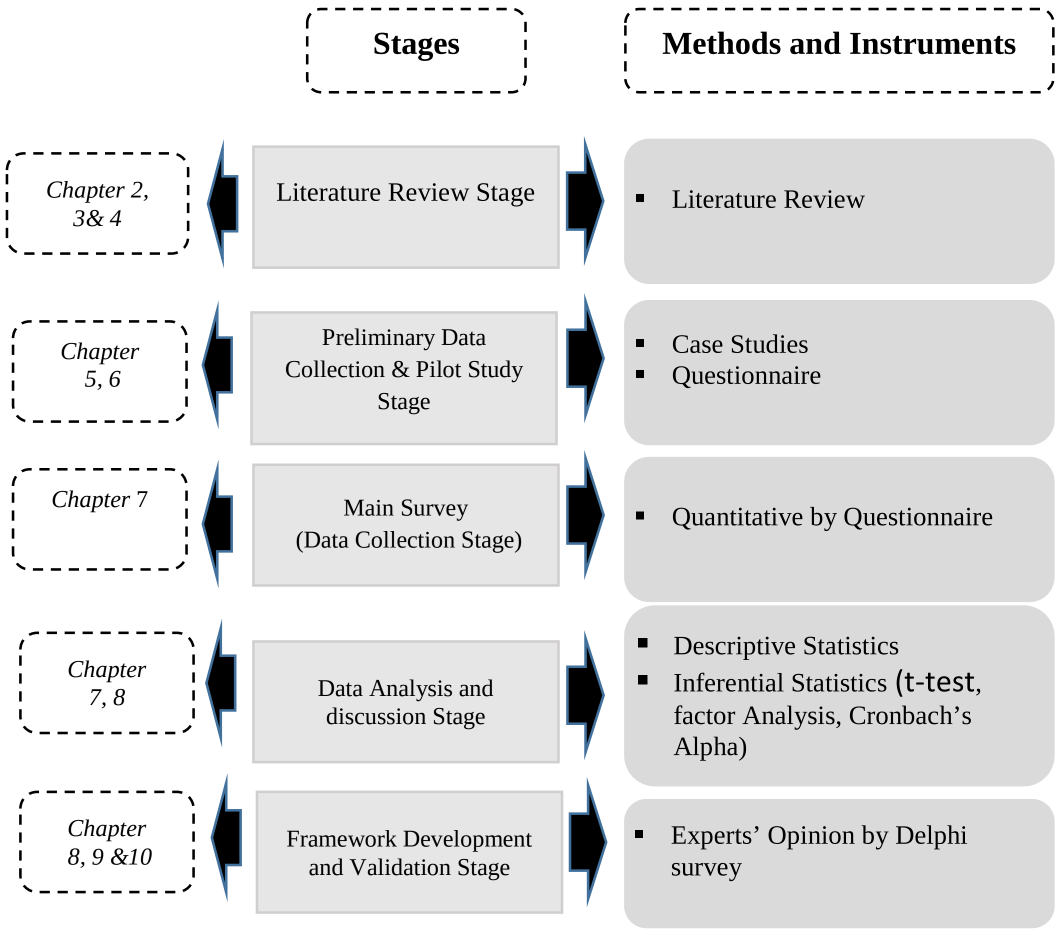

Figure 1-4 Research method and instrument

1.11 Thesis outline

This thesis has ten main chapters. A summary guide to each chapter is found below:

Chapter one: this chapter is devoted to giving a general review and introduction to the study. The background and history of the current CSP are explained and are followed by the initial propositions, client needs, aims and objectives of the study. Design of research methodology and research problems are also discussed. Significance of the study is also illustrated in order to give the reader a conceptual framework to the study.

Chapter two: this chapter gives a general introduction to the current status of the Libyan context. This includes information about history and geography. The current statue of the LCI is also highlighted.

Chapter three: the purpose of this chapter is to review and discus some of the most important issues and aspects associated with the contractor in the CI in order to help the researcher to discover the key variables of the study.

Chapter four: this chapter gives an overview of the CSP and it key issues. This chapter is also aimed at establishing a better understanding of subjects related to the CSP in both developed and developing countries in order to allow the researcher to determine the key variables of the research as well as to help researcher design the methodological framework and the empirical study. It starts with a brief introduction of the CSP and then addresses the aims, pre-qualification, advantages and disadvantages of this process. Then country-specific CSPs are discussed.

Chapter five: this chapter presents and discusses the research methodology. The chapter starts with a description of the types of research methodologies available and their advantages and disadvantages. This is followed by a discussion of research approaches and model development. The chapter also briefly presents the research techniques utilized, including SPSS analysis, the Delphi survey, AHP, and TOPSIS, all of which will be describe in more detail in the next chapters.

Chapter six: this chapter reports on and explains the proposed methods to be used and helps to establish a framework for the contractors' selection criteria. It then presents key issues and aspects of these criteria.

Chapter seven: this chapter addresses the core of the research. It provides the findings of the data collection and analysis of the first stage of the primary research (the questionnaire survey) into the LCI. It begins with the questionnaire addressing administrative procedures. The average response rate and content of responses from different positions are then explained. The chapter also includes description of the pilot study as well as addresses issues such as the validity and reliability of the questionnaire. Then the chapter discusses the tools and techniques used for the analysis of the questionnaire.

Chapter eight: this chapter is considered the main chapter in the research presenting the main objectives. It provides the findings of the analysis of the first stage of the primary research (the questionnaire survey) and second stage of the primary research (the Delphi survey). The chapter also includes the findings of the secondary research (the literature review). The chapter provides a framework for enhancing the contractor selection procedure in the Libyan construction process.

Chapter nine: demonstrates the validation of the framework for enhancing and improving the contractor selection procedure in the Libyan construction process. It begins by clarifying the details and procedures utilised to validate the framework. After that, the chapter illustrates collected answers from the Delphi survey. The feedback analysis is also outlined. Finally, the discussion and summary of the chapter is also included

Chapter ten: this chapter is the final chapter of the research. It explains the conclusions and the findings from the research work, covers all the chapters including the literature review, questionnaire and Delphi survey. The limitations of this study are also presented. Then the chapter identifies the areas of weakness where future research is recommended. Finally, the summary of the conclusions is given.

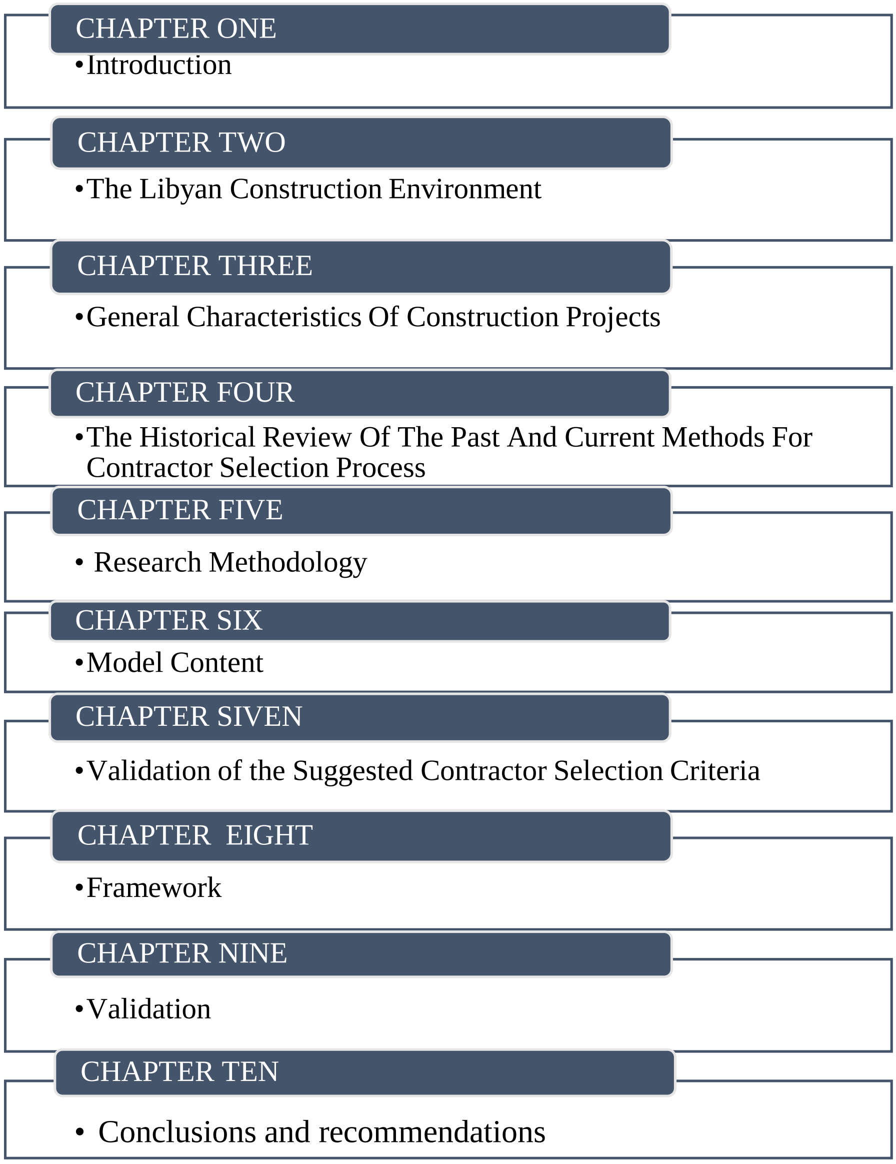

Figure 1-5 representing the organisation of the thesis

1.12 Summary

This chapter has provided a general introduction to the research study. This included the aims and objectives as well as the significance of the study and clients' needs some of its problems were also presented. In this chapter, an overview of the design of the research methodology was also illustrated. Finally, the chapter concluded with a research outline and the thesis guide. The following chapter identifies and assesses the environment of the LCI

CHAPTER TWO: THE LIBYAN CONSTRUCTION ENVIRONMENT

2.1 Introduction

The aim of this chapter is to address and review current practices of the operating environment of the LCI. Also, it investigates and identifies the key features that influence the operations of the LCI. This will help to increase and improve understanding of how these factors can assist and contribute to building a better and more effective contractor selection framework for the LCI.

The chapter begins with general information about the Libyan political system, geography and climate. Then, a brief introduction about the country’s social characteristics will be presented. The Libyan construction culture is then discussed followed by an explanation of the employment rate and labour force for both Libyan and foreign workers. The tender process is also presented in this chapter. The chapter also covers contractor and subcontractors types as well as procurement methods. Finally, the chapter concludes with a chapter summary.

2.2 The Libyan environmental and social characters

2.2.1 Culture characters

Project construction success is based upon many criteria and differs from one project to another and from one organisation to another. This could also be related to many circumstances such as the nature and location of a project within a country's geographical boundaries. The construction industry in Libya, in particular, tends to suffer from late completion of projects and high levels of costs affecting overall budgets, and poor quality of construction on completion. Ali et al (2011) argued that culture in construction projects is one of the key factors in the successful completion of construction projects in Libya. Therefore, to avoid any misunderstanding and delays that can affect project success, the awareness of cultural issues should be taken into the account when selecting project teams such as project manager, consultant, contractor or subcontractor.

In literature, such as Grifa, (2006), one finds that the economics of business are considerably influenced by culture. Certain texts highlight how culture has an effect on projects of the construction industry and also other business organisations. Culture involves relationships within and between organisations, resources and the environment within which work and project activities take place. Cultural practices within the Libyan context have always played an influential part in defining public life. The government takes into consideration the political and economic situation, coupled with the environmental constraints that define the working culture. Thus, theoretically, the various organisations should be in a position to be innovative and adjust their work culture accordingly. The effect of culture on certain aspects of public systems and organisations is largely dependent on centralisation, bureaucracy, task orientation, team reactions towards problems and methods of work (El-Hasia, 2005).

2.2.2 Social Organization and Tribalism

Libya is an Arabic country and the dominant religion is Islam. Libya shares a common language, religion, cultural values and other social values with other Arabic countries (Ahmed, 2011). Elmagri (2013) has argued that loyalty to family and tribe, as well as regionalism, usually outweigh loyalty to the organisation and the law. Environment and culture have also been considered as significant factors in the construction management sector especially in Middle Eastern society (Alyousif, et al., 2010). This section aims to review and deliberate the general appearances of the tribalism environment in Libya and address those matters relevant to the CI and its connected processes and actions. Grifa (2006) described the basic units of Libyan society as the family, the clan and the tribe. Hence, in Libya, a tribe is a significant social unit, which is known in Arabic as 'Al Qabilah'. However, in many cases, devotion to the tribe's interests and affairs comes before loyalty to the state or place of work. Therefore, to date, tribal loyalty has strappingly affected civil society and its organizations in Libya. Thus, it can be said that tribalism and its associated relationships are vital aspects in Libya's framework. Therefore, Libya's contractor selection system is duly affected by public and tribal pressures. Thus, tribalism is likely to be one of the crucial aspects which form the outline of the CSP and its allied operations. This subject should be taken into justification when dealing with the CI and its connected activities in Libya. Further empirical evidence will be provided to support the above conclusions. The current shape and future operations of the LCI are likely to be shaped, in part, by the demographic context. However, the current age structure of the Libyan population gives the opportunity to train youths in construction.

2.2.3 Climate characteristics

The Mediterranean Sea and Sahara Desert are considered as the most dominant climatic influences on Libyan weather. The climate in the north of the country “coastal lowlands” where the majority of the population lives is Mediterranean, with moderate summers, rain and mild winters. On the other hand, the climate in the south (desert) of the country where a minority of the population lives is hot in summer and cool and dry in winter, where sometimes temperature can drop to sub-freezing at night (Rhett A, 2009).

Libya is a huge country where about 90% of the total land is desert and the terrain is mostly barren, with flat to undulating plains, plateaus and depressions. Within Libya, different climatic areas have been acknowledged (www.weather-and-climate.com, 2014), but the main climatic influences are Saharan and Mediterranean. In the winter, the weather is cool with some rain on the coast and in the desert temperatures can drop to sub-freezing at night. The Sahara is very dry and hot in the summer and cool and dry in the winter. The main difficulties in the desert environment are a low and variable rainfall, high and extreme temperature, drought and scarcity of water, desertification, and sand or dust-storms (Grifa, 2012, p64). Consequently, it can be said that these geographical characters and their influences on the social, cultural and economic environment should be taken into consideration when conducting any study in this country (El-Hasia, 2005).

2.2.4 General information of the Libyan geographical characteristics

Libya is located in North Africa in the middle of the Mediterranean Sea. It is bordered in the west by Algeria and Tunisia; in the east by Egypt and in the south by Sudan, Chad, and Niger. Further, it is bordered in the North by the Mediterranean Sea, with a coastline of approximately 1,970km, to the west by Algeria (982km), to the North-West by Tunisia (459km), to the East by Egypt (1,115km), to the South by Chad (1,055km) to the South-East by Sudan (383km) and South West Niger (354km). This represents a total land boundary length of 4,348km. It is a large country, considered as the fourth largest country in Africa, with a total area of 1,759,540 square kilometres of landmass. This makes the country larger than Alaska or around three times the size of France. The area and the location give the country great strategic significance and, therefore, it has a high profile in North Africa (Ghashat, 2012).

Source: The US Department of State, Diplomacy in Action (2007),

Figure 2-1 Showing Libyan borders with major cities and settlements

(http://www.state.gov/p/nea/ci/ly/)

2.3 The Labour Force and Employment in Libya

In this section, issues of the labour force and employment in Libya are briefly highlighted from the perspective of their influence on the operations of the CI.

2.3.1 Libyan Labour Force

The labour market in Libya is not very large and human resources are limited. Recent statistical data from the Libyan government demonstrated that the official number of Libyan people who were considered to be in employment was 1,635,783. However, the contribution of the Libyan Gross Domestic Product (GDP) is approximately 5.2% employing about 3.2% of the total labour force. Despite the enormous investment in the construction industry within the last five decades, the LCI is still underdeveloped and undergoing major research. In addition, Libya's fragile construction domain is facing difficulties and real challenges due to its quick evolution and dependence on foreign exports (Ngab, 2007).

In effect, it is established that the northern coastal regions house 80% of the total Libyan workforce. This is due to the fact that a major portion of the construction and other economic activities are concentrated here due to the favourable climatic, geographic and demographic situation.

2.3.2 Foreign Workers in Libya

The number of employees of foreign origin has been an increasing aspect in the labour force of Libya for the past four decades. This is due to the limitations experienced in Libya's human resources. A huge amount of people of foreign origin comprise the workforce in Libya. Due to the changes in the political and economic scenario of the country, the quantity and characteristics of the foreign workforce also varies. For example, though there were 2 million foreign workers in March 2004 employed in the different sectors of the economy, 85% of the total was illegal or informal. Also, a majority of foreign employees were involved in informal activities in the CI and its associated operations (Grifa, 2006).

2.3.3 Unemployment

Even as the number of unemployed people that have moved to Libya in view of obtaining jobs has increased drastically, the focal predicament that challenges the population and administration of this country is the rise in joblessness.

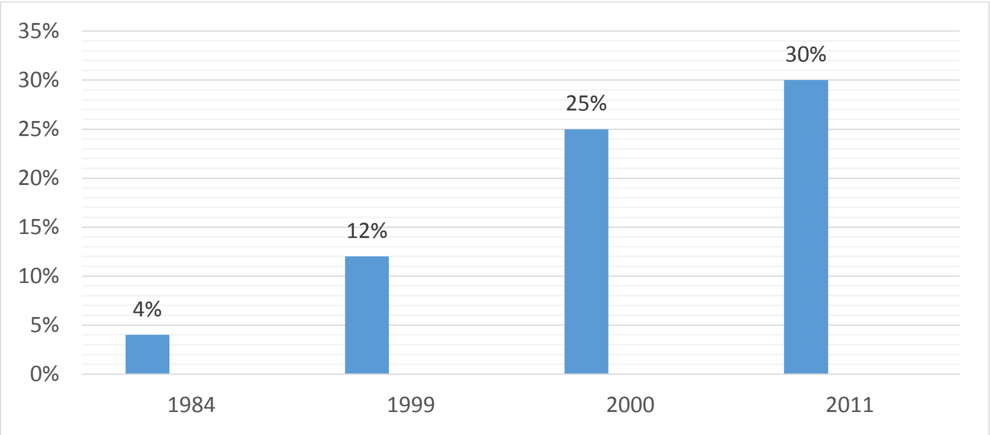

Figure 2-2 Structure of the Libyan unemployment rate in Libya

Source: (Grifa, 2006) and CIA World Fact book for Libya, 2011

As reported by Grifa (2006) the proportion of unemployment in 1999 escalated up to 12 percent as compared to 4 percent in 1984 and 25 percent in 2000. Further, the final report revealed by CIA World Fact book for Libya, 2011 stated the unemployment rate in Libya as 30%.

One conclusion that can be drawn from these growing figures is that Libya has faced a serious rise in unemployment since the last decade. Besides, recent demographic statistics predict that this problem will continue to mount eventually as the youth cohort will soon cross the threshold to come into the labour pool Figure 2-2. Thus, as a result, the community and economy will be threatened with the crisis of unemployment. Accordingly, the LCI should be held at high in view of its capacity in creating prospects in employment while possessing the alternative of merging with other divisions to assuage the brunt of joblessness in Libya.

2.4 The Current Statue of Libyan Construction Industry

During the last fifty years, the construction sector in Libya has seen dramatic changes in several ways. In the 1950s, when the country was occupied by the Italians, the construction industry was to a great extent inadequate and limited because of the occupation and lack of resources. However, with oil booming in the 1970s, the construction industry in Libya witnessed real growth and it has been considered one of the significant key roles in the Libyan social and economic development processes.

Table 2-1 Showing the summary of the conducted contracts in Libya

No	Project Sectors	No. of Contract	Total value
1	Residential & Infra Sector	372	4,606,535,126.381
2	Education Sector	1300	9,832,847,941.580
3	Healthcare Sector	743	2,693,672,099.732
4	Administrative& Services Sector	1395	4,927,539,437.766
5	Sports Sector	244	1,775,544,219.832
6	Social Affairs Sector	56	227,405,612.263
7	Archaeology &Truism Sector	62	820,828,606.891
8	Culture & Media Sector	191	358,227,640.881
9	Justice Sector	128	497,237,046.854
10	Interior Ministry Projects	327	492,257,833.244
11	Manpower Sector	186	139,705,576.547
12	Other Sectors	20	3,802,275.139
Total value			6,375,603,047.110

Reported since 2003, the Libyan construction sector has witnessed tremendous growth, especially when UN sanctions were lifted, which was blunted in 2009 by the global recession (www.companiesandmarkets.com, 2010). However, most projects have continued to concentrate on Libya’s utilities sector as foreign firms have come to Libya with aspirations of improving and developing infrastructure in relation to the energy sector. The above table (2-1) shows the summary of the important contracts that have been conducted by the Ministry of Housing and Utilities (2012) in the last ten years.

All of these projects and other investments in the construction sectors – such as residential buildings, hotels, tourist villages, and the paving of roads – have put the country in third place in the field of construction and development within Africa after Algeria and Morocco. Despite strong inputs as a result of continued international investment, the country raised a number of concerns regarding how project finances are managed due to feeble contract enforceability and the randomness of government intervention. This, in turn, raises price risks for energy and transport assets and lowers scores for the rule of law whilst the LCI remains powerless to meet national housing demands. Especially since the country has entered a new phase of boom and bust after a long time of isolation from the West, new homes, railway systems, airports, and roads are being built, repaired and upgraded, in addition to office buildings, resorts, and hotels to accommodate the expansion of the tourism industry.

All the above projects require effective and adequate construction policies because the industry currently suffers from a wide array of problems that can affect project management processes and which subsequently affect the profitability of the construction projects. In addition, Libya and the West have had a few political problems during the last three decades which have affected the country in several ways, particularly the economy and construction industry. Compared with other developing countries, Libya is considered to be less advanced with regard to construction project management. The reason behind this is the lack of knowledge, financial training, effective managerial strategies, technical capabilities, and experience within Libyan construction companies. In addition, lack of commitment from foreign companies for many years also negatively affected the outcome of construction projects in Libya. To meet the present and future needs of Libyan people and infrastructure, as well as repairing the fragile state of the construction industry, new policies have to be implemented. Compared to other countries, the outlook for the LCI is still positive in the face of shrinking infrastructure budgets that are the result of the global recession. In addition, the position of Libya as an energy exporter assures foreign interest in development projects, particularly given its proximity to Europe and the improvement of political relations in recent years.

2.5 Summary

This chapter has highlighted the Libyan context in which the research study takes place. Discussions of the Libyan context have included general information about the geography, climate. In conclusion, the physical characteristics of the land in Libya indicate that it possesses arid zones with extremely high temperatures, water shortage and droughts and are geographically distributed.

Economic issues regarding the CI include privatization, unemployment and the hiring of foreign workers, all of which have a direct influence on the functions of the CI and have been elaborated on in previous sections. On the whole, one can infer that a number of political, social, and economic plans and various authorities and organizations have played a vital role in the CI in Libya. In the next chapters the organizational and technical developments of the LCI and its current functions will be investigated.

Section three discussed issues raised in the context of actions carried out by the LCI such as the fact that most of the construction orders will be carried out exclusively in urban areas. That is because the north of the country holds over 88% of the Libyan population.

CHAPTER THREE: GENERAL CHARACTERISTICS OF CONSTRUCTION PROJECTS

3.1 Introduction

The purpose of this chapter is to review and discuss the general characteristics of the construction industry (CI). To achieve this purpose, the chapter reviews the CI and discusses its main concerns and characteristics. The chapter is divided into five key sections. The first section briefly highlights the general characteristics of tender process, invitation to tender, tender form, type of tender, tender strategy, and tender process in Libya. Section two presents general information about the construction procurement system, classification of the construction procurement system, and the effect of the procurement system. The third section sheds light on the relationship of the contractor to other contractors, clients, and consultants. Section four explores general information about the firms in the construction industry and discusses theory, type, size, resource availability, and subcontractor firms. The types of contracts available in the LCI are also identified. Finally, the chapter closes with a summary and some concluding points.

3.2 Tender process

In construction, the main tender process is commonly for the choice of the contractor that will construct the works (Wilkinson, 2015). Contractor selection and tender evaluation continues to be an area of significant importance and interest to organisations responsible for delivering work outcomes (Watt, *et al*., 2009). The evaluation of tender process takes place in the early stage of the project's life cycle and could be one of the most critical undertakings performed by owners. The study of the contractor and tender evaluation process is a complex and challenging task plagued with many uncertainties (Watt, *et al.*, 2010). Bochenek (2014) confirms that the selection of a contractor for building works is a complex and difficult procedure and relies in its major aspect on the correct preparation of the tender requirement, where all the requirements and necessity of the tender must be clearly defined. Incomplete description about tender specification usually increases the risk that the selected contractor could become incapable to meet the desires of the projects. A tender is a submission made by a prospective supplier in response to an invitation to tender. It makes an offer for the supply of goods or services.

3.2.1 Invitation to tender

In the normal process, the duty of any client is to publicise the availability of their projects to probable tenders (Bennett, 2003). In public and private projects, clients usually issue an invitation to tender or advertise for tender by giving basic information about the project. The information usually includes time of tenders, the location of tender, and cost including the tender's deposit. In addition to that, the invitation should contain information about size of the project, the nature of its main materials and its approximate cost. However, many ways have been used to invite interested contractors for tender such as, media, email and post.

3.2.2 Tender form

The form information is usually dependent on the category of the contract (Bennett, 2003) (Plebankiewicz, 2009). Further, if the client anticipates a lump-sum contract, in this case the form of the tender will be rather simple, providing the single price and a few other details. If the contract will be a unit price, measure and value type, there have to be places to indicate unit prices corresponding to each bid item. Framework tender documents are likely to include a request for a schedules of rates and time charges and a breakdown of resources and overheads to be applied including any proposed subcontractor or sub-consultant details (Wilkinson, 2015).

3.2.3 Type of tender

There are only three main groups of tender type. Open competition, closed competition and negotiations. The classifications of the different tender type are as follows:

3.2.3.1 Open (competition) tendering

This method allows those contractors who are unable to fulfil the essential criteria to participate and submit a tender (Ashworth, 2008). Inappropriate contractors are removed from the list if the number of tenders becomes too large (Ashworth, 2013). The process of open tendering allows contractors to give in their tenders for a project. The client describes the project briefly and then extends invites to suitable candidates to apply for the project (Bennett, 2003).

3.2.3.2 Closed (competition) tendering

This is known as the traditional system and is still the most popular technique of awarding construction contract. Under this method, the number of companies is usually limited to six, and only a number of selected companies with a good reputation are invited by the project team as possible companies who may tender for the work (Ashworth, 2008). The invitation to tender is issued only to a pre-determined list of organisations. The invitation in this type of tender starts with two or more organisations with the advantage of closed tender being that it is easy and quick to set up. The weakness of closed tender is always the complaint by the public for keeping the tender closed (Khairy, 2010).

3.2.3.3 Negotiation Tender

Negotiation of construction tender could be used instead of the tendering process. If the client has had enough experience in the constructor sector, the client's representative can invite one company to set up and offer a proposal, after which the parties negotiate the agreement. If the negotiation is successful, then constructing the contract is finally settled. If it is not, another executer might then be requested to offer a proposal and in this case the procedure might be repeated (Bennett, 2003). This type of tender is characterised by the contracting parties having the opportunity to negotiate all parts of the tenders as part of the tendering procedure (Euclid Infotech Pvt Ltd, 2012). It usually occurs when the client approaches a single contractor depending on their track record or a previous relationship and the terms of the contract are then negotiated (Wilkinson, 2015).

3.2.4 Tendering strategy

In a competitive tendering situation, many problems and dilemmas face the contractors in determining the profit margin, where tenders with high price are submitted in order to maximise profit margin, which sometimes results in failing to win the contract thereby suffering a shortage of work. Alternatively the executer might submit a low price which wins the contract, but shows little margin of profit. Abiding strategy could evolve for determining the best bid, which will be the relationship between maximum project and the possibility of being the lowest tenderer. Therefore, it is important to analyse the bidding pattern of contractors and to compare those results with the company's own estimated production costs over a number of contracts (Ashwork, 2008).

3.2.5 Tender process in Libya

In the tender process, all bidders should understand and obey all directives set by the Libyan Government, in addition to other guidance documents contained in the request for proposals and other documents delivered to him. However, the committee calling for tenders has the right to exclude any participant if they either have, or are suspected of having, bribed any member of the committee who have the authority to determine the winner of the tender. Additionally, when the offer is made it must take into consideration all of the tender's expenses including the cost of documents, transportation shipping, procurement, insurance, and taxes. Tender prices must be in Libyan dinar, and the prices have to be written in both numbers and letters. Further, if the contractors forget or do not include price fees for any items, then the highest price given by other bidders will be considered. In addition, participants in the bidding process are not allowed to write-off or change any items' tender attributes. However, any alternative suggestions to the technical specifications set out can be provided in a separate document provided that it is attached with an offer that refers to the technical and financial offer. Furthermore, priority is given to bidders who can meet the required standard by using local manpower, equipment, machinery, and materials. Finally, to prepare a realistic bid, the contractor should visit the project site, investigate the existing conditions on the ground and take all the relevant data into account.

The present practice for contractors' eligibility to participate in tendering is illustrated in Figure 3-1. Some criteria have been adopted by the Ministry of Housing and Utilitie in 2007, these including:

1. The contractor must have experience and a proven track record of not less than ten years. They must have experience with projects of similar size and technical and working conditions as well as in the implementation of all of the components of the subject scope of work involved.
2. The contractor has to be financially capable to complete the project without struggling as well as that the candidate contractor has to prove his current financial ability, for example bank statements from the last three years.
3. The contractor is not allowed to participate in any public project unless he is fully registered with the Libyan authority. The necessary documents for registry of local, foreign and consulting companies in Libya, established by

Housing and Utility Ministry Libya, Housing & Infrastructure Board (HIB) and Office of Companies Relationships are:

a) *Attached letter of request addressed to the director of HIB Office Companies Relation Ships (Request of Registration).*
b) *Letter from the Company manager's or representative's letter in Libya and identification proof (Passport Copy)*
c) *Certificate of non -bankruptcy issued from official authority at the company country and nationality*
d) *Last balance sheet of the company main office and its branch in Libyan.*
e) *Form of the commercial registry*
f) *Registration of the Chamber of Commerce*
g) *Certificate of experience stating the history of prating professional contracting*
h) *The contractor must not be barred from doing business with public associations or excluded from the progress of the contracted.*
i) *The contractor most not have any criminal convictions (be of good character and reputation)*

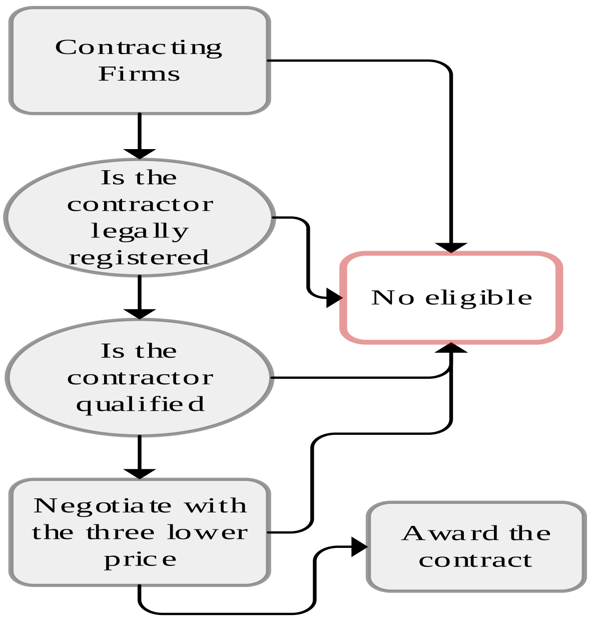

Figure 3-1 Showing the present practice for contractors' eligibility to participating in tender in Libya developed by researcher

3.2.6 The Libyan public client

In the LCI the public client is considered the main source of work, as the public sector accounts for the commission of more than 85% of the construction projects in Libya. The public sector can make a significant difference when it comes to encouraging the widespread adoption of best construction procurement policy. It has a significant vested interest in attaining the greatest whole-life value from construction, particularly if can demonstrate that it is spending taxpayers' money efficiently and economically. Further, municipalities are the most important source of public sector construction projects in the local context as there are numerous departments which have the authorities to contract construction works (El-Hasia, 2005).

3.3 Construction Project Procurement Systems

Ali (2011) argues that choosing the type of procurement system to be used is one of the most essential issues involved in completing a project effectively. It is important to determine a suitable procurement method for any given scenario and to define the approach that a project manager should take. Projects in the LCI are usually done with partners so the role of the project manager, amongst other things, will be that of the facilitating partner communication. Therefore, it can be said that selecting the right procurement approach has a huge influence in project success. In the LCI selecting the right procurement approach does not happen very often and this is likely due to the decision maker who is administrating contracts systems being unqualified as well as to the out-dated contracting process that are utilised in the country. Moreover, the selection of a proper procurement system is a complicated task and it is based on numerous aspects. The major factors influencing the selection of the right construction procurement method are identified as being cost, time and quality (Leu, et al., 2015). In another major study, conducted by Grifa (2006, p. 55), it is reported that the selection of the project procurement system is based on a number of criteria related to client considerations, the nature of the project, and complexity of the project.

El-Hasia (2005) has investigated the procurement system of the national and municipal public sectors in Libya. The research found that the procurement systems in most developing countries, like Libya, are directly affected by their political and economic circumstances. In the Libyan public sector there are limited methods in procuring construction projects; for example, they can use either traditional tendering or D&B. Tam et al (2013) have argued that as traditional construction procurement methods are found to be inadequate in meeting the demands and challenges of recent times, alternative procurement routes such as through management contracting or build-operate-transfer are increasingly being adopted.

3.3.1 Procurement strategy

The procurement strategy is about determining the best method of achieving the objectives of the project and value for money, keeping in mind the risks, leading to decisions about the funding mechanism and asset ownership for the project. The purpose of a procurement strategy is to attain the ideal balance of risk, control and funding for a particular project (Davis, *et al*., 2008) (Fox, 2014). Gibson (2010) pointed that choosing the procurement approach fundamentally involves establishing:

- The structure of contract packages to ensure that large and small operators are able to compete
- A contract structure for each of the contract or work packages involved as mechanisms of the selected delivery system
- How the procurement will be achieved by the client and contractor to suit the delivery system and contract system(s) selected

3.3.2 Type of Procurement system

There are many types of procurement systems. However, Rashid et al (2006) (Davis, et al., 2008) identified the most important three procurement systems. Each group is dependent on the relationship between construction and responsibilities design. The classification of the different procurement methods are as follows:

3.3.2.1 Traditional procurement System (TPS)

The Separated and Cooperative System has many different names such as: the linear or sequential contracting method, or the multiple responsibilities contracting system. It is a system where the responsibilities of the design and construction of the project are usually implemented by separate parties, namely the designers and contractors, as shown in figure 3-2. Under this system the work usually starts with a feasibility study; then preliminary design, documentation to construction and hand over are carried out sequentially, one after another. There are three types of contract under the traditional procurement method, *Lump sum contracts*, *Measurement contracts and Cost reimbursement.*

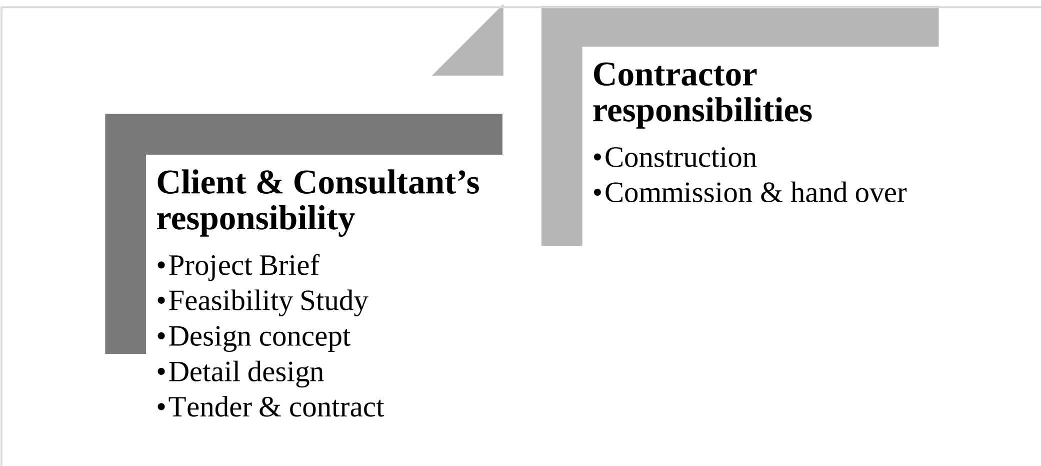

Figure 3-2 Showing the process of the traditional Procurement System

According to Anumba & Evbuomwan, (2010), Rashid et al (2006) and Davis et al (2008) there are some advantages and disadvantages associated with the TPS system of construction procurement:

<u>The advantages of using traditional procurement method</u>

- Answerability due to a competitive choice
- Labour force can be controlled and determined at each step of the design
- Quality of work and materials can be monitored by project team
- Competitive equity as all tendering contractors bid on the same basis
- It gives a good expectancy to the project team
- Client is capable of having a direct influence which could provide a high standard level of functionality and improve the quality in the overall design
- Price certainty at the award of the contract
- Easy to arrange and manage
- It's a proven technique which the market is very familiar with

<u>The disadvantages of using a traditional procurement method are:</u>

- Since each stage is done separately, it takes a long time to start
- The probability of risk for the client is higher than the other procurement method, especially if there are mistakes in the design of the project
- Disputes and delays in the project and exceeds of the budget are expected
- The contractor cannot input into the design or planning of the project as they are not appointed during the design stage

3.3.2.2 Design-Build Procurement Method (D&B)

The Design-Build Procurement Method (D&B), as the name implies, integrates or merges the responsibilities of design and construction of the project. Both responsibilities are contracted out to a single contracting organization (Ashworth, 2011). According to Grifa (2006 p.56), under this system the client contracts with a single contractor to undertake both design and building of a project. Thus, the contractor assumes full responsibility and carries sole liability for both design and construction. Tam et al (2013) maintained that the D&B method has many advantages such as "single-point responsibility, fast-track project delivery, enhanced financial certainty, improved build ability, reduced disputes and increased productivity". Figure 3:3 shows the key characteristics and allocation of duties and responsibilities between the clients in the D&B Procurement System.

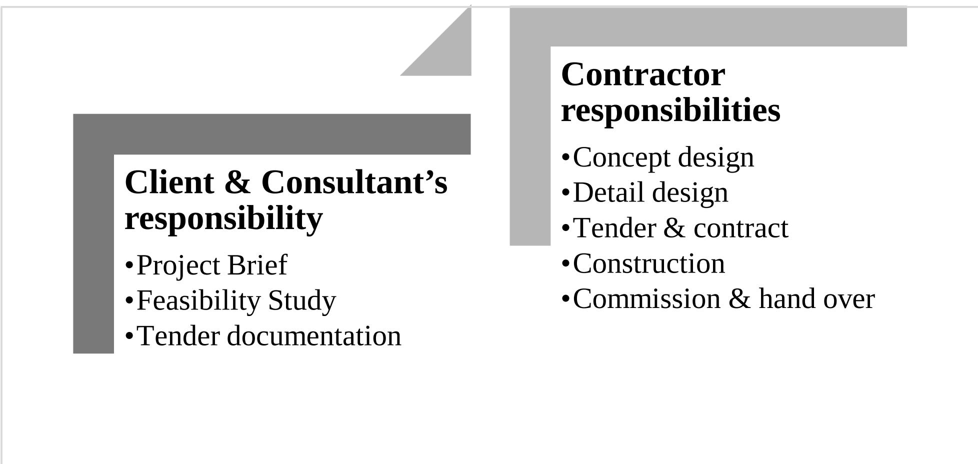

Figure 3-3 Showing the Process of the D&B Procurement System

According to Davis et al (2008) and Anumba & Evbuomwan (2010), Millman (2013), Tam et al (2013) there are some advantages and disadvantages associated with the D&B system of construction procurement:

<u>The advantages of using D&B procurement method</u>

- Client has to deal with a single contractual arrangement for the total project
- Incorporation of design and construction knowledge, easier decision-making shortened construction time, better co-ordination and communication

- More opportunity is given to select construction materials with shorter lead times
- Price certainty is obtained before construction starts as client's needs are specified
- Changes are not introduced
- Improved and developed levels of constructability involving contractors into the design

The disadvantages of using a D&B procurement are:

- A lack of certainty of expected performance
- High tendering costs
- Lack of flexibility in accommodating client changes and inappropriateness for complex projects
- Difficulty in comparing contractors since each design will be different
- Project design liability is limited to the standard
- The contractor is responsible for the risk related to the design
- Tight time schedule
- Frequent changes are introduced by client
- Difficult to control workmanship
- Ineffective communication
- Not clear client design brief and requirements
- Conflict of interest between design consultants and contractor
- D&B contractors are not competent with design issues
- Difficult to control in design quality
- Lengthy evaluation of tender and high bidding cost
- Lack of experience

3.3.2.3 Management Procurement Systems (MPS)

Rashid et al (2006) state this approach focuses on the management and integration of the design and construction of projects (Davis, et al., 2008). Under this method the design and project construction management is done by a contractor who works as a management consultant on behalf of the client. This procurement system relies on a designer or contractor having the knowledge to manage and control the design and construction of a project, as it shown in figure (3:4). There are three types of procurement system that fall under the category of Management Oriented Procurement methods, they are:

- Management contracting
- Construction management
- Design and manage

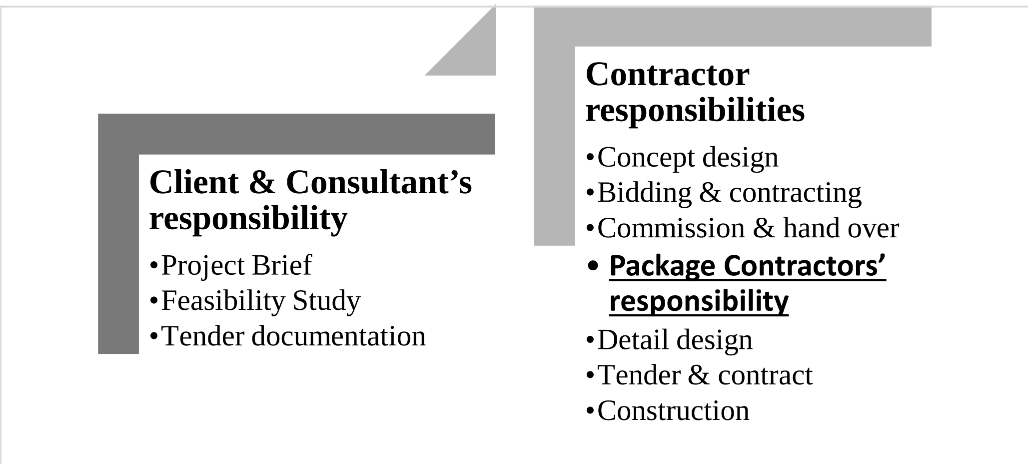

Figure 3-4 Showing the Process of Project Designing and Construction in the Management Contracting Procurement System

Rashid et al (2006) recognized that among other alternative project delivery systems, MPS system appears to be gaining popularity. However, those working within the industry have a limited exposure (Davis, et al., 2008) (Millman, 2013).

The main advantages of using a management approach to procurement are:

- Better collaboration and coordination between designers and constructors
- Flexibility for changes in design
- The client deals with only one company
- Risks and responsibilities for all parties are clear.

The main disadvantages of using a management approach to procurement are:

- Price certainty is not determined until the final project package has been informed and proactive client is required

- Poor price certainty, close control over time and information are required
- Client has to provide a good quality brief to the design team as the design will not be complete until resources have been committed to the project (Construction management and management contracting)
- Client loses direct control of design quality which is influenced by the constructors (design and manage).

3.4 Type of Construction Contracts

Many researchers have defined construction contracts; for example, Loosemore, (2007) and Dainty, *et al.*, (2003) stated 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 through the legitimate power of the courts".

Similarly, Grifa (2006) stated that "contracts are fundamental to any project, and selection of the main construction contractor is a critical and vital task." Generally, the decision to determine the kind of contract takes places in the early stages of the construction operation. The contract selection operation is usually influenced by the legislation, environment, culture and organization of the country-specific CI and determines the relationships between of the parties involved in construction operations, from start to finish. The choice of a construction contract is based on the client's needs and background. The most common construction contracts are:

- Lump sum contracts
- The time-based contract
- Cost reimbursement contracts
- Measurement contracts

The ***Lump sum contract*** is considered the most straightforward of all contracts. In this contract the terms and conditions are exceptionally simple, uncomplicated, and easy to understand. They are widely used for environmental studies, simple planning and feasibility studies, preparation of data processing systems, detailed design of standard or common structures, and so forth. In addition, the total amount of the contract is more often than not determined before a construction project is started and payments are due on clearly associated and specified to outputs deliverables, such as reports, which is considered the main advantage of this type of contract (Grifa, 2006) (The Warled Bank, 2013).

Under this contractual arrangement, the payment systems can be hourly, daily, weekly, or monthly, and rates for staff are usually listed in the contract. The rates for staff include salary, social costs, overhead, fee (or profit) and, where appropriate, special allowances. This kind of contract often outlines a maximum amount of total payments to be made to the consultants. The total amount should include a contingency allowance for unforeseen work and duration, as well as provisions for price adjustments where appropriate. Further, to ensure that the project progresses adequately, this type of contract needs to be personally supervised and directed by the client (The Warled Bank, 2013).

The ***cost reimbursement or cost-plus*** contracts rely on paying fees to cover contractors' overheads, which include the profit to the contractor, cost of labour, materials, and equipment (Grifa, 2006)

Measurement contracts are a type of contract where the full sum is not confirmed until after the finishing point as the project is valued on completion. These contracts are usually utilised for both the building and civil engineering sector. This type of contract is appropriate for works where client needs are not obviously determined or where a prompt start on project is required

The ***Time-based contract*** is suitable for difficult cases, especially when it is hard to define the scope and determine the period of work. This kind of contract is generally utilised for complicated cases such as the administration of construction, counselling services, and most training assignments; therefore, high standard of works are required (The Warled Bank, 2013).

3.5 Firms in the Construction Industry

The aim of this segment is to evaluate the role, features and resources of contractors or organisations in the Construction Industry

3.5.1 Types of Firms

There are a number of techniques to organise firms in the construction industry, comprising overall contractors, professional and subcontractors firms, minor and big firms, or resident and overseas contractors. Grifa (2006, p.32) specified that in the UK construction business there are several types of construction businesses: partnerships, private firms, and limited firms. These types and associations exist in the modern world.

3.5.2 Size of Firms

The size of firms in the construction industry is determined by numerous pointers like revenue, amount of workforce; capacity and magnitude of projects carry out. Conseqently, the gap between minor and big firms, in terms of amount of workforce, magnitude of project and value of revenue, and managerial, commercial and organisational capability, is very wide. Usually, firms in developed countries are categorised into big and minor firms; international contractors (typically working on big ventures); joint venture contractors and state owned companies, and private firms (engaging in large and medium projects); while the second are minor native companies fluctuating in magnitude and capacity of minor works (Grifa, 2006).

To conclude this segment, proliferation of a company's magnitude is connected with its capability to accomplish development and divergence in its undertakings. Further, the magnitude of a company is controlled by quantity of workforce, revenue, capacity, project scope and the company resources. Normally, the major companies in the construction industry are small.

3.6 Summary

Understanding the surrounding environment is essential to any study because it establishes a sound base for forming a definite outline of the field of study. The purpose of this chapter was to achieve an understanding of the CI issues related to contractor construction; therefore this chapter has briefly reviewed the main phases of the construction industry and the key issues that are directly associated with the contractor. The first section of this chapter explored the structure of the tender process including: the invitation to tender, tender form, identifying the most important type tender, open (competition) tendering, closed (competition) tendering, and negotiation tendering. In section two, construction procurement systems and their associated types. Thus, it can be concluded that utilizing different project procurement methods illustrates that the CI is now making an effort to address clients' requirements. When selecting the appropriate procurement system for constructions project it is essential that at the outset of a project the projects teams are aware of all the factors involved. This is because each project procurement system has its own features and has different effects on the cost, time and quality of the project. Thus, it can be concluded that one of the most important contractual phases is the procurement systems stage. Section three, discussed contracts and contracts types. It concluded that selecting the type of contract is the most important stage before the start of a project because at this initial stage there are a lot of possible risks that have to be taken into consideration. Consequently, contractors should avoid risk and adopt types of contracts where there is a minimum of risk for their company. Following this, the types and sizes of firms were discussed and reviewed in section five.

CHAPTER FOUR: THE HISTORY OF CONTRACTOR SELECTION PROCESS

4.1 Introduction

This chapter reviews the general background and history of the contractor selection process and discusses its key issues. The chapter is aimed at establishing a better understanding of the related subjects of the contractor selection process in both less developed and well-developed countries. It starts with a brief introduction of the contractor selection process including a discussion of the strategies used, as well as the aims, advantages, and disadvantages of different contractor selection processes. Definitions of the current criteria and methods for contractor selection are also introduced.

4.2 Background and History of Current Contractor Selection Process

The history of contractor selection started in the early age of the construction industry, and by the end of the 18th century builders and architects had established the traditional procurement process. This era was hugely important in the evolution of the construction industry and tender process (El-Sawalhi, 2007). Many researchers have found that clients often believe that project success can only be ensured by accepting the lowest priced tender (Topcu, 2004). Furthermore, when contractors were able to submit their bids in a process of free competition and when every job was advertised separately, then suspicions that contracts being awarded on the basis of friendship and favouritism were removed. In this way, no firm was discounted until all tenders were received.

Furthermore, Aje et al. (2009) have noted that choosing an experienced contractor is paramount to successful delivery of a construction project. Thus, the contractor’s managerial abilities have a strong impact on the performance of any project. Considering this fact, it is very important that due care be taken in the selection of contractors for construction projects so as to ensure that the required performance of the project in terms of cost, time, and quality is met. The successful performance of a contractor will lead to increased client satisfaction, an enhancement in the reputation of the contractor and thus their competitiveness in the market. Consequently, it is important for the client to take all necessary precautions and to properly select a contractor so that the project is completed efficiently as the participation of a capable contractor with excellent management track records will help the project team members to reach the project's aims.

Mahdi et al. (2002) confirm that when a construction contract is awarded to the lowest bidder without consideration of the selection criteria, it normally results in big problems such as delays, cost over-runs, and poor performance. A lower bid amount may be attractive to the client at the tender stage, which might lead project managers to overlook other criteria that should receive more consideration and be given a higher priority. If a contractor is not able to finish the project on time, for example, quality will be compromised in an effort to reduce costs. In addition, other problems embedded in the contractor selection process are that such contractors have to rely on the experience, skills, and relevant knowledge of the decision-maker – i.e. the client. Experience and knowledge of the relevant decision-makers differ from one to another and there are no specific standards to ensure the quality of the selection process even when being made by knowledgeable and experienced decision-makers.

Salama et al. (2006) say that choosing the most appropriate executor for a construction project is a vital decision for proprietor and project managers alike. Further, this research proved that in the tender process the bid price is remaining the main significant criterion in the financial assessment. It additionally reflects the absence of essential criteria such as the contractor's credit rating, financial status, and history of claims and arbitration in the financial assessment of the bid. The lowest bid price is still the most principal criterion for choosing the most appropriate executer among several qualified contractors in the final evaluation. This is obviously reflected in public and private sector projects due to the fallacy that doing otherwise will not reflect transparency.

The process of choosing a winning contractor is such a difficult decision to be taken by a client. Any project can encounter risk, uncertainty and adversity. Picking up an inappropriate contractor would certainly lead to cost overturns, delays and substandard work. The only way to avoid this is to make sure that the contractor is able to execute the project and comply with contract specifications which indicate client's needs (Kog & Yaman, 2014).

Palaneeswaran and Kumaraswamy (2001a) indicated that the selection of contractors constitutes a major part of the construction industry. The risk, complexity and adversity are aggravated in the construction industry, as well as influencing their ultimate performance levels. Different procedures such as open and restricted tendering are practised for contractor selection.

Different countries vary in the approach they follow in order to take the final decision (Marzouk, et al., 2013). Countries such as Denmark, Italy, Portugal, South Korea, France, Australia, Saudi-Arabia, Turkey, Canada, the United States of America, Lithuania and Iran have different approaches as shown in Table 4-1.

Table 4-1 Showing approaches for (CSP) developed by Marzouk, et al., (2013)

Country	*Decision making approach*
Denmark	Rejecting the highest two and the lowest two and selecting the contractor that offers a price closest to the average
Italy, Portugal, South-Korea	Rejecting the highest one and the lowest one and selecting the contractor that offers a price closest to the average
France	Rejecting the highest one and the lowest one and selecting the contractor
Australia	The process is implemented in two stages: assessment the contractor’s experience; Than, second, bargaining for a price then occurs
Saudi-Arabia,Turkey, Canada, Lithuania and Iran	The lowest bidder is selected

The traditional contractor selection process generally depends on selection according to the low price. The fundamental choice of the lowest price depends on the assumption that the specification utilised clearly defines the work that will be delivered by the contractor. Additionally, it assumes that all executers are the same and it is therefore best to select the lowest bidder cost alternative. However, apart from securing lower prices, clients would usually prefer to choose a contractor who is responsive, responsible and competent, as it shown in figure (4.1).

1. ***Responsiveness***

Palaneeswaran & Kumaraswamy (2001a) and Huang (2011) reported that to be responsive, a bidder must conform to all the requirements of the instruction to bid. To be responsive a contractor has to conform to all the requests of the instruction to contractor; for instance, the forms have to be completed properly and the bidder may not place condition or restriction on his willingness to be awarded a contract (El Sawalhi, 2007).

2. *Responsibility*

Palaneeswaran & Kumaraswamy (2001a) and Huang (2011) confirmed that responsibility can be attributed according to the contractor's track record and compliance with other mandatory/desirable requirements such as quality system, registration with societies/organisations, safety policy, conformance with bylaws, standards and regulations, and experience in/ attitude to partnering. The responsibility of the bidders can thus be evaluated on the basis of past performance records and reports. It refers to a bidder's apparent competence and capacity to perform the contract (El Sawalhi, 2007).

3. *Competency*

Palaneeswaran & Kumaraswamy (2001a) and Huang (2011) pointed that the competency of the bidders is their capability to undertake contracts of the type usually awarded by the given organisation (or a specific contract) with respect to their resources and capacities such as financial capacity, technical capacity, plant and equipment, human resources, organisational and management capabilities. The competency of the bidders can be evaluated on the basis of available resources, track record, and current workload.

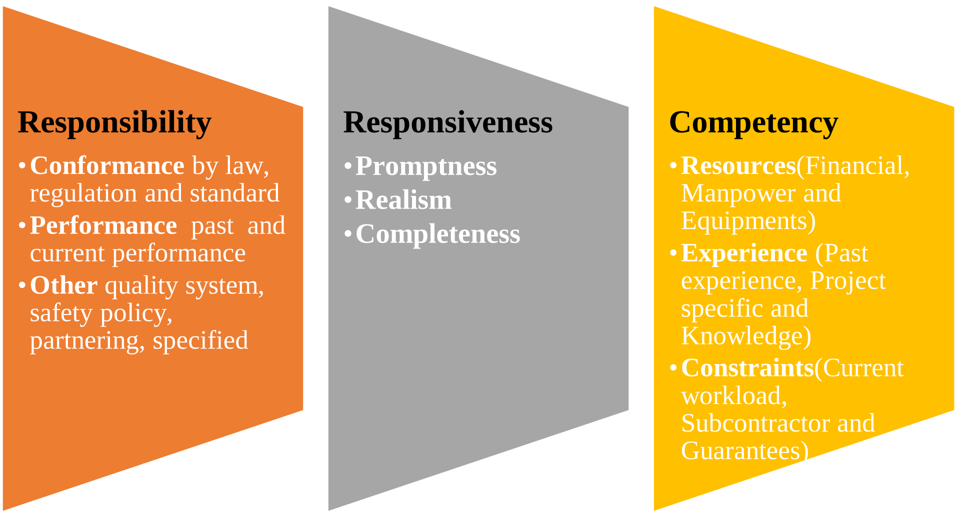

Figure 4-1 (Responsiveness, Responsibility, and Competency) frame work for CSP

4.3 Aims of Contactor Selection Process (CSP)

The objective of Contactor Selection Process (CSP) is to make certain that candidates who complete project needs can apply for such a tendering process. CSP, on the other hand, is a selection phase where the minimum abilities, below which any potential contractors would not be considered for the assessment phase, are established (Topcu, 2004). Accoring to Aje and Ogunsemi, (2006), only contractors who are able should be given the contract. It also gives a chance to the client to assess the candidate and his potential thoroughly before recruiting him for the job, as well as, it means to achieve the optimum result in cost, time and quality trianggle for the construction project management (Kog & Yaman, 2014). It also helps to reduce and eliminate incompetent, unsuccessful contractors from the bidding process (Morote and Vila, 2012).

It has been pointed out that CSP means the elimination of unqualified candidate contractors from the bidding process and can assist the private and public client in attaining successful and efficient use of their money by guaranteeing that it is competent contractors who will execute the project (Huang, 2011; Al-Harbi, 2001) In addition, because of the efficiency, capability and skill of the candidate contractor, completion of work within the specified cost and time is more probable.

Darvish *et al.* (2009) state that the main goal of contractor selection process is to reduce the opportunity of contractor default in bidding and restrict the number of eligible contractors involved. However contractor selection process is an essential task carried out by a contract administrator or clients due to the complexity involved in this process. Hence, it is highly important to avoid or reduce risks of contractor failure, to improve client satisfaction, and to optimize the contractor selection in terms of attaining a better balance between price and performance parameters

4.4 Bases for Exclusion of Contractors

According to Dagbanja (2009), candidate contractor must show evidence for eligibility and has to submit relevant certificates or, if no such certificates are issued, a declaration or statement under oath or a solemn declaration made before a competent body. The Directives of European Communities (EC) contractor may be excluded from participating of pre-qualification and contract process operators for many reasons, including:

1. Being bankrupt
2. Conviction for an offense concerning professional misconduct, fraud, or money laundering
3. Serious misrepresentation in supplying required information
4. Failure to pay taxes or to contribute to social security systems

4.5 The strength and weakness of Contractor Selection Process (CSP)

Contractor selection process is not purported to be a cure-all. Like any other systems it has advantages and disadvantages which are represented below (Mahdi *et al.*, 2002; Topcu, 2004; PubliConstructionLaw, 2008).

Advantages of CSP

The process of contractor selection has a number of advantages. By using CSP, the client can avoid selection of unprepared contractors. Also it protects bidders from being given projects they may be powerless to do. It can also reduce the percentage of project risk. In addition, it can speed up the process of evaluation and contract awarding. Furthermore, it can control the number of bidders who have limited financial resources or experience. Moreover with CSP some mistakes and potential claims could be avoided if sufficient consideration and planning is put into the CSP stage of a project. Finally, by the CSP process it is possible to provide feedback to the unqualified contractors about their weak areas and help them to improve these weaknesses.

Disadvantages of CSP

Like any other processes, CSP of the contractor also has some disadvantages. For example, it depends on the skill, experience and information of the decision-maker. Also the high level of competition may cause contractors to make bids at or near cost to keep the organization viable.

4.6 Some of the most important methods for contractor selection criteria

Numerous researchers have invented various approaches for contractor selection criteria. The following are some of contractor evaluation and selection systems that were identified as examples of good practice in evaluating contractor in the construction industry:

4.6.1 Price-Quality Method (PQM)

The Price-Quality Method (PQM) is used by the Singapore Building and Construction Authority. It is a framework that takes into consideration of both the price and the quality of work attributed for assessing construction tenders as they are being developed and implemented. The main idea of using the PQM is to offer a more structured framework for non-price criteria to be measured alongside price while the tender is being assessed. Further, PQM is applied to all construction project tenders with an estimated procurement value (EPV) of 3 million U.S. dollars and above (Tao, 2010).

In effect, the PQM transforms qualitative attributes into quantitative scores which, when combined with the price scores, enables the client to select the most appropriate company for the award. PQM optimizes value by awarding to the tenderer with the highest combined price-quality score for the project. The model adopted to evaluate the builders in the tendering for public projects. The model was adopted because it is transparent and simple to use (Singapore Buliding and Construction Authority, 2010).

PQM is a mutual price offering system to balance the power of price placement among worker and requester. It leverages the quality-price ratio based on negotiations betweem both sides which discourages cost cutting at the expense of quality (Jazi & Zahrani , 2015).

4.6.2 Dimensional Weighting Method (DWM)

In the dimensional weighting method, the determination of each criterion and their importance (weight) depend on the decision-makers – be they the owner or the consultant – and their desires. In dimensional weighting, the total score of the contractor is determined by this basic equation, the contractor's total score is calculated by summing their ranks multiplied by the weight of the respective criteria. Then, contractors are ranked on the basis of their total scores, and this rank order of the contractors is used for prepublication (Sonmez et al. 2002) (Al-Harbi et al., 2001). However, the main advantages of the DWM are that it is simple to apply and special knowledge to understand it is not needed. The DWM model suffers from a weakness in some major points. First, the DWM depends on the subjective judgment of the decision makers. Second, a low score in one section can be compensated by a high score in another. Third, the risks associated with the inconsistency of contractor data are not considered. Forth, the risks inherent with different decision maker's opinion are not considered. Finally, different criteria with dis-similar units of measurements cannot be accommodated.

4.6.3 Multi-Attribute Utility Theory (MAUT)

The Multi-Attribute Utility Theory (MAUT) has been considered to be one of the most significant methods in multiple criteria decision-making, and effective international applications for real and complex problems (Sonmez, 2006).

Another study (Pohekar & Ramachandran, 2004) used MAUT method as multi-criteria decision making to sustainable energy planning a review. They confirmed that the MAUT model is an important tool developed to assistance decision makers assign utility values to outcomes by evaluating these in terms of multiple attributes and combining individual assignments to obtain overall utility values. The result shows MAUT is not very extensively used in energy planning. This may be due to requirements of interactive decision environment required in formulating utility functions, complexity of computing scaling constants using the algorithm.

MAUT is not purported to be a cure-all. Like any other system or method, it has advantages and disadvantages, which have been discussed ((Sonmez et al (2002) (Almeida, 2007) (Sanayei, et al., 2008) (Kahraman, et al., 2009)). One of its positive aspects is that MAUT can deal with different types of contractors and it is capable of dealing with uncertain data, including the risks a decision-maker might take. In addition, it is particularly helpful as it permits the consideration of both qualitative and quantitative criteria and can also take into consideration numerous stake-holders. Despite these advantages, MAUT has some limitations and it is not always possible to use MAUT. A major weakness relates to the burden this method places on decision-makers by asking a large number of hypothetical, lottery-type questions of them in order to discover their real preferences. In addition, it requires providing the exact probability values so that the utility function can be derived. Another disadvantage of MAUT is that the process of decision-making takes a long time and becomes tedious if there are numerous criteria to be taken into consideration. Also the main requirements of this theory imply a rationality that involves compensation among the criteria, involving the procedure for aggregation of all criteria obtaining a synthesis multi criterion utility function. This rationality is not always accepted by the decision-maker. The decision-maker rationality may require a non-compensatory method. Finally, MAUT does not have the capacity for dealing with multiple decision-makers simultaneously.

4.6.4 Multi-attribute analysis (MAA)

The multi-attribute analysis method (MAA) method has historical links to construction management. It has also been used to evaluate different sectors in which management and environmental impacts are the main issues under consideration (Zavadskas, et al., 2009). Basically, MAA consists of a decomposition technique for constructing and solving decision-making problems where a given set of available behaviour has to be assessed with regard to multiple, often conflicting, objectives. However, the decision-maker is required to choose what he considers to be the best action (Zavadskas, et al., 2008b). The MAA model is an easy scoring method that relies on a quantitative approach for the consideration of multiple attributes. MAA techniques facilitate multi-attribute decision-making as exemplified by the task of contractor selection (El-Sawalhi et al. 2007).

The advantage of the MAA method is that it is a simple model and, because of that, it is often used by decision-makers. It also facilitates decision-making, even when there are multiple conflicting criteria to be considered (Zavadskas, et al., 2008b) (Zavadskas, et al., 2009). However, as pointed out by El-Sawalhi et al. (2007), an argument against the MAA is that the input variable is usually a subjective measure used by practitioners. Likewise, the MAA fails to incorporate systematic checks on the consistency of judgment. Further, non-linearity between contractor's attributes and decision criteria does not consider the uncertainty of contractor data not taken into account.

4.6.5 Artificial neural networks (ANN)

The first introduction of Artificial Neural Networks (ANN) was by McCulloch and Pitts (1943), and since then ANN have become widely used in solving problems where an extended information process is needed. ANN have been defined as '*artificial intelligence tools created by a huge number of processing elements called neurons, where each element receives and transfers the input from an element to another element through connections* (Sozgen, 2009). ANN are also described as a 'massively parallel distributed processor' that can store information taken from a data set supplied from a given network (Bendana et al. 2008). Additionally, ANN can use this information to create similar behaviour with respect to the data supplied. The primary process units of ANN, called *neurons*, are connected to each other with synapses that can have different weights or strengths, called *synaptic weight*. These neurons are organised in different layers and the number of the neurons and layers are open to change in order to increase the performance of the NN system.

Like any other system or method, The ANN holds some advantages and drawbacks that have been discussed by a number of authors. The following list of advantages has been compiled from the work of Cheung et al, 2010 and El-Sawalhi et al, 2007. According to them, an obvious advantage of ANN is that it is a data-driven, self-adaptive method in that there are few a priori assumptions about the models of the problems under study. A further strength of this method is that both inaccuracies and uncertainties are reduced to the lowest level possible. Furthermore, the distribution of statistical data need not be known In addition, with a complex combination of quantitative and qualitative data, the model is able to make both calculations and inferences. Another positive aspect is that the model is capable of analysing the non-linear relationship between output variables

Looking at the strengths of ANN, we have also to take into account its limitations. The major disadvantage of ANN is that the ANN model fails to give an explanation as to why a candidate contractor is qualified or disqualified. Additionally, the ANN is often criticised for exhibiting a low degree of comprehensibility. Another potential problem of the model is that it suffers from difficulties in the acquisition of training pairs for the private client's project. A further serious criticism of the ANN is that it requires a large amount of historical data for training.

4.6.6 AHP

The basis of the Analytic Hierarchy Process (AHP) relies on the clear mathematical structure of reliable matrices and their associated right eigenvector's ability to create a true or approximate weight. Further the AHP is a multi-criteria decision-making method that utilises hierarchic or network structures to describe a decision problem and then develops weights for the sub criteria or alternatives relied on the decision maker's judgments throughout the system. It deals with the issue of how to structure a complex decision problem, identify its criteria, measure the interaction among them and in the end synthesise all the information to arrive at weights, which depict preferences (Saaty, 2012)

The AHP enables the decision makers to structure a complex problem in the form of an indication by evaluating huge numbers of qualitative and quantitative data and criteria in a systematic method via multiple criteria. This approach also enables a decision maker to develop the trade-off among multiple criteria implicitly in terms of structuring and analysing a series of pairwise judgmental comparison matrixes. Also in addition to this, AHP helps to solve conflicts and analyse judgments through a process of determining the relative weight of a set of activities or criteria. The AHP can accommodate both tangible and intangible criteria, individual values and shared values, in the group decision process (Chen, 2006).

Like other methods reviewed above, the AHP has also a number of positive and negative aspects, though the advantages seem to outweigh its limitations. According to Pearson, (2010) and Johnson and Christensen, (2007) the strongest aspect of the AHP is its capability to rank choices in the order of effectiveness in meeting conflicting objectives. These authors also point to the fact that the method is simple and easy to utilise and it allows for rapid re-planning. Moreover, the AHP has the ability to incorporate qualitative and subjective factors. It also uses a psychometrics scale to quantify managerial judgments. An additional advantage of this method is concerned with its well-designed methodology which allows for measuring the consistency of these judgments. Further, it is also very convenient for individual and group decision-making and it has the ability to measure a number of factors at the same time, equally qualitative and quantitative criteria.

Having said that, however, the method appears to suffer one serious limitation as pointed out by Pearson, (2010) and Johnson and Christensen, (2007), centred on the fact that the method only works when the matrices are all of the same mathematical form – known as a positive reciprocal matrix.

4.6.7 Two-Stage Partial Least Squares (PLS) Path Modelling

The PLS technique was first intrdused by Herman Wold in the 1960s and 1970s to solve econometrics, and was then adopted by many others such as his son Svante Wold in the 1980s for addressing a regression problem in chemometric and spectrometric modelling (Boulesteix & Strimmer, 2006). PLS path modelling does not require a large amount of data, and the distributions of the initial variables are not assumed. Thus, this approach has been applied in many research fields. Based on their work, Hensler & Chin (2010) used the PLS path modelling approach based on multipliable analysis to compare approaches for the analysis of interaction effects between latent variables.

The basic idea of Two-Stage PLS Path modelling is that the signs of the weight coefficients of the latent variables in typical PLS path modelling are specified by the correlations between the comprehensive evaluation variable and the latent variables. Consequently, if the correlations of the latent variables are not all the same, negative weights will be found for some indicators, which are contrary to making a practical decision.

This model can explain the relationships between latent variables and manifest variable groups and the relationships between latent variables and the comprehensive assessment variable. Also the model can integrate valuable information from initial variables and attain a comprehensive assessment variable that can not only integrate the latent variables but also perfectly represent the indicator variables of the system. It can effectively solve such problems as correlation, subjectivity, and heterogeneity among the experts.

Even so, there still exit some limitations that ought to be taken into the consideration when using this model. For example, when calculating the comprehensive assessment values of the positive and negative variable groups, the latent variables estimated by this model are endowed with the same weights. In practice, as these variables represent different indicators and the experts give them different levels of significance, they ought to be given different weights. Meanwhile, determining the number and weights of experts needed to address projects of varying complexity, as well as realizing programmable automation of the two-stage PLS path modelling remain to be the orientation of future (Liu, et al., 2014).

4.6.8 FAHP

Both Fuzzy-AHP and AHP methods check the consistency of decision makers' judgments. Utilizing these systems, the qualitative scores of attributes are converted into numerical values. The methods have also the ability to handle scores evaluated by a group. This approach, however, cannot capture the uncertainty of the preference ratings for scoring the contractors. The fuzzy scale, utilized in Fuzzy AHP, overcomes this problem by allowing the decision makers to give their opinions in terms of a range of values in the scale. The biggest disadvantage of AHP, Fuzzy AHP and Fuzzy AHP-SMART however, is the rank reversal problem. Such a problem is said to occur when the relative ranks of contractors change whenever one or more contractors are either added or deleted from consideration (Padhi & Mohapatra, 2009; Wang & Triantaphyllou, 2008).

4.6.9 SAW-G & TOPSIS-Grey

Zavadskas et al. (2010) proposed an assessment model which covers method of TOPSIS (*Technique for Order Preference by Similarity to Ideal Solution*), method with attributes values determined at intervals (*TOPSIS-grey*) (Hwang and Yoon 1981) and a new technique of *Simple Additive Weighting with Grey relations* (*SAW-G*) (MacCrimon 1968). The outcome of the study presented that the newly developed methods TOPSIS grey, SAWG could be effectively used for the valuation of alternatives described by multiple criteria with values expressed at intervals. This method is used to support decision-making procedures and to increase its efficiency. (Önder, et al., 2013). The Simple Additive Weight (SAW) is one of the most famouse methods in modelling a multi criteria decision making (MCDM) problem. This technique is widly used by different researchers for many reasons such as that the SAW technique is understandable and rational. It is also easey to use and clearly described by a simple mathematical form. However, the *SAW* technique also has some disadvantages in that it is unable to deal with the imprecise and ambiguous detail involved in real-life decision-making problems, so that without taking the inherent uncertainty into account, the results are unrealistic and may be a cause of unreliable assessment (Rikhtegar, et al., 2014). Further, the estimates yielded by *SAW* do not always reflect the real situation. The outcome obtained may not be logical, with the values of one particular criterion largely differed from those of other criteria (Podvezko, 2011).

4.6.10 TOPSIS

The first proposed *Technique for Ordering Performance by Similarity to provide an Ideal Solution* is TOPSIS, which was introduced in 1981 by Hwang and Yoon as a new method to solve the problem of multi-attribute decision-making (Aryaeefar, *et al.*, 2011). It is an analysis and measurement method for evaluating and comparing numerous projects and ranking them according to a number of indicators (Jiang and Yan, 2010). Briefly, the basic idea of this method is that the best alternative would be the one that is closest to the positive-ideal solution and farthest from the negative ideal solution. Shih *et al.*, (2007), Hung and Chen, (2009), Karimi *et al.*, (2010) and Amiri, (2010) all mentioned some of the advantages of the TOPSIS. One striking advantage in this method is that TOPSIS logic is an understandable model. Its computational efficiency is good and the process is straightforward. A further strength is its ability to measure the relative performance for each alternative in a simple mathematical form. Plus the TOPSIS method has great flexibility in the definition of the choice set. The method has the ability to identify the best alternative quickly; it is easy to add, remove and expand the TOPSIS matrix. Finally, errors can be checked in this software.

4.6.11 The linear regression model

The linear regression model was developed in late 2006 for the Nigerian construction industry, by Aje. The aim of this model was to develop a method for selecting contractors for construction projects. Also it aims to ease clients' burden during the contractor assessment procedure while also benefiting contractors by assisting in the elimination of incapable contractors and therefore creating equitable competition among contractors. The model is based on linear regression equations. The data for the model consisted of both primary and secondary data. The primary data was collected via a structured questionnaire administered on clients and professionals in both the private and public sector of the construction industry. A random sampling technique was used in determining the number of respondents for the study. In designing the model, the fundamental task involved was to ascertain which discriminating independent variables were to be included in the model and this was achieved through a survey of selected professionals and clients of building and civil engineering projects. The outcome of this study revealed that past performance, experience of the contractor, the tender sum, plant and equipment and workmanship quality are the independent variables useful for determining the most suitable contractor for projects and hence forms the most significant decision criteria (Aje & Ogunsemi, 2006).

4.6.12 Integer programming

The integer programming model was developed in 2006 for the Austrian construction industry, by Missbauer to select the winning contractor. The main idea of the method is a bid calculation that includes two calculations, which we term *virtual* and *real* bid calculation. The virtual bid calculation is the disseminated (to the client) calculation, and its data need not concur with the expectations of the bidder. By contrast, real bid calculation, of which the client has no knowledge, determines the actually anticipated profit margin. However, the representation of real bid calculation in the model is significantly simplified. It considers the cost of project completion as a given quantity that can only be estimated with uncertainty but cannot be influenced. Additionally, it considers the decision to submit a bid as given. Thus the goal becomes the maximizing of the profit margin at given costs, i.e., maximizing the proceeds amount of the final bill. Consequently the approach must comprehensively reflect virtual bid calculation while only considering the calculation of the final bill for real bid calculation. This final bill is to be maximized using the rules of virtual bid calculation (Missbauer & Hauber, 2006).

The main disadvantages of using integer programming model is that this model was designed based on the bid price and the designer did not consider other important non-price attributes, such as quality, time of completion, physical resources, and past performance of the contractor.

4.6.13 Fuzzy AHP-SMART

This method is combined fuzzy Analytical Hierarchical Process (AHP) and Simple Multi-Attribute Ranking Technique (SMART) method. It is designed to deal with the contractor selection problem in government procurement auctions. The designed method uses a set of ten factors for the assessment of a contractor. (Padhi & Mohapatra, 2009). In this method, both qualitative and quantitative data attributes can be evaluated (Kabir & Sumi, 2014).

4.6.14 The Performance Assessment Scoring System (PASS)

In an effort to improve construction in the management quality of public housing in Hong Kong, the Hong Kong Housing Authority have implemented a performance assessment scoring system (PASS) as a method for assessing the effectiveness of the capability of a contractor to execute projects with specific criteria. The activation of

PASS was started in the 1990s by the Hong Kong Housing Authority. Since that time, PASS has become widely used in many fields, especially in the management and construction sector. The system is quite useful in the tendering process assessment, prequalification of the contractor, as well as having been used in work monitoring to make sure of both a good quality building product and proper construction process. Furthermore, the PASS operating system has a variety of uses including the environment of projects, site safety, architectural issues, and management input (Man Li & Poon, 2008). The major reason is the lack of any direct financial incentive to contractors with high PASS scores. Other reasons include only a small number of contractors can achieve the desired quality, so the client has less room to bargain with contractors on quality issues. Slack in quality performance by the remaining majority of poorly performing contractors may occur. The PASS scores do not show an upward trend, which indicates that the target of continuous quality improvement has not been realized. The method also fails to guarantee consistency in determining the attribute weights therefore, some improved measured have to be recommended (Tam, et al., 2000).

4.6.15 Multinomial logit (MNL) model

The Multinomial logit (MNL) model was developed in 2006 for the Taiwan construction industry, by Wang et al to select the winning contractor. A lump-sum lowest bid system allows project decision makers of public construction projects to reject any bid if they determine the bid price is unreasonable. In practice however, few bids are rejected because of the lack of an objective procedure for assessing the lowest bids. The main idea of this mothed is that the lowest bid is evaluated according to the unit prices electronically gained from the client and all qualified bidders. Additional, a bidder has to determine the unit price of each cost item to prepare a detailed estimate of a project. Then, the unit price is multiplied by the quantity for each item yields the costs of the item. The sum of the costs of all cost items is the total bid price of the project. Such a detailed estimate takes a long time for a responsible bidder to make. The decision is made according to whether the total unreasonable cost exceeds the total bid price by a pre-defined threshold ratio (Wang, et al., 2006). However, due to the extent of previous research and tools of criteria assessment, table 4.2 provides a summary of the most important method and approaches that have been used in the CSP:

Table 4-2 Modelling approaches to the problem of construction contractor selection

Author	*Country*	*Selection attributes used*	*Modelling approach*
(Lam, et al., 2000)	Hong Kong	Quoted financial stability, management capability, health and safety, reputation, relationship, claims & disputes, project-specific criteria	ANN
Al-Harbi (2001)	UAE	UAE Experience in handling similar types of projects, financial stability, quality performance, manpower resources, equipment resources, and current workload	AHP
Enyinda et al.,(2011)	Ghana	Past experience, manpower resources, relevant equipment, Financial stability	AHP
Hatush and Skitmore (1998	UK	Quoted bid price, financial soundness, technical ability, management capabilities, safety performance, and reputation	Multi-attribute utility theory
Lambropoulos (2007)	Greece	Quoted cost, quality of work, and completion time	
Liu, et al.(2014)	China	Quoted finance capability, tendered price, technological capacity and Health/safety/environment (HSE) management ability	Two-Stage Partial Least Squares (PLS)
Watt, et al.(2010)	Australia	Quoted Organizational experience, Project management expertise, Tendered price, Technical Expertise, Past Project Performance, Reputation,	Multinomial logit (MNL) model
Zavadskas, et al. (2010)	Lithuania	experience of executives, number of constructed houses, turnover, number of executives, market share, production method	SAW-G & TOPSIS-Grey
Huang (2011)	China	Financial Standing, Technical ability, Management capability, Quality, Current projects	Theoretical method
(Aje & Ogunsemi, 2006)	Nigeria	Quoted Past performance, Contractors' experience, Workmanship quality, Tender sum, Plant and Equipment, Contactor's reputation, Management capability, Project complexity, Quality assurance, Contract period , Health & Safety policy , Financial standing , Response to instructions , Project size , Location , Project type , Current workload , Competition , Length of time in business , Procurement system , Relationship with client ,	The linear regression model

(Missbauer & Hauber, 2006)	Austria	Bid price	Integer programming
Lai, et al.(2004)	China	Contractor organization structure, firm honour and competence, quoted bid price, and amount of materials used	Multi-attribute utility theory
Kumaraswamy (1996)	Hong Kong	Financial status, technology offered, and experience in handling similar types of projects	Performance Assessment Scoring System (PASS)
(Padhi & Mohapatra, 2009)	India	Quoted bid price, financial status, available physical resources, amount of work done, service during warranty period, cooperation and coordination offered, meeting of completion time, value of work done in each of the past projects, and pollution control measures	Fuzzy AHP-SMART
Wang et al. (2006)	Taiwan	Conversion of all the attributes to price	Unit price based
Topcu (2004)	Turkey	Quoted cost, quality of work, and completion time	AHP

According to Akortsu (2011), the method used in the selection of the contractor must be simple and transparent, to make it easier to explain why a particular contractor was unsuccessful.

A capable and responsible contractor has been recognized as the key to smooth project delivery (Watt et al. 2010). As such, cautious assessment is critical to ensure that the selected contractor is capable of smoothly delivering the project according to its contract requirements (Jaskowski et al. 2010). Modern capital projects require high technology and aesthetic design so the selection of an appropriate contractor leads to economical and timely construction service with good quality (Arslan et al. 2008). Essentially, the selection of a contractor involves a multi-attribute decision process that requires individuals to leverage competing objectives and limited resources when making their decisions (Watt et al. 2009).

Theoretically, the decision problem can be better formulated with respect to reality. However, as each multi-attribute analysis technique has different properties suited for different types of problems, there is no simple answer as to which method to use for a particular problem. Weighting and scoring systems are critical in most multi-attribute analysis. However, the processes of assessing weights and scores have been criticized as highly arbitrary and subjective and furthermore, the use of arbitrary weights in multi-attribute analysis and lack of a standard methodology increases the scope for misuse and deliberation (Zavadskas, et al., 2008b).

A series of the most important decision models based on various approaches were developed for contractor selection, as shown in table (4.2). Although these methods were designed for a single decision maker, they have drawn great attention to the area of contractor selection in construction projects and provided the basis and new ideas for group decision-making. More importantly, it is these decision models that motivate the group decision-making of contractor selection in large scale construction projects in this study. The above-mentioned studies incorporated a variety of methods to consider a large number of indicators and improve the precision in the selection of an appropriate contractor. Nevertheless, shortcomings still exist especially in the subjectivity of the weights as well as determination of the best and the worst contractor. This can be a critical problem with long-standing contractor evaluation frameworks for different projects. This process may result in biased evaluation results and the selection of a contractor that is not compatible with project execution.

Looking to the advantages and disadvantages of the linear regression model as discussed in 4.6.11, the result of this method is based on a random sample for the Nigerian construction industry and only on independent criteria. In our research, a correlation method is adopted as this research is a study based on dependent and independent variables. Further, this study is comparing public and private sectors and the samples of this research are not random.

As consistency checks are very important to prevent inconsistency, many models such as PASS, TOPSIS and MAA fail to guarantee consistency in determining the attribute weights, therefore, the consistency verification operation of AHP contributes greatly to preventing inconsistency because it acts as a feedback mechanism for the decision makers to review and revise their judgments. Consequently, the judgments made are guaranteed to be consistent, which is the basic ingredient for making good decisions and thus is considered the key reason of using the AHP method.

Additionally, most of the models have a weakness in identifying the relative weights of the decision criteria (DWA, MAA, and PLS), which usually require the relative weights to be decided in an earlier stage by another models. However, it is found that the most accurate and easy method for identifying the relative weight is AHP. Some of the above methods are based on the contractor's financial stability such as (PQM and MNL) models and this measurement is one of the disadvantages of the CSP. Moreover, some models are complex and require an amount of historical data, such as ANN and Fuzzy set methods whereby in those models the user should acquire extensive mathematical background and it could be hard to collect, to understand and run the analysis. On the other hand, with the AHP and TOSIS just a few numbers are required.

From above it is clear that the existing models are not very suitable for the LCI for the following reasons:

1. The existing models are much complex as compared to the proposed model in this thesis. Libyan decision makers do not have the required level of skills to handle them.
2. The existing models use a large number of historical data. In Libya it will be difficult to trace the historical data relevant to Libya.

3. Some of the existing models are based on the financial stability and neglect other important criteria such as experience, quality, health and safety. The proposed model includes consideration of these neglected but important criteria.
4. The proposed model is capable of identifying the best and the worst solutions, which other modules are not able to do.
5. The proposed model has the ability to do consistency check, which other modules cannot. Libyan decision makers are not skilled enough to work without consistency check with confidence.

As seen in comparison of the existing models, the AHP and TOPSIS were selected as the decision maker's tool for CSP in the LCI. AHP and TOPSIS can determine the best and the worst ideal solution. AHP and TOPSIS method has shown good results in exploiting the decision information and objectively assigning weights to the primary decision attributes, especially being well applied in area of contractor selection of large scale construction projects. Further, the most positive advantage is that AHP and TOPSIS are reliable and systematic techniques as they have the ability to capture an expert's judgment when complex MCDM struggles are considered (Lin et al. (2008), Cheng and Fan (2009), Yi-chuan et al. (2009), Percin, (2009)). Therefore, the integration of the AHP and TOPSIS approaches makes the decision-making process more realistic and rational. Because of this capability, decision-makers can use this combined approach in making their strategic decisions. More importantly, it considers the hierarchical structure, pair-wise comparisons, and consistency checks in the evaluation process. Thus, this approach can be considered as an exceptional tool for calculating quantitative and qualitative criteria.

Another clear benefit of AHP and TOPSIS is that the processing of calculations is faster than with other mathematical methods such as DEA or ANP. Likewise, the integration of the AHP and TOPSIS techniques is a very suitable and flexible method for dealing with different decision-making situations. Another strength of using the AHP and TOPSIS is that the ranking of the alternatives obtained by using the AHP and TOPSIS methodology may change if a new criterion is added.

Having discussed the methods of contractor selection and the advantages and problems associated with their application, it is obvious that the design has been marred by a number of methodological limitations.

From the above review of these methods, it seems that TOPSIS and AHP approach has offered the best designed method. The present study, therefore, adopts this approach for the best contractor for Libyan projects, while aiming to avoid the limitations found in most reviewed methods. The major limitation of TOPSIS, on the other hand, is that it is not designed for weight estimation, and consistency checking for judgments. However, these problems can be solved by using a method such as AHP to weight the criteria and the TOPSIS to rank the criteria. For further information about the AHP and TOPSIS see chapter 6.

4.7 Pre-qualification of contractor

Bid evaluation and pre-qualification of the contractor is a decision making process that takes place within the overall procurement process. This process involves investigating and developing a variety of sufficient and necessary decision-making factors as well as the participation of several of decision-making groups (Aje and Ogunsemi, 2006). Pre-qualification of contractor is considered as an important process in a construction project. This is a process of assessment that evaluates a contractor's capability to complete projects effectively and might guarantee meeting project aims (Attar, et al., 2013). Pre-qualification checking is the process of sorting out a number of contractors selected by the client to prepare and tender for a particular project (Plebankiewicz, 2012) (Huang, et al., 2013). In fact, pre-qualification of the contractor is necessary and good practice for the client as well as for the contractor himself because it is good for the client to select the right contractor for the project, and good for the contractor to discover any weak points in his company as he can then improve upon them. Thus, the ability of selecting a short list of potential contractors from a larger pool would result in the final selection of the right contractor as top-quality contractors will be identified quickly and short listed quickly.

4.7.1 Pre-qualification definition

Since it is considered one of the most important tasks in the project’s lifespan, several studies have been carried out regarding the problems of pre-qualification and many researchers have discussed the definition of contractor pre-qualification. Lam *et al*. (2004) state that the pre-qualification of contractors is a regular process used for classifying a pool of competitive, talented, and able contractors from which tenders might be sought. Another definition was presented by McCabe et al. (2005) who wrote that pre-qualification is a screening process that is applied to contractors before tendering in order to reduce the risk of project failure through the process of short listing potential contractors. Finally, this process could be used to aid clients in the selection of the right bidder. However, that means that the quality of the client's final selection could only be as good as the best of those contractors short listed.

Pre-qualification is a critical function of the construction project's lifecycle and is strongly implicated in issues of risk management (Turskis, 2008). Contractor evaluation is ranked as one of the most vital parts in the tendering process. Much accurate and sensible information should be obtained for selection of the appropriate contractor: owners must have enough information about bidders' past experience, workload, financial stability, management and technical ability, health and safety, quality include quality control, quality policy and quality assurance also resources include equipment and number of staff etc.

4.7.2 Principles of contractor pre-qualification

The main aims of pre-qualification selection are to classify those contractors who have the ability to undertake the project less expensively. However, only qualified contractors will be invited to the tender, and the selection process there should not discriminate between local and foreign contractors in the approved list (Wai, 2004). The candidate contractor should be competent to perform to standard (El Sawalhi, 2007) and to the owners' desires. In addition pre-qualification of contractor is done to make certain that the contractor characteristics and competences match the desires of the project under consideration, as well as being used to set up a set of criteria through which the competence of contractor measured and judged.

4.7.3 Contractor pre-qualification system

There is much evidence of extensive efforts and research across the world, designed at structuring and developing of contractor selection (Palaneeswaran & Kumaraswamy, 2001) (Darvish, et al., 2009) including descriptions of some of the most important systems that have been used by clients to select contractors in the world as follows:

Table 4-3 Construction contractor pre-qualification criteria in some developed countries

Author(s) Year (Nationality)	Sum of Criteria
Contractor pre-qualification - a Hong Kong perspective	The lists of approved contractors are in three groups (A, B and C) based on their capacity (Group A — up to HK$20 million; Group B — up to HK$50 million; Group C — exceeding HK$50 million). Experience on in Hong Kong Government including type, size of projects, and overseas contracts in the past 5 years, also professional and technical staff management experience, details of equipment, special plant, workshops, safety and accident records, history of financial resources and finally, a brief history of all litigation, claims and arbitration proceedings in connection with government building and engineering contracts
Contractor selection by the Queensland Government of Australia	Queensland, Australia, to be eligible to tender for Government building projects with a contract value of more than Australian $100,000 Technical capability, financial capability, quality assurance, skill formation, occupational health, safety and welfare, industry initiative and human resources management.
Contractor pre-qualification — a US perspective	Registration and license; Experience of the firm (level of responsibility and extent of experience, experience with similar projects authorities/size of the project, experience in the kind of service); Quality of personal experience.
Contractor pre-qualification system in Turkey	Organizational expertise, availability of experienced technical staff, availability of resources such as machinery and equipment, ability to timely complete projects.

4.8 Review and definition of Contractor Selection Criteria

Contractor selection is a commonly used procedure for identifying a pool of competitive, competent and capable contractors from which tenders may be sought. It can aid public and private owners in achieving success by ensuring that only qualified contractor are selected to execute the work (Mills, 2011).

Cheng and Li (2004) concluded that, in terms of contractor selection, the performance of the project will be highly affected when inappropriate methods are used. It is presented that considering the great importance of construction projects in countries and the role of contractors as the most significant executive agents, selecting an appropriate contractor is the most important concern of clients (Bakhshi & Bioki, 2013). Therefore in choosing a professional executor, the critical function is that he has unique skills and judgement. An incorrect selection may not only lead to an acrimonious contractor and client relationship but also lead the project to the failure. However, the majority of the past researchers verify that a “price-only” selection of contractor system is inefficient in choosing the most knowledgeable contractors who can execute projects profitably with winning results. Selecting the cheapest bid usually leads to delay, cost over-runs and sub-standard quality and sometimes guides the project to the failure with disputes and escalated claims, etc. (El Wardani et al., 2006; Kumaraswamy, 2006).

Contractor selection and tender assessment continues to be an area of importance and interest to decision makers responsible for delivering project outcomes. Occurring early in the project life cycle, it is possibly one of the most serious undertakings performed by clients, the effectiveness of which is directly related to project success and the accomplishment of specified objectives (Watt, et al., 2010).

With specific regard for quality in construction projects in LCI, on reviewing the previous related literature on determining contractor selection criteria (CSC) and studying categories of various criteria presented by each researcher, the need for a new category of criteria covering all contractors’ capabilities and the clients’ aims is clearly observed in Table 2.1.

Steps have been taken to provide a new category regarding CSC including eight main criteria which represent the needs for a qualified contractor to do the project and also dividing each of the main criteria to several sub criteria: financial stability, human resource management, technical and management ability, experience, health and safety, quality and reputation were respectively introduced. In addition, the importance of each sub criteria concerning the relevant criteria has been studied. For instance, experience measures have been introduced: experience in same projects, experience in region of project and experience with same contract. The new category of criteria and their weighting in this study has protected the clients from making wrong decisions in selecting the appropriate contractor and has facilitated making the right decision for them.

4.8.1 Financial stability

This indicator category signifies the financial credibility of a contractor with which it can handle capital crises (Isik, et al., 2009; Watt, et al., 2009). It considers that one of the most notable things the construction industry is dealing with is a huge number of firms, from small to large multinational firms with contracts undertaken by the contractor, supplied by the client throughout the project's life. It is very important for the company and contractor to run the business and maintain financial stability. Where a contractor can utilise the company with his own money, but only for a few months, to avoid the failures, bankruptcy and provide the cash flow, the contractor should receive support by client in any stage of the contract. In addition, improving the work needs money to improve conditions for acquiring new equipment or develop new technologies (Harris *et al.,* 2006). Further, the client must reach an informed opinion regarding the overall financial position and ability of contractor (Nieto-Morote & Ruz-Vila, 2012). Financial stability can be divided into four sub-criteria: tender price, banking arrangements, financial statue, and positive credit rating.

4.8.1.1 Tender price

In running a business, the tender price of a contractor is an essential consideration. Both in the past and at present, the majority of contractors working on maintenance projects are selected purely on basis of having put forward the lowest tender price. However, researchers have increasingly shown that the practice of awarding tenders on a basis of lowest price often leads ultimately to quality problems (Chau *et al.,* 2003).

The construction industry has been in a price based, commodity marketplace for the last 30 years. Increasing price pressure has had an impact on performance, levels of risk, and value (Kashiwagi, et al., 2004).

Construction clients are becoming more aware of the fact that selection of a contractor based on tender price alone is quite risky and may lead to the failure of the project in terms of time delay and poor quality standards (Singh & Tiong, 2005). The tender price has been the most significant factor influencing the process of the tendering procedure and the choice of the contractor in time. Low tender prices should not attract the client, rather they should behave cautiously otherwise the decisions that are made are based on the lowest price and could cause greater losses in terms of the other goals, such as quality and time (Kog & Yaman, 2014).

The use of the lowest bid to determine the final choice of a contractor has been further criticized by many researchers e.g., (Al-Reshaid and Kartam, 2005; Padhi and Mohapatra, 2009). Accordingly, a contractor, quoting a very low bid price and eventually winning the bid, could find the quoted amount totally untenable. Such a contractor usually provides a quality of work which usually leads to serious time and cost overruns, quality problems and increased risk to the project. The selection process, consequently, does not distinguish a more technically superior contractor from other marginally qualified ones.

- *The effect of the competition on margin profit*

Risk and insecurity have a strong relationship with margin of the profit. Seeing that the risk raises in the business, the potential profits for any bidding are different from one project to another. It is likely that the margin of profit added on the bid by the contractor will decide whether the contractor will win the bid or not. This shows to us that for an easy bid the margin of the profit increases and number of contractors will increase as well, but when the number of contractors increases, the margin of profit decreases because of the competition between the companies. However in some projects less profit may not be considered because those kinds of projects might need a special contractor for special jobs. Adding a small amount of profit margin may lead the company to failure, and on the other hand adding a high margin of profit to the bid the contractor may lose the project. Hence for a contractor it is not easy to estimate his profit amount and that is one of the most essential reasons for a contractor to fail due to contractor competition (Al-Barrak, 2004; Bader, 2004).

- *Cost estimation practices*

For any contractor especially in the competitive bid, cost estimation is not an easy task. Estimation of cost needs unique skills. Construction material, equipment, taxes, insurance, subcontracts, and cost of labour, all those things will determine whether a contractor will get the bid or not. In the construction boom, management of cash estimation plays a key role in the project's life. Whilst cost estimation is very important throughout engineering planning, still it is not easy for professionals to estimate an accurate price for the project because of the shortage of the information and the natural project work (Wen and Chien, 2006).

In construction industry and civil engineering, planning cost estimation and forecast is a critical factor. It is customary that around 70% of the life cycle of the product could be determined at the early stage of the project's design (Hietikko, 2012) .

4.8.1.2 Banking arrangements

Bank arrangements have been explored as a measure of the financial soundness of a contractor (Watt, et al., 2009) whereby it was regarded as an essential criterion for the time and cost of a project and a key factor in successful contractor selection. Evaluating bank arrangements includes looking at a contractor's financial statements to check the financial exposure of the contractor when considering his tenders for both local and overseas contracts.

In another major study, El Sawalhi (2007) reported that understanding a contractor's bank arrangements is important because it shows whether or not the contractor has sound financial status and would be able to complete the contract.

4.8.1.3 Cash flow

For a contractor, running the business cash flow is necessary, because the majority of contractors' expenses are paid in cash. It largely reflects a contractor's capacity to meet its financial obligations (Huang, et al., 2013). However, sometimes it is easy for a contractor to find a supplier to support him with equipment and the rest of the facilities, but the problem with that is that the supplier cannot offer everything for the contractor and usually the price is not as same as when the contractor buys with cash payment. Hence the contractor has to have his cash flow strategy otherwise he will not be able to cover his expenses. This strategy should be shared between the client and the company to avoid the failure and delay. Therefore cash flow has been considered as the priority payment in the construction industry (Al-Barrak, 2004).

Cheng *et al.* (2009a) addressed that more than 60% of the failures in the construction industry can be attributed to the financial issue. The forecasting of the cash flow will largely affect the project's life and work achievement, as well as the project control. Dealing with cash flow requires great care and advanced knowledge has to be used to avoid the failures in the project. It has been concluded that failure to give sufficient attention to predicting cash flow has frequently caused the construction industry to be the largest economic sector facing bankruptcies (Alzahrani & Emsley, 2013). Therefore, cash flow predicting is critical for the survival of any contractor during all times of the project.

4.8.1.4 Positive credit rating

Scanning the potential contractor's credit rating is a valuable step in judging the financial status, financial soundness, and trustworthiness of that candidate contractor. Furthermore, it allows the client to see if the executor is financially able to execute the construction works according to the contract requirements. Consequently, it is concluded that the most dominant CSCs in terms of variance values that affect Project Success Factors (PSF) are financial status, credit rating and financial stability (Gaojun & Yan, 2006).

Al-Otibi (2011) stressed the importance of identifying contractor credit rating in the pre-selection performance evaluation. Credit rating identifies contractor's financial strengths and weaknessesand an insight into their ability to cope with the project and fulfil its commitment to the project and contractor financial stakeholders.

4.8.2 Human resource management

The criterion of human resource management includes two sub-criteria: staff experience and staff qualifications (Belout and Gauvreau, 2004). Huemann *et al.* (2007) agreed That Human Resource Management (HRM) has become a critical element in most modern organisations. Projects often have several different goals and may include several external and internal factors. However, since 1980 numerous researchers have argued that HRM is one of the most important keys to an organisation's success. The main benefit of HRM is that it helps the contractor selector to decide whether a candidate contractor is likely to satisfactorily carry out the contract or not. Further, Palaneeswaran and Kumaraswamy (2001) reported that the key purpose of HRM is to encourage workers to set up and maintain a successful system to manage the safety risks to workers and others that arise from the nature of the work performed.

4.8.2.1 Staff experience

El Sawalhi (2007) confirmed that for any company, the staff experience and their time spent with the company is an essential criterion to be considered in the assessment of the company. Darvish, *et al.* (2009) carried out a number of investigations into the contractor’s ranking and they reported that the time staff members have spent in the company is significant.

4.8.2.2 Staff qualifications

Nassar and Hosny (2013) provided an in-depth analysis of contractor performance evaluation and their results demonstrated that the proposed framework can be utilised to classify contractors into different performance groups. Their study confirmed that the qualification of contractor's staff and equipment was deemed to be the most significant measure of staff experience. Additionally whether or not the company has a staff qualification training program is illustrative of whether the company has plans to improve and develop the quality of their staff. According to Alzahrani and Emsley (2013), in order for contractors to finish their work, they should allow well qualified and trained staff with project management abilities to carry out projects during construction time.

In another major study, Alzahrani *et al.* (2012) found that maximum financial capacity and availability of highly qualified technical staff ranked highly in the importance indices assigned by the consultants.

4.8.3 Technical and management ability

In this factor, the contractor must prove that it has the technical capacity to perform all activities required by a specific project (Watt, et al., 2010). Brauers,*et al.,* (2008) discussed the criteria for contractor selection and found that the most popular criteria considered by procurers during the selection and pre-qualification procedures were those relating to financial stability, management and technical ability, contractor’s experience, contractor's performance, resources, quality management and health and safety concerns.

The contractor must prove that he is technically capable of achieving the activities of the specific project for which it is seeking the pre-qualification (Nieto-Morote & Ruz-Vila, 2012). Alzahrani and Emsley (2013) utilized multiple regression analysis to invest 43 influencing technical attributes in contractor selection and their influence to project success objectives. The findings of their study reported that technical capability, past success, time in business, work methods and working capital crucially impact on contractor performance across time, cost and quality success objectives. The technical and managerial ability criterion was divided into three sub-criteria:

4.8.3.1 Project manager qualification

A project manager is considered to be one of the main factors that can contribute to the success of construction projects. The success of the construction project could be based upon the knowledge, skills experience, authority and relationship of a project manager. Many authors have been identified a project manager, for example, (Ali, 2011) identified as:

"The person who is charged with managing the resources to complete project implementation on time, within budget and with agreed functionality"

Muller et al (2007) have stated that the success of a project manager is usually based on competence, especially in terms of leadership style, skill and knowledge. Different projects need different abilities and skills of the project manager. Therefore, all project partners, clients, consultants and contractors are looking for good, appropriate project managers (Zavadskas, et al., 2008a). The selection of the project manager has an important influence on successful achievement of the project life. The project manager selection procedure includes the consideration of many factors and has been widely discussed by many researchers.

Zavadskas, et al. (2008a) investigated the project managers' criteria in many papers and suggested a set of factors that can be used for the selection of construction managers. They confirmed that the most significant criteria that should be taken into accounts are the project manager's personal skills and experience in similar projects.

Ali (2011) concluded and summarised eighteen main criteria and their sub-criteria which affect project manager efficiency. Those eighteen criteria and sub-criteria are:

education level (academic qualification), age, gender, availability, experience in similar projects, dependability, work experience in project management, ability and knowledge of using project management software, interest in the project, previous projects successfully managed, personal skills (mobilizing, political sensitivity, verbal communications, high self-esteem, enthusiasm, delegating authority, conflict resolution diplomacy, hard-nosed manager, ability to keep project's team happy), technical skills, technical engineering background, management and managerial skills, knowledge of national building code, dispute resolution management ability and knowledge, health and safety training, risk management assessment ability, design making ability, project management skills (team leadership, knowledge of project management implementation process, developing recourse plans), business skills, control, quality, conceptual and organisational skills (planning, organizing, and strong goals orientation).

4.8.3.2 Past performance

Past performance of a contractor is the measure of the body of similar work done satisfactorily by a contractor in the past (Padhi & Mohapatra, 2009) resulting in a higher or lower degree of confidence in the possible contractors regarding the quality, time and cost control requirements (Morote & Vila, 2012).

One identified issue is client insecurity leading to desire to maximize the amount of criteria that identify a contractor’s past performance (Kashiwagi, et al., 2004). Further, a contractor’s past performance record is a key indicator for predicting future performance as suggested by Mamavi and Nagati in studying the impact of performance history on supplier selection (Mamavi & Nagati, 2015) in addition to the awarding of future contracts.

A comprehensive comparison made by Xiao and Proverbs (2003) between contractor performance in Japan, the UK and the USA indicated that the contractor performance is made up of several equally important factors: construction time, construction quality, construction cost and sustainable development. Their philosophy is that developing one aspect of performance should not be at the expense of another aspect.

Aje et al. (2009) stated that it is important to improve the performance and reputation of a contractor and to lead to increased client satisfaction and hence their competitiveness in the market. In general, contractors who have positively accomplished work are more likely to smoothly deliver similar projects. This indicator factor is usually highly prioritized over others factors, as it also indicates the capability of a contractor to complete a task with the best quality and the lowest cost (Kadefors, et al., 2007).

Akortsu (2011), carried out a number of investigations into the process for evaluating tender in the Ghanaian construction industry and found that performance record helps in analysing how the contractor has achieved the desired objectives in:

- Previous projects
- Cost
- Quality of work
- On time
- Safety
- The client‘s ultimate satisfaction
- Previous relationships with subcontractors, suppliers and insurance companies

A lack of soundness in business and workforce may also have been influential in project inefficiencies (Doloi, et al., 2011). However, past performance is found to have negligible influence on project success in the Australian construction industry which contradicts the findings reported by above studies which asserted that contractor's past performance is one of the most critical factors contributing to success on projects.

4.8.3.3 Company equipment

Goldenberg and Marat (2007) published a paper in which they investigated UK construction clients’ tender selection processes. They confirmed that choosing the lowest-price tender should not be the owner’s main goal. Contractor’s equipment plays a significant role in contractor evaluation. For example, a contractor who has his own equipment will be ranked higher than a contractor who rents their equipment. For that reason, information about the quantity, category, situation, age, and condition of equipment is very important for assessing a contractor’s capacity (El Sawalhi, 2007).

4.8.4 Experience

Many researchers have considered management as one of the most important factors in the company’s life cycle. The owners or stakeholders have to employ highly trained staff in the company. In addition, the administration team have to be at the same level of competence. However, owners should be alert and intelligent mainly for two reasons. First, if owners have no such experience, in this case, it is highly unlikely they can be persuaded into accepting any new ideas or appreciating any improvements in the company. As for the second reason, having no experience, owners can be very easily cheated from outside or inside the company. However, companies could be led by a resident engineer, project manager, or site manager, who should possess knowledge, skills and the right attitude in order to reach the project’s goals. As attitudes are not acquired skills, they can be supported by experience and strengthened by attending the relevant courses (Lin, 2008).

In the Singaporean construction industry, contractors’ selection criteria and their perceived importance among the practitioners have been investigated (Singh & Tiong, 2006). They analysed 128 questionnaire responses collected from quantity surveyors, developers, contractors and public and private clients. The results of their study confirmed that a contractor's experience in similar projects is one of the most significant criteria for ensuring a contractor's success in projects.

Contractor experience has been focused on by many researchers, and it has been evaluated under many different names such as past project performed, past performance, experience, etc. This process involves assessing the potential contractor’s project history records to decide whether or not he has handled projects of similar scope and complexity in the past or currently (Mir, 2005).

Contractor experience usually depends on current and completed work, experience and capability of technical personnel, complexity of work performed and level of technology (Aje & Ogunsemi, 2006).

Both Ibrahim *et al.* (2002) and Mahdi *et al.* (2002) claimed that, in the construction industry, experienced contactors are a strong requirement for the project’s life. Thus, choosing the right contractor is one of the most key decisions in any project. There are some factors that need to be considered when choosing a contractor, namely:

- Contractor’s years of service in the construction field and in similar projects
- Contractor’s average work volume in the construction field and in similar projects
- Contractor’s average work value with different types of contract
- Geographical conditions

- Weather conditions.

4.8.4.1 *Experience in the region*

Experience in the region is considered an important factor and should be prioritized when considering a contractor (Cheng and Li, 2004). Further, experience in the region is a sensitive factor, especially in conservative societies, and it means that a contractor and his employees should be familiar with and knowledgeable about the local culture, religion and regulations.

4.8.4.2 *Size of project*

Considering the success of past projects that a contractor has completed plays a significant role in determining future project success. Furthermore, the contractor who has completed more projects will have learnt from prior mistakes and thus avoid delays in future projects. Therefore, contractors under consideration should provide a list of completed projects. This is to determine whether the proposed project would be larger than the contractor could handle (Alzahrani and Emsley, 2013).

In order to achieve the aims of a construction project, qualified contractors must be selected for execution of construction works. Thus, their qualification must be evaluated by determining and defining appropriate evaluation criteria. Evaluation criteria for bids of contractors must be selected considering the size and complexity of a construction project (Banaitiene & Banaitis, 2006). Four key factors have been identified in deciding contractor selection: current workload, size of project completed, formal training regime, and national or local experience (Zavadskas & Vilutiene, 2006).

4.8.4.3 *Current workload*

The capability of bidders can be evaluated on the basis of available resources, track record, and current workload. The workload sieve eliminates those contractors who are overloaded and qualifies others `dynamically', depending on the contractor’s pre-qualification ratings and current workload levels (Palaneeswaran & Kumaraswamy, 2001).

The contractor’s present workload and capability to support the new project was explored in the fieldwork survey and the literature survey as an important sub-criterion. The survey stressed the importance of identifying the contractor’s current workload and capability, and the commitment to support (Al-Otaibi, 2011).

Watt et al. (2009) investigated various factors to identifying key factors in the evaluation of tenders for projects and services. The study established that organisation expertise, workload capacity, physical resources, and company standing (reputation), client-supplier relations, technical expertise, and method technical solutions are the most significant factors in evaluation of tenders.

Egemen and Mohamed (2007) built a framework for contractors to reach strategically correct bid/no bid and mark-up size decisions. The research identifies the key determining factors and their importance weights for the contractor selection. The current workload is considered as the most significant criteria in the decision making procedure.

4.8.4.4 Type of project

The contractor must show its participation in other previous projects, especially if they are similar to the project that will be executed (Nieto-Morote & Ruz-Vila, 2012). Alzahrani and Emsley (2013) investigated the impact of contractors' attributes on construction project success and reported that the type of project completed has an impact on project success. Therefore, it is advisable to choose a contractor who has experience with similar projects in the past.

4.8.5 Health and safety

According to Hoonakker et al. (2005), the construction industry has been one of the most dangerous industries in the world. In addition, it is well acknowledged that the construction industry has the highest accident and illness related records over any other branch or industry sector. With that in mind, many thinkers have considered safety in the construction industry as a priority in the research area.

Similarly, Tam *et al.* (2008) argued that around the world, health and safety in the construction industry is a grave concern. There have been some efforts by companies to improve their safety by executing their own safety system management, especially the implementation of the latest international standard: Occupational Health and Safety Assessment Series (OHSAS) 18001 which has been adopted only in some countries such as the United Kingdom, Singapore and Australia. A few countries have addressed the regulation of safety working system practices on site. Since safety in the construction industry is usually a notable concern for both researcher and practitioner, a variety of factors influence the performance of safety in the construction sector identified as containing construction company size, workers' attitudes, safety economic pressure, and policy project coordination.

Deng *et al.* (2004) affirmed that the value of program training for the development of construction safety has been promoted. They highlighted that training programs have a real effect on helping companies to carry out and establish positive safety attitudes during various activities, in addition to combining safety and quality construction and goals. As a matter of fact, improving the educational level and training the workforce is an important factor for the occupational health and safety implementation process.

A good safety record reduces the cost of construction and aids to support the desired attitude toward quality and productivity (Huang, 2011). The aforementioned research of Alzahrani and Emsley (2013) reveals that safety and a quality contractor are fundamental in achieving project success.

4.8.5.1 Safety record

Aksorn and Hadikusumo (2008) confirmed that good safety records are achieved when a company adopts a safety inspection program and is also well organized. To certify praiseworthy safety records, each employee has to be aware and be motivated to complete their job carefully and safely. A contractor can encourage this by adopting a successful safety system and hiring the right people.

Alzahrani and Emsley (2013) reported that variable hazards and poor safety records have a huge impact on the work environment and employees' morale, and in some cases a poor safety record might result in the job stopping on site.

4.8.5.2 Company safety policy

A successful safety policy can significantly decrease risks because it helps management to develop safer operations and to build a safe working environment for employees (Aksorn and Hadikusumo, 2008). Edwards and Thomas (2005) stated that one of the most influential criteria underpinning safety in the construction industry is the company organisation and company safety policies. Teo *et al.* (2006) concluded that one key element of worksite safety is a specific safety policy that must put into operation policies relating to the safety management system (SMS) and occupational health and safety management system (OHSMS) by project managers.

4.8.5.3 Experience in noise control

According to Ballesteros *et al*. (2010) the noise produced by construction activities is one of the main acoustic polluting elements in society. Consequently, not only the employees of certain sectors, but all people, are exposed to high noise doses.

4.8.5.4 The Occupational Safety and Health Administration (OSHA)

Previous construction studies discussing evaluating safety performance of contractors have reported frequency of utilising the Occupational Safety and Health Administration (OSHA) for record incidence rates (El-Mashaleh *et al.*, 2010). However, the OSHA recordable incidence rates rely on computing and calculating incidence rate information that was often recorded and reported by workers according to the US Occupational Safety and Health Act (1970).

4.8.6 Quality

In a large longitudinal study, Juan *et al.* (2009) investigated the CSC and an in-depth interview was carried out with twelve experts with the aim of identifying new contractor selection criteria. Juan *et al.* (2009) found that the most relevant criteria for contractor selection were quality and service assurance. In 2004, Topcu (2004) published a paper in which he built a decision model proposal for construction contractor selection in Turkey, identifying key criteria that should be taken into account at the selection stage: a contractor's ability to complete projects on time and organizational experience. The former refers to the issue of *time* and the latter to the issue of *quality*. Kog and Yaman (2014) emphasized the necessity of encouraging a quality contractor over one offering the lowest price. This view is reflected by Alzahrani and Emsley (2013) who studied the impact of contractors' attributes on construction project success again illustrating that low cost and speedy construction should not be achieved at the expense of the quality of the project

4.8.6.1 Quality work

As discussed previously, Singh (2005) has suggested that selection based on the lowest tender price is achieved by reducing their quality of work. This can be interpreted as insufficient financial standing of a successfully selected contractor and can lead to late completion and unsatisfactory quality of work. In addition to producing high-quality work on time and within budget, firms should also understand the clients' needs, develop close relations, deliver high-levels of service, induce trust and foster loyalty and then seek repeat business (Egemen & Mohamed, 2005). Therefore, the owner, in order to guarantee sufficient quality of works, should select a capable contractor if he is to participate in a tender or negotiation procedure (Jaskowski *et al.*, 2010).

4.8.6.2 Quality control

According to Lambropoulos (2007) where contractors are capable of achieving the minimum quality standards defined by the client's requirements, this then guarantees after contract award through strict quality control procedures and is not negotiable.

To ensure project success, contractors should have adequate staffing level, a good track record for completion on budget, and ability in financial management and quality control (Doloi, et al., 2011). Quality control of contractor processes is valuable and helps in making a decision of whether to enter into a partnership with a contractor or not (Straub & Mossel, 2007). Some aspects that require special attention of construction managers include: adequate staffing level, use of appropriate plant and equipment, good financial management, excellent quality control, and possession of superior technical and design capabilities (Ling, 2004). When selecting contractors, project managers should therefore concentrate on these factors and use them as a basis for selecting contractors.

4.8.6.3 Quality assurance

Quality assurance means keeping up the methods and procedures of quality control, i.e. systematically checking that they are efficient, that they lead to the desired objectives, and that they are applied in a correct way (Straub & Mossel, 2007). An empirical analysis was conducted to explore customer satisfaction in construction as perceived by two customer groups: public and private customers (Kärnä, 2004). Results indicated that the need for contractors to improve performance relates mostly to quality assurance as the most important factor. As construction companies face increasing competition, greater attention continues to be given to customer relationships and satisfied customers. In order to achieve client satisfaction, contractors must understand what their clients need and how to meet those needs.

Quality assurance embraces all the activities and functions needed to provide adequate confidence in a product or service for satisfying given requirements for quality. It is essentially a preventive function. Quality assurance is based on the principle that prevention is better than cure and it is more economical to get things right in the first place (Lau & Tang, 2008).

4.8.7 Reputation

A longitudinal study of contractor ranking carried out by Darvish *et al.* (2009) reported that contractor selection is considered to be the most essential element in construction procurement and the life of a construction project. Many analysts (Watt *et al.,* 2009) argued about the importance of the contractors' reputations. For example, Watt *et al.* (2010) indicated that contractors' reputation and other organisational criteria are the most important criteria, and they also specified that technical expertise and cost are the least important criteria. Successful project performance depends on the legal and business relationships of the prime contractor. The decision-maker must collect and analyse information about the contractor's relationship with other entities which participate in the construction activities (Nieto-Morote & Ruz-Vila, 2012) (Aje & Ogunsemi, 2006).

4.8.7.1 Relationships between subcontractors, clients, consultant and suppliers with subcontractors and suppliers

- ***Contractor - subcontractor relationship***

Gunderson *et al.* (2012) observed the attributes of the successful subcontractors and identified six emergent criteria and attributes that general contractors look for in subcontractors: quality work, reliability and responsiveness, communication, managerial competency (including competitive estimating and pricing), and preconstruction services. Additionally, they also indicated that it was important to take into consideration any negative attributes of a subcontractor such as unprofessionalism, dishonesty, unreliability, change order focused, poor communication, and poor quality work and/or personnel. In construction sectors, subcontracting plays a significant role in important specialty items such as heating, plumbing, electrical, roofing and tile work. Thus, these areas are more often not successfully carried out by a subcontractor.

Hartmann, et al. (2009) stated that the four most significant criteria in the subcontractor selection procedure are price, technical know-how, quality, and cooperation. They suggested that a subcontractor has to prove professionalism, experience and knowledge of specific technical issues as a subcontractor is mainly ‘‘hired to perform specific tasks of a project’’ which require technical knowledge.

Ko, et al (2007) designed a model to evaluate the performance of sub-contractors where twelve main criteria are identified from items used by general contractor to construction technique, duration control ability, corporative manner, material wastage, services after work completion, collaboration with other sub-contractors, safety and protection, tool usage habit (tools borrowed from contractor), working space clearance, management ability, sub-contractor's personality and economic condition.

- ***Contractor-client relationship***

The relationship and integration between contractor and client is considered to be the most significant component to reach the aims of a construction project (Kog & Yaman, 2014). Many researchers have confirmed that one obstacle to an effective contractor-client working relationship is the failure to make successful agreements which are usually reflected in the project successes. However, some factors also affect the relationship between clients and contractors, such as culture, commitment, ethics and communications (Bryde and Robinson, 2005). Previous studies have reported that the construction industry should utilise best practices from other industries. Moreover, contractors and clients ought to cooperate together to reach a planned goal, particularly in difficult projects that have a limited budget (Eriksson, 2013) (Spang and Riemann, 2011).

According to Ng, et al (2002), there is an unwillingness of clients to be totally committed to the project partnering relationship, especially with regard to a lack of client compromise and a conflicting organisational culture. This is usually caused by a lack of contractor’s faith in their client’s capability to successfully facilitate the project partnering procedure, which eventually induces their lack of commitment, in addition to a lack of technical knowledge as an empowerment on the part of the client’s representatives. This has a negative effect on both the efficiency and the effectiveness of the problem resolution process, which could result in a damaging impact on the budgets of the contractors, which further hampers their level of commitment to the project partnering procedure.

- ***Contractor-consultant relationship***

The relationship between the contractor and consultant is typically only regulated by the fact that the consultant is the client's agent in day-to-day decisions (Reve and Levitt, 1984). Thus, to finish a project successfully, it is very important to build a good relationship between the contractor and consultants. This can be done by improving communications between the two parties (Grifa, 2006).

Choosing appropriate consultants with high level experience is a very significant stage in the selection procedure. Ignoring this factor will typically affect the project success. Efficiently securing contractors and consultants is a policy engaged by the top corporations to achieve their tactical and functioning goals (Weathington, 2010).

To make sure that the project will be finished successfully to a particular time, cost and quality, the right consultant ought to be selected. To attain this, some important criteria for the selection of the appropriate consultant are summarised (Totaljobs Group, 2012) (Ali, 2011):

1. Organisational capacity
2. Technical and professional expertise and qualifications
3. Previous experience
4. Innovative ability
5. Resource availability
6. Health and safety management
7. Registration and license
8. Financial capacity
9. Organisation structure documents
10. Past performance
11. Experience in similar project
12. Methodology
13. Quality assurance

- ***Contractor-supplier relationship***

A recent study by Jeroen (2012) reported that recent improvement in the construction industry has resulted in an improved significance in the relationship with and managing of suppliers by prime contractors. This proves that the main contractors always depend upon their suppliers, both for realising projects. Therefore, this suggests that the relationship of the contractor with suppliers is a significant aspect to be considered in determining the possibility of project success.

4.8.7.2 Claims and disputes

It is suggested that a poor choice of contractor by the owner may not only lead to disputes between client and contractor, but also contribute to a waste of resources (Oke & Ugoje, 2013). Further, it is important to consider if the contractor has a good or bad record of claims and disputes. A contractor with a strong litigation history is probably experienced at claims and dispute, and this could be classed as having an eye for opportunity to take advantage of it and use it in their side. Hence, in the CSP, it is vital that contractors report all information related to litigation or arbitration arising from contracts – either completed or on-going that have been executed recently (Younis, et, al., 2008).

Previous research undertaken suggests time and cost overruns as a result of disputes has become a ubiquitous feature of the construction industry (Waldron, 2006). Significant factors that have been identified as contributing to disputes are rework, variations, incorrect design, and incomplete documentation and late authority approvals. Further factors that have been revealed to have a direct influence on disputes between clients and contractors include owner management ability, contractor management ability, and project complexity, poor communication has been identified as a cause of disputes, and personality differences between design team and contractors can lead to conflict (Love, et al., 2011).

4.8.8 Cultural and weather considerations

4.8.8.1 Cultural considerations

The significance of culture in the achievement of construction projects has been notified by various researchers. Cultural influences, in particular, have often made a huge impact on projects success in relation to times, cost, quality, and client satisfaction. Furthermore, cultural awareness is a significant factor for selection, as it helps the achievement of construction projects by enabling integrated project team working. Therefore, it should be considered at the outset of any project, especially, when choosing project team members including a contractor, subcontractors and project manager, in addition to project site workers (Ali, et al., 2011).

Recently, researchers have shown an increased interest in the influence of culture and weather on the contractor selection. Usually in developing countries big projects involve multiple international companies working together. At many levels, the performance of those projects is impacted by cultural differences. There might be dissimilarity in national cultures among international joint-venture partners; there might be differences in organizational cultures between contractors; or there might be differences in certified cultures between owners, consultants, and contractors (Mahalingam *et al.*, 2005). A recent study by Ankrah and Proverbs (2009) confirmed that in order to develop and improve project delivery the culture of procedures and outputs should be considered as an essential element.

4.8.8.2 Weather consideration

Previous studies have reported that, in CI, inclement weather is considered as a major delay risk. It has been confirmed that construction work is affected by weather events such as snow, cold temperature, humidity, and rainfall conditions (Thorpe & Karan, 2008). Additionally, Halpern, (2005) states that some delays, such as those caused by weather conditions, are beyond the contractor’s control and could not have been reasonably anticipated at the time of bidding for the contract. These delays make it difficult or impossible to meet the project completion date. Workforces could transfer such weather risk to contractors by deleting the corresponding contractual provision for extension of time in the contract, but in return the tender sums would be inflated to reflect the costs of this risk. Since delays are very general problems accrued on construction projects and bad weather appears to be a major cause, then knowledge of contractors’ pricing strategy in accounting for weather risk becomes important in the optimization of contract cost (Chan and Au, 2007).

4.9 Summary

The history and strategies of contractor selection process have been illustrated, in particular the aims, strengths and weaknesses of the process. The factors affecting the principles on which the contractor selection process is based were discussed. Further, some contractor selection systems in developed and well-developed countries or regions were collated. In addition, the most important criteria for contractor selection and the corresponding sub-criteria were considered. In the next chapter the research methodology and the empirical study will be established and discussed in detail.

CHAPTER FIVE: RESEARCH METHODOLOGY

5.1 Introduction

This chapter will highlight the most essential research methods that are usually used by academic researchers. Researchers tend to separate their research methods into three types: quantitative, qualitative and mixed methods. Each approach has its advantages and disadvantages as well as its limitations. Regularly the difference between qualitative and quantitative methods is that qualitative methods use words, in the form of open-ended interview questions, as their main data and quantitative methods use numbers or closed-end questions (Creswell and John, 2008).

5.2 Research philosophy

For a layman, the philosophy of research means the search for knowledge. Further, the philosophy of research is sometimes considered erroneously for gathering information, documenting facts, and rummaging for information. Research is the procedure of gathering, collecting, analysing, and interpreting data in order to understand a phenomenon (Williams, 2007). Saunders et al (2009) have defined research philosophy as the development of knowledge and the nature of knowledge. Identifying the type of research methods that could best fit a given research agenda could be a difficult task for the researcher (Jones & Alony, 2011). According to Burrell and Morgan (1979, p1), “all theories of organisation are based upon a philosophy of science and a theory of society”. The researcher then needs to select an appropriate study type based on the nature of the problem and guidance from the literature. The choice of the right study type represents nothing more than the end of the beginning of the challenge (Ellis & Yair , 2010). Research philosophy categorisations such as ontology, epistemology, and anxiology and their applications to the ‘quantitative-qualitative’ debates, are a source of dilemma to the researcher in establishing their relevance to the subject areas and discipline (Mkansi & Acheampong, 2012). Ontological assumptions, axiological and epistemological undertakings indicate the nature of the world complementing the formulation of research philosophy, thus influencing the selection of applicable research methods (Pathirage & Amaratunga, 2008), Sauders et al (2009) argue that the most significant determinant of the epistemology, ontology and axiology you implement is the research question as one might be more fitting than the other for answering particular questions.

5.2.1 Ontology

Ontology explains 'what' knowledge is and assumptions about reality (Pathirage & Amaratunga, 2008). The root of ontology has been described as assumptions concerned with what constitutes reality (Burrell and Morgan, 1979; Saunders, et al., 2009; Scotland, 2012). It raises questions of the assumptions researchers have about the way the world operates and the commitment held to specific views. In other words, researchers should take a position regarding their perceptions of how things really are and how things really work. In a discussion regarding the two aspects of ontology, of **objectivism** and **subjectivism** (Saunders, et al., 2009), both are likely to be accepted as producing valid knowledge by most researchers going on to describe that objectivism portrays the position that in reality, social entities exist external to social actors concerned with their existence. Meanwhile, subjectivism holds that social phenomena are created from the perceptions and consequent actions of those social actors concerned with their existence. Consequently, the ontology for this study is objectivism since the researcher adopts the views that see the social world as "external to individual congnition" and it is "out there" which its existence is "as hard as concrete as the natural world as Burrell and Morgan (1979) descriped. This differentiates this ontological belief from another ontological view that believes in the social world as soft and a production of the social actors. Thus primary data for the research is dependent mainly on the questionnaire and the statstics analysis.

5.2.2 Epistemology

Accroding to Scotland, (2012) epistemology is concerned with the nature and forms of knowledge (Cohen et al., 2007, p. 7). Epistemological assumptions are concerned with how knowledge can be created, acquired and communicated – in other words, what it means to 'know'. In addition, epistemology describes how researchers know about the reality and assumptions, about how knowledge should be acquired and accepted (Pathirage & Amaratunga, 2008). Flowers (2009) described epistemology as 'the theory or science of the method or grounds of knowledge' expanding this into a set of assumptions about the ways in which it is possible to gain knowledge of reality, how what exists may be known, what can be known, and what criteria must be satisfied in order to be described as knowledge.

Moreover, epistemology as knowing how you can know and expands this by asking how knowledge is generated, what criteria discriminates good knowledge from bad knowledge, and how reality should be represented or described. Epistemology presupposes to assist researchers in controlling the approach of their research, increases validity of the results and ensures that knowledge produced from the research procedure is cumulative (Alsulamy, 2014).

An essential question facing most researchers engaged in social research is for them to build a philosophical position and orientation towards their enquiry. Unlike other sectors, construction and project management is a comparatively new field which consists and draws from both the natural and social sciences (Alsulamy, 2014). Researchers study usually draw from both traditions when designing their research projects in a way which remains sensitive to the theoretical and philosophical foundations upon which their enquiry is based (Dainty, 2008). However, the extent to which this has resulted in a plurality of methodological perspectives is questionable. For many years, positivism and quantitative methods have been in the dominance in the field of construction management research (Dainty, 2008). In the following two sections, postivisim and interpertivism (anti-postivism) are illustrated.

5.2.1 Positivism

Positivism is basically connected to pure scientific rules and dependent on fact in order to satisfy the four requirements of falsifiability, logical consistency, relative explanatory power and survival (Alsulamy, 2014). Positivism depends on values of reason, truth and validity and there is a focus purely on facts, gathered through direct observation and experience and measured empirically utilizing quantitative methods surveys and experiments and statistical analysis (Flowers, 2009). Positivism, a research paradigm, is very well known and well recognised in universities worldwide (Taylor & Medina, 2013). This scientific research paradigm attempts to explore, confirm and predict law-like patterns of behaviour, and is usually utilized in graduate study to investigate theories or hypotheses. It is serviceable in physical science, natural science, and, to some extent, in the social sciences, particularly where very large sample sizes are involved. Commonly it concentrates on the objectivity of the research process.

Baxter (2013) explained that the positivists and post-positivists adopt a 'scientific' approach to research which has the elements of being reductionist, logical, with an emphasis on empirical data collection, is cause and effect oriented and deterministic based on prior theories. He confirms that the social world is real, is independent of human consciousness, measurable, objective and rests on order. Further, this technique views human beings as rational individuals controlled by social laws. A researcher adopting this paradigm will commonly view investigations as a series of logically-related steps, believe in multiple perspectives from participants rather than a single reality, adopt rigorous approaches of qualitative data collection and analysis and write their qualitative studies in the form of scientific reports resembling quantitative approaches. Their research usually purposes to investigate pre-conceived hypotheses and those generated from prior studies and the literature.

5.2.2 Interpretivism

The interpretivism paradigm concentrates on the examination of text to determine entrenched meanings, particularly regarding how people use language and symbols to define and contrast social practices in order to understand people’s actions and behaviours (Alsulamy, 2014). Interpretivists adopt a perspective wherein reality is understood as being socially constructed. This perspective seeks understanding rather than explanation, and the aim of social research is usually on the participant's views of the situation. Rather than beginning with a theory, the investigator generates or inductively develops a theory of pattern or meaning. In reality, the questions utilized for data collection become broad and general so that the participants can construct meaning from discussions or interactions with other people. With this paradigm, researchers recognise that their own background shapes their interpretation and then 'position themselves' in the research to acknowledge how their interpretation flows from their own personal, cultural and historical experiences. The researcher's intent is to make sense of the meanings others have about the world (Baxter, 2013).

The understanding that people are feeling and thinking and how they communicate, verbally and non-verbally are counted significant. The nature of the researcher and the research in this paradigm, and the risk that any interpretation is framed within the mind of the researcher means that steps must be introduced to avoid bias. The use of self-reflection is advised (Flowers, 2009).

Based on the above discussion, this study also follows the industry trend, wherein the data collection and analysis takes on positive prospective. This research contains both natural science and social science in that it investigates and builds a framework for contractor selection procedures in the LCI from a social science prospective that relies on the seeing, perceptions, understanding and opinions of the researcher respondent. The data collection for the research will be analysed based on statsistics. The research was divided through significant stages. In the first stage, the research study began with determination of the research problems that relied on the research questions, and from this the research objectives were clarified. The study then applied a staged approach towards conducting the study beginning with a review of relevant literature, development of the conceptual framework and design of the questionnaire and pilot study of the questionnaire. The second stage of the research is the data collection followed by analysis of the data collection in the third stage. In the final stage of this research, the resulting model from the data analysis is presented in addition to the conclusion and recommendation. Since positivism is involved to achieve the research objectives by investigating theory and the measurement of observable social realities, the fundamental paradigm of this research study is a positive paradigm.

5.3 Research paradigms

There are many different paradigms used in social sciences research (Dash & Ignon, 2005). There are essentially two paradigms to the verification of theoretical propositions, i.e. positivism and anti-positivism. “Paradigm is a way of examining social phenomena from which particular understandings of these phenomena can be gained and explanations attempted” (Saunders, et al., 2009). Another definition is that “paradigms are patterns of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames and processes through which investigation is accomplished” (Weaver & Olson, 2006). Consequently, to illuminate the researcher’s structure of inquiry and methodological selections, an investigation of the paradigm adopted for this research will be discussed prior to any discussion about the specific methodologies used in this research. The two approaches are underpinned by different ontological and epistemological assumptions: quantitative approaches generally being associated with objectivism and positivism; and qualitative approaches with constructionism or interpretivism (Baxter, 2013).

From the discussion in the previous chapters, the paradigm of this study is shown in the figure below:

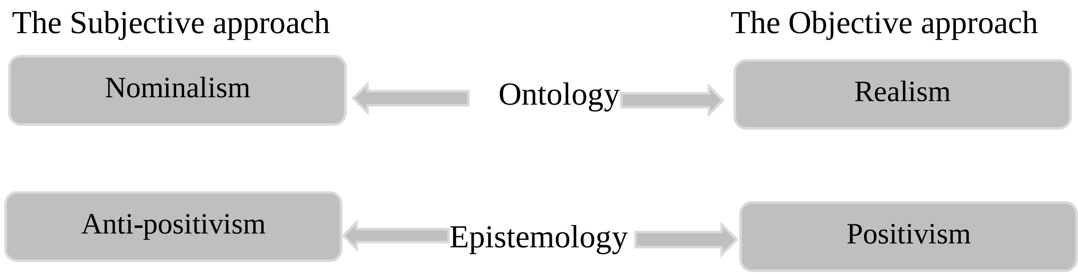

Figure 5-1 Subjective-Objective dimension

5.4 Research Logic

Research logic is explained as referring to different approaches for deductive and inductive research (Pathirage & Amaratunga, 2008). It is argued that academic research has been influenced by two key paradigms of logical thought: deduction and induction (Jensen, 2006).

5.4.1 Deduction

Jenson (2006) defined "the deduction method as the process of reasoning typical of scientism, whose conclusions follow necessarily from their premises". It is a systematic approach of deriving conclusions that cannot be false when the premises are true. From this, positivists have stated that the rigors of science are found through deductive processes, whereas the creativity of science has been relegated to the inductive processes of logical inquiry. In common, deductive research tends to progress from theory to data (theory, method, data, and findings) (Pathirage & Amaratunga, 2008). Further, a deductive research system entails the development of a conceptual and theoretical structure prior to its testing through empirical observation. In this method, the researcher could have deduced a new theory by analysing and then synthesising ideas and concepts already present in the literature. The emphasis in this sort of technique will be on the deduction of ideas or facts from the new theory in the hope that it offers a better or more coherent framework than the theories that preceded it. However, there are five sequential stages through which deductive research will be progressed:

- Deducing a hypothesis from the theory
- Expressing the hypothesis in operational terms
- Testing the operational hypothesis
- Examining the specific outcome of the inquiry
- If necessary, modifying the theory

5.4.2 Induction approach

Induction research is a procedure of scientific reasoning by which a general conclusion is drawn from a set of premises that rely essentially on experience or experimental evidence. The conclusion goes beyond the information contained in the premises and does not follow necessarily from them. Therefore an inductive argument might be highly probable, yet lead from true premises to a false conclusion (Jensen, 2006). In the inductive approach, the theory would follow the data rather than vice versa as with deduction. It tends to proceed from data to theory (method, data, findings, theory). According to Alsulamy (2014), the inductive research approach builds theory by collecting qualitative data from personal interview with the aim of understanding what is happening within particular circumstance. However it is claimed the modern justification for taking an inductive approach in the social sciences tends to revolve around two related arguments (Pathirage & Amaratunga, 2008):

- The explanation of social phenomena grounded in observation and experience
- Critique of some of the philosophical assumption embraced by positivism

Table 5-1 Major differences between deductive and inductive approaches to research

Deduction	Induction
Moving from theory to data Common with natural sciences A highly structured approach Explain causal relationships between variables Select samples of sufficient size to generalise conclusions	Moving from data to theory Common with social sciences Flexible structure to permit changes Understanding of meanings humans attach to events Less concern with the need to generalise

It can be said that the research approach followed through this research takes on a deductive approach as there is alignment with the positivist paradigm which supports a scientific approach to managing the research study as outlined below.

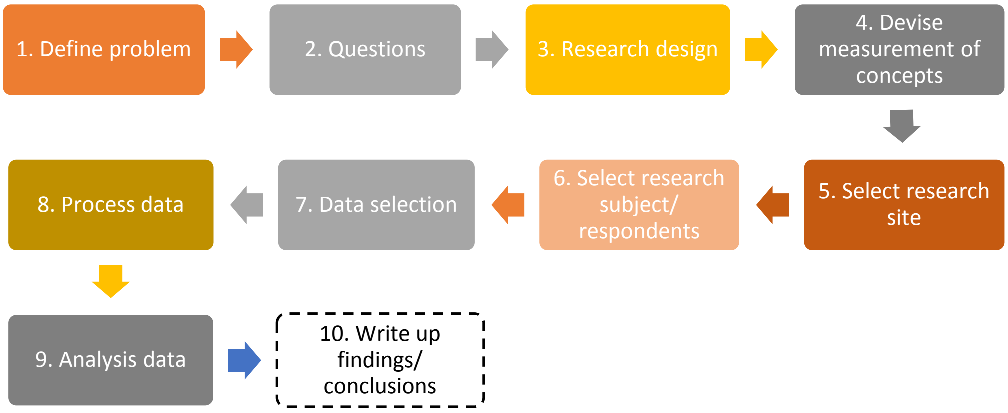

Figure 5-2 Deductive approach process

The study began with the definition of the problem and theory that there is a lack of systems and tools for monitoring and controlling CSP in the Libya and this is one of the reasons accountable for delay in construction projects in the country. This was followed by development of the research questions which targets to developing a framework for contractor selection process. The data was then collected to test the research questions, and the results analysed utilizing of the SPSS statistical software V20. The result was utilized to develop a performance measurement framework, which was validated using Delphi survey. This procedure is essential in order to develop, improve and increase success of the contractor selection procedure to the meet the satisfaction level of clients. The specified process followed in conducting this research is highlighted above in figure (5-1)

5.5 Research approaches

Research approach refers to the three main approaches to conducting research: qualitative, quantitative and mixed method research approach. There has been confusion in some regards about what type of methodology should be employed in the research enquiry, and how construction and project management researches could be approached. A lot of researchers, such as Fellows and Liu (2008) have reached to the two most recommended research approaches that have been widely identified by researchers as suitable for the construction management sector: quantitative and qualitative research methods. The main objective of the quantitative method is to address questions that hypothesize relationships among variables relating to natural phenomena by utilizing mathematical models hypotheses and theories. While the qualitative research method covers the disciplines and different matters, the aim of this method is more about the human behaviour and the motive leading to such behaviour. However many researchers have clarified the difference between qualitative and quantitative research methods. For instance, qualitative researchers are seeking answers to questions that stress how social experience is created and given meaning.

On the other hand, quantitative studies emphasize the measurement and analysis of causal relationships between variables, not processes. The specific approaches used in the current research can be classified under both of these research streams, as will be discussed later (Denzin and Lincoln, 2003).

5.5.1 Qualitative research approach

There are no doubts that the general consensus of qualitative approach is as an interpretative, naturalistic method, which is concerned with the understanding of the meanings that people attach to decisions, beliefs and actions through social world. Further, qualitative approach could describe further comprehension of research and its contextual setting, donate explanation of reasons and associations, assessment effectiveness, and help the development of strategies or theories (Dey 1993); (www.ons.gov.uk, 2008).

As a matter of fact, there are only a few qualitative research approaches and methods being utilised by researchers. However different data collection methods have been proposed by researchers such as interviews, analysis of documents observation, and audio/visual materials. There were five qualitative approaches suggested by Creswell (2007): ethnographic research, narrative research, case study, grounded theory and phenomenological research.

Johnson and Christensen (2007) summarized the strengths and weaknesses of the qualitative approach as follows.

Advantages

- It is helpful for a limited number of cases in depth
- It is helpful for complex phenomena
- In qualitative research, data are usually by naturalistic settings
- It is easy to determine interpret constructs of participants, e.g. self-esteem, IQ)
- Qualitative methods are particularly responsive to local situations, stakeholders' needs
- It is useful for determining idiographic causation, i.e. determination of causes of a particular event

Disadvantages

- It is not easy to build quantitative prediction
- It is quite compacted to analysis theories and hypotheses especially with big numbers of participants
- The credibility of qualitative approach could be conceded low especially with administrators and commissioners of programs
- There is the slowness of collecting data
- Data needs a long time for analysis
- Results can be easily influenced by researchers

5.5.2 Quantitative Research Approaches and Methods

The main positivist paradigm of quantitative methods is to examine objective theories through testing the relationship among variables. These could be evaluated typically on instruments, so that data numbers could be sorted out by utilizing statistical process. After that, the final report will be written by containing all research bodies such as an introduction, literature and theory, methods, results and discussion (Creswell, 2008). Paranormality.com (2011) indicated that the quantitative method is a research method that relies less on interviews, observations, focus groups, subjective reports and case studies but is much more focused on the collection and analysis of numerical data and statistics, which is likely based on more statistical use of numerical data.

In general, the quantitative approach has the following advantages and disadvantages (Mamia, 2007):

Advantages

- It provides good results especially for comparisons between groups with quantitative description
- It has the ability to describe changes
- Quantitative method enables the researcher to compute and investigate data
- It is able to examine hypotheses in experiments because of its capability to analyse the data by utilizing statistics

Disadvantages

- It is exceedingly complicated to study processes or “dynamic” phenomena
- Context of the study or experiment is usually ignored
- It is only capable of analysing quantifiable phenomena
- It does not study the cases in natural setting

5.5.2.1 Surveys and questionnaires

Briefly, surveys are a data collection method which is usually used to provide the required information about individuals’ knowledge. However, to ensure that surveys have validity and reliability they are should be generally standardized to ensure the results could be circulated in to the larger population.

Advantages of using surveys

- It allows researchers to gather a large amount of information in short time
- It is easy to create and control
- It is a cheap tool comparing to another technique
- It can be utilised to provide information on a wide area of things, attitudes, including personal facts, and past behaviours and opinions

Disadvantages of using surveys

- Poor administration and survey can easily influence the research concept
- The provided answer on the survey might not be an accurate one which may impact on the final result
- Random sampling sometimes targets the wrong participants and responding rates could bias the results of a survey
- Pallant (2011) determined the type of question to two styles:
- Open format: in this style the respondents have the right to formulate their own answers, for example, what is your favourite food?
- Closed format: respondents are provided with a list of alternative answers, for example, Gender: male......... female...........

5.5.3 Case Study

Case study research is becoming gradually more accepted as a scientific tool in the qualitative research. Case study approach is an increasingly popular method among qualitative researchers. Many authors have contributed to methodological developments, which has increased the popularity of case study method across disciplines (Hyett, et al., 2014). Case study is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a specific project, policy, institution, program or system in a "real life" context. A case study is an analysis of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more techniques (Thomas, 2011).

One of the big advantages of the case study is that it can provide some important information which cannot be provided from another research approach. Also a case study can give the opportunity for the researcher to go deeper in the research project (Fellows and Liu, 2008). Furthermore, a case study is able to be utilised to test hypotheses, especially to examine a single exception that shows the hypotheses to be false. An additional case study can be highly statistical institutional research and vocational count-selling (Cherry, 2011).

Types of case studies

- Explanatory: This kind of case study is used to do causal investigations.

- Exploratory: This type of case study gives the opportunity to collect more information. This usually has happened before developing research questions and hypotheses.
- Descriptive: It usually starts with a descriptive theory and the gathered information is matched up to the pre-existing theory.
- Intrinsic: In this kind of case study the investigator has a personal interest in the case.
- Collective: It involves researching a group of individuals.
- Instrumental: This type happens when the group or individual permit researchers to understand more than what is initially obvious to observers.

Limitations of the case study

- It is difficult to generalize the findings to the wider population
- Researcher's feelings toward their own case study may influence the subjective (researcher bias)
- It is time consuming
- It is difficult to understand and organize, because of huge amounts of data that are involved and required (McLeod, 2008).

This section shows the case studies results. The data collection for the case studies was in interview via telephone. The section begins with the introduction about case studies then interviewees' selection criteria, and profiles of their organisations which the interviewees worked for. Following that, the purpose of the case studies and subsequently, the case process and the method of analysis of case studies are presented. Finally, the chapter demonstrates the results of the analysis of the case studies.

Case study technique assists a researcher to closely investigate the data within a particular context. In general, a case study approach chooses a small geographical area or a very limited number of individuals as the subjects of research (Zainal , 2007). As a research technique, case study approach is well recognised in the Social Sciences. It is a technique of research inquiry that examines a real-life contemporary phenomenon. It is typical for multiple sources of evidence to be utilise (Yin, 2009). Case studies are in-depth investigations of a single person, group, event or community. Usually, data are gathered from a variety of sources and by utilising many different approaches, e.g. interviews or observations (McLeod, 2008; Farooq, 2013). Critics of the case study technique think that investigation of a small number of cases cannot offer grounds for building reliability of generality of findings. Others believe that the case study method is valuable only as an exploratory instrument (Susan, 2006). In explaining what a case is, Noor (2008), described case studies as being concerned with how and why things happen, an empirical inquiry that examines and investigates a contemporary phenomenon within its real life context utilizing multiple sources of evidence.

The case study method was adopted in this study due to the fact that there was limited information and limited studies in this field in Libya. The case studies were chosen in order to determine the main themes of the questionnaire and as a guide for the questionnaire questions. As argued by Yin (2003) that case study method can be used when the researcher has little information about the real-life context. According to Yin (2003, p1) "in general, case studies are the preferred strategy when "how" or "why" questions are being posed". This is in line with the main research question of this study which is introduced earlier.

5.5.3.1 Purpose of Case studies

Many researchers who are not sure about their research or data analytical capabilities will select a case study technique for their research believing that they could sidestep some of the rigor and complication of other empirical research designs information (Garger & Gromisch, 2013). As lack of data was considered one of limitations of this research, the researcher decided to conduct some cases studies. In the two case studies, four in-depth interviews were conducted with two project managers and two consultants. The first case study was about building a refugee center in the south of Libya (case study A). The second case study is the establishment of a water supply network in Tripoli (case study B). Each project manager was working in a different place. The main idea of those case studies and the literature review are to help the researcher to articulate and determined key research questions which will be used in a questionnaire survey and also to provide more information and understanding of contractor selection in the Libyan construction industry. Additionally, they are used to explore models identifying contractor's selection criteria, to identify the failure in the projects occurring from the side of the contractors and to focus on the contractor selection procedures of construction projects.

5.5.3.2 Case studies Process

The most advantageous element of the case study technique is utilizing multiple data sources, a strategy which also enhances data credibility (Baxter & Jack , 2008). Procedure for case studies is likely similar to those utilized for other empirical studies. In this respect, a five-phase research procedure is suggested and explained in detail how each step should be carried out when conducing a case study approach (Susan, 2006) (see Figure 5.3)

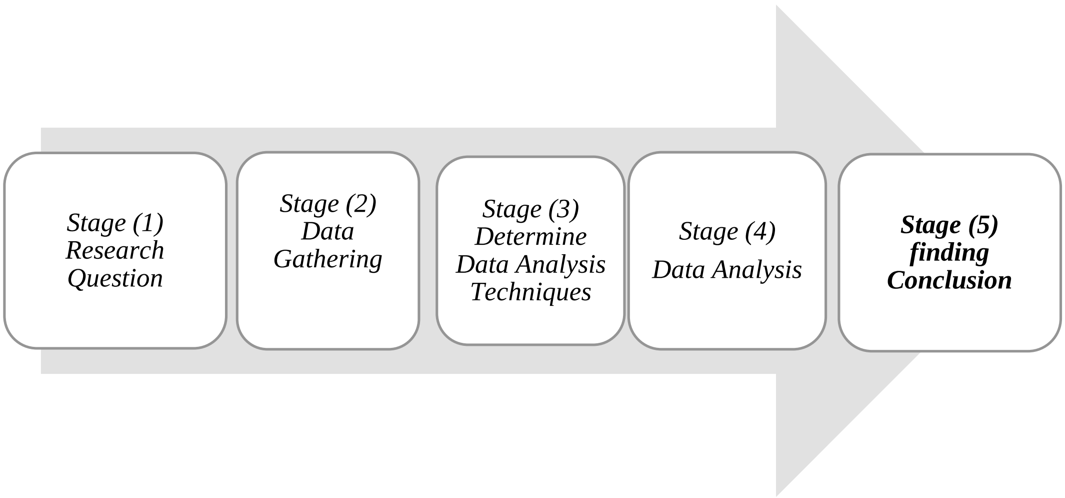

Figure 5-3 Case studies Process

Stage (1) Research Questions: The first step in case study approach is to establish research questions. This can be determined by investigating in-depth the case study objects by utilizing a variety of data gathering methods to produce evidence that leads to answers to research questions and understanding of the case study. The researcher has prepared a list of questions that every decision makers should ask the interviewee during the interview procedure. The researcher's questions are focused about why contractors failed to finish the building of the refuge centre and the failure of the establishment of a water supply network in Tripoli in terms of the contractors side (see the appendix)

Stage (2) Data Gathering: The semi-structured interviews were carried out with two experts from two main public construction organisations mainly, two different project managers and other two different consultants. All these interviewees were associated with the case study projects. The interviewees were selected from the organisations with different expertise and knowledge to offer valuable and relevant information. The small numbers of the participants in interview of this research was due to the civil war resulting in a shortage of additional interviewees which is one of the research limitations. The interview was conducted in May 2011 by telephone interview. The choice of the organisations was also dependent on the management system, the success achieved by those organizations, and the qualifications and experience of the people working in those organisations.

The interviewees, however, were chosen based on their responsibility, specialty and expertise. The below table provides some information about the interviewees including organisation, position experience and qualification illustrating that the interviewees were from two different categories, namely senior consultant, and project manager. The position of the participants shows that they have sufficient experience and are familiar with the project area.

Table 5-2 Organisation and Expertise of Interviewees

No	*Organisation*	*Expertise*	*Position*	*Years of experience*	*qualification*
1	A	Consultant	Supervising construction projects in Sebha	10	MSc Civil Engineering
1	A	Project Manager	Supervising construction projects	7	MSc Civil Engineering
1	B	Consultant	Director of Technical Affairs and Supervision - Tripoli	15	MSc Civil Engineering
1	B	Project Manager	Supervising construction projects	12	B.Sc Civil Engineering

Telephone interview: Face-to-face interviews have long been the main interview method in the field of qualitative study (Sturges & Hanrahan, 2004; Opdenakker, 2006). In the last two decades, telephone interviewing became more and more common. Due to the explosive growth of new communication forms, such as computer mediated communication for instance e-mail and telephone. Compared to the previous traditional techniques, the telephone interview technique has more advantages that the previous method. Some of the advantages are as follows (Musselwhite, et al., 2007) (Sturges & Hanrahan, 2004) (Opdenakker, 2006):

- It offers chance to cover wide geographical areas
- Compared to other methods, telephone interview are cheaper and faster
- They offer more flexibility to the researchers and access to dangerous or politically sensitive sites such as disease or war zones
- It helps to improving quality of data collection
- It helps for developing positive relationships between researchers and participants

In this study there are some significant reasons to use telephone interview. Using a traditional data collection method, such as face to face, requires travelling from the UK to Libya. Consequently travelling to Libya is associated with risk due to the civil war. Furthermore it consumes time and is costly especially in the unsafe environment as mentioned earlier. Also, conducting face to face interviews in Libya means the researcher has to travel to more than one city further increasing the risk due to Libya being a large unstable country. Therefore, telephone interview procedure was selected to for this study.

Stage (3) Determine Data Analysis Techniques: Data analysis was carried out by first transcribing the interviews, then translating the interviews as they were conducted in Arabic. The researcher then conducted a content analysis for the interviews. The findings were discussed with interview participants to validate the findings. A comparison was also drawn between the two case studies in order to validate the findings further and enrich the analysis.

CASE STUDY A

Due to the large geographical area covered by the Libyan borders, more than four thousand kilometres of difficult terrain and arid desert, the Libyan government has a very difficult time controlling their borders (see section 2.2.1). This situation contributes to the prevalence of smuggling and illegal immigration, and has resulted in several problems such as the deaths of many people as a result of dehydration and starvation. As a result, the Libyan government, with the support of the European Union, has decided to build a number of centres for providing refuge to those people who might otherwise have died in the desert crossing. These centres are spread over several areas adjacent to the Libyan borders, and have been built in order to provide health services. These centres have been designed with high technical specifications including:

- Bedrooms
- Integrated medical clinics
- Rooms for general surgery
- Laboratories with high technical specifications
- Sports centres with football pitches, tennis courts, etc.

To build all the above facilities, however, the Libyan government's Organisation Development of Administration Centre (first part), signed a contract with the Holding Group for Engineering and Construction (second part). The total amount of the contract is 15 million Libyan dinars, which is equal to about 12 million U.S. dollars. The proposed duration of the project was two years. The refuge centres are distributed in five main places: Sabha, Ubari, Murzuq, Alkufra, and Ghat. The construction company is based in the capital (Tripoli), which ranges from 1,000 to 2,000 km away from the locations of the centres. A huge delay in project implementation was recorded by the first part. After that, the company was given notice twice. Finally, the contract was withdrawn from the company.

Stage (4) Data Analysis Case study (A) analysis: From the context analysis of the project, it was identified that the very long distance between the company headquarters and the area the project was located in was one of the reasons of the delay in the project which led to the failure later. This finding was confirmed by the project manager of the project as he saw the problem in terms of the importance of the local knowledge for the success of the project. The project manager states in the interview:

> "I advise the higher authorities to give our branch to involve in the decision making program, and taking into account the local society and culture into their consideration in the selection process." A project manager, Sebha, 2011

The above statement sheds light on two aspects from the project manager's perspective: the bureaucracy involved in the project and the importance of local knowledge for the project. In terms of bureaucracy, from the researcher's perspective, it is not clear enough if it is the case of just reflect a kind of power conflict between the headquarters and local branches. Further, unfamiliarity of the company with the geographical area of the Libyan borders might affect the decision making process and the reaction of the company to local factors such as the required infrastructure, choosing the appropriate suppliers, and good estimation of the required materials, the unqualified and unprofessional labour force as well as choosing the right sub-contractors. From the interviews, the participants agreed on two main selection criteria for contractors: the financial stability and the experience of the contractor. In terms of financial stability, organisations can not track the contractors as there is no national data base for that. The measurement used is the audited financial statements of the contractors only which may be an unreliable measurement. From case study A, the researcher found that participants emphasised the importance of the socio-political settings in the area in terms of supporting the project or working against the project in different ways which lead to the failure of the project. As stated by a consultant in the south of Libya regarding case study A:

> "The contractor neglected many important issues in the area such as the tribal society which could push towards the success of the project by consulting them, giving them employment opportunities, choosing some sub-contractors and suppliers from the area rather than bringing everything from the capital" Consultant, Sebha, 2011.

The socio-political context seems to be very important to projects in some areas of Libya that are set within a tribal society. Projects should navigate their way by adopting some policies in order to bring the project to full success. Overall, the socio-political context on the local as well as national level seems to have some importance and overlap with other factors which might affect the project and works for or against the contractor.

In the following section, case study B is investigated and analysed to check any differences might exist other than what has been found in case study two. Case study B has different socio-political context as well as the different project nature.

CASE STUDY B

The project is the establishment of a water supply network in Tripoli. This job was given to five companies. In the beginning, work went well, but after some time, finance was reduced and accordingly the performance of the companies also reduced. Some of the companies lacked the experience to complete the job. Infrastructure work requires underground maps of existing work, but the engineers did not have these maps. The proposed duration of the project was three years, but there was no detailed plan for its implementation and, in addition, import of material was delayed. Moreover, the construction caused problems with telecommunication, traffic and transport in the city. All these problems combined to delay the project, with the contractor blamed for the delay because at that time most of the materials were supplied by the state.

Stage (4) Data Analysis Case study (B) analysis: The issues with this project can be outlined under the combination of three factors: lack of experience of the companies, delay in material supply and lack of good planning for the project. A project manager blamed the state on two levels, firstly not providing the contractor with vital planning materials:

> "It was difficult to finish the project on time from the beginning as the essential information for the telecommunication infrastructure was not there at all, the state failed to supply the materials on time, then how anyone expect the project to finish on time or even to be a successful project at all?"
> A project manage, Tripoli, 2011.

It is not clear enough whether the companies were already aware of these issues or not. Furthermore, the project manager did not explain why there was a delay from the state side in delivering the materials. When a consultant was asked about the delay of the materials delivery by the state his answer to that was:

> "Although it is true there was a delay in supplying the materials to the project, the project manager should put this into account when planning for the project. The delay in state administration [has] unfortunately, also been the case, thus the project manager should be aware of the issue and ordered the materials in enough time but not waiting! Here, I blame the project manager as he is the responsible person for the overall delay and then failure of the project" Consultant, Tripoli, 2011.

It was bad planning and lack of experience by the contractor which caused the delays and failure of the project. Clearly, if the senior project manager who was appointed by the contractors had the necessary experience and authority, and was appointed early enough in the project, then the necessary preparations – obtaining essential plans and maps, liaising with the local transport authorities, etc. – would have been carried out and any unavoidable delays planned for. Also, it is possible that avoiding delays could have helped avoid the reduction in finance, and the delays in deliveries of materials could have been managed in such a way as to have had considerably less impact on the project. From this example, it is clear that one of the major problems in this project was the lack of experiences and authorities of project managers. To eliminate such problems a project needs a project manager with the same background, experience and ability to complete the project within plan and taking into account how to monitor any deviations. A successful project manager should have managerial and technical skills as well as be responsible for resolving any problems which occur on the site.

Stage (5) Case studies finding and Conclusion : Regardless of the financial and legal penalties of the failure of those projects, poor planning and management of contractors is usually to expose citizens to the risks leading to serious losses, for example, in the first study non-refugees completion centres exposes the life of migrants to real risk (risk of death). Further, we see in the second case study the closure of the road for a long time leading to increased costs from delays and disruption of services as well as directly affecting citizens' lives by increase the likelihood of accidents or ill health as well as impact the company's reputation. However, comparing the findings of the two case studies we found that the main reason behind the failures of that project is wrongful selection of the proper contractor as well as lack of experience of the decision makers. Contractor selection needs to be controlled and monitored on a regular basis to ensure any failure or undesirable shortfalls can be repaired and avoided without further delays.

The social and environmental situations in Libya are compounded by the lack of experience, shortage of technological resources, and poor performance of contactors. This, combined with an absence of accountability among official managers has had an impact on Libyan project procurement. Unsystematic achievement, long delays, as well as the low quality of major, national projects and of the contractors available are problematic. All those factors show that there is an unclear image of the practices that should be utilized in construction management. Capable and suitable contractors are needed who are able to achieve the highest project performance and able to complete the project in time and on cost according to the quality needed.

Unfortunately, the construction industry in Libya is not adequately prepared for the policy implementations and project management problems accompanying the anticipated boom in construction sector and the increasing complexity of projects. In comparison with international evaluation standards, the level of contractor selection criteria in Libya is insufficient as a number of important factors are not currently taken into account by decisions makers. Such factors include the health and safety record of a contractor or their performance record. The performance of a contractor, in particular, is important to take into consideration and especially their reputation for project success, time, cost, and quality, which are currently not adequately taken into decision-makers' consideration. Even the criteria that have been considered are still not totally covered by selection teams. For example, the attributes of financial stability such as credit rating, turnover, bank arrangement, debit ratio and profitability are still not taken to the consideration. The only financial attribute of a candidate that is currently taken into consideration is liquidity.

The other problem facing the decision-maker in Libya is that there is not a real system for contractor selection that can be used to help clients to consistently rate a contractor's ability. Some contractor's criteria are assessed in one way by one group of owners and a different way by another, the selection system relies on the individual evaluator's skills, experience, and background. Moreover, there is no clear link connecting the contractor's attributes and the owner's aims. Therefore, the owners are not fully confident that the chosen contractor will be capable of executing their projects. This defect in the system of the contractor selection has a large impact directly on the construction projects. Thus, there is immediate need for a new framework and special tools to be developed that will help stakeholders to select a qualified contractor from amongst the possible candidates who are able meet the project's needs.

5.6 The Delphi method

The Delphi method has been described as 'a tool for constructing a group of communication procedures to deal with a complex problem'. The Delphi method was firstly used in 1950, developed by the Rand Corporation funded by the United States Air Force (USAF). The Delphi method was developed in order to find out what the most reliable expert opinions were on how Soviet forces could possibly attack the US industrial military systems (Underhill and Facilitator, 2004) (Gnatzy, et al., 2011). The method is normally composed of a series of surveys that are given out multiple times where, in each round of surveys, a pre-selected panel of participants is asked to give their expert opinion or to make a decision about the particular question under discussion. Answers from previous rounds of surveys provide feedback to the panel and are assembled for the next round so that participants can re-evaluate their answers in light of the other panel member's answers (Ghashat, 2012). For this reason, the research design binds the research project all together. Apart from structuring the research, the research design is used to illustrate how the most important parts of the research project – the methods of assignment, the samples groups, measures, and treatments or programs – work collectively to address the initial research questions (Trochim, 2006). The Delphi method is an iterative procedure employed to gather and obtain the opinions of participants by utilising a series of surveys interspersed with opportunities for participant feedback. The survey is usually built to concentrate on problems, chances, solutions, or forecasts. The questionnaires always depend upon the results of the previous survey. As soon as the research question has been answered, the process stops (Skulmoski *et al.,* 2007). As Paul (2008) explains, the Delphi technique is a method that controls the collected information from selected experts through the study moderator. The Delphi method has advantages over other communication methods. There are three elements to the Delphi technique as follows:

- Structure of information flow
- Feedback to the participants
- Anonymity of the participants

The Delphi technique is not purported to be a cure-all. Like any other system or method, it has advantages and disadvantages (Stitt-Gohdes & Crews, 2005), Skulmoski, *et al*., (2007), DSE, (2012):

Advantages

- The Delphi technique is considered to be one of the best ways of gathering data on expert opinions
- It has the ability to attain consensus in an area in which there is a great deal of imprecision or lack of observed data

- The feedback of information between survey rounds increases knowledge amongst the panels of experts and provides new ideas
- The experts are able to express their views impersonally
- There are no geographical constraints on the selection of experts
- Collecting expert opinion is very easy and flexible
- The Delphi method employs group decision-making systems and involves experts in the field in question all of which means that the results have more validity than those arrived at by a single individual
- Applicable to deal with both qualitative and quantitative data

Disadvantages

- Length of the procedure
- In some cases the procedure might also be costly to run
- It can be difficult to maintain active participation by participants the whole way through, and so drop outs are more likely than at one off meetings.
- Requires skill in written communication;
- Lack of face to face interaction could be a disadvantage.
- The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis.
- More individuals are needed than can effectively interact in a face-to-face exchange.
- The heterogeneity of the participants must be preserved to assure validity of the results, i.e., avoidance of domination by quantity or my strength of personality

5.6.1 Delphi characteristics and features

Anonymity of Delphi participants: Skulmoski et al., (2007) confirmed that this kind of technique is achieved by permitting experts to express their judgments freely without any undue social pressures. Ali (2005) stated that the Delphi participant's anonymity allows experts to cooperate, rethink and compare opinions in a non-threatening forum without being influenced by each other's opinions.

Iteration: As the method usually comprises a number of rounds, the experts have the opportunity to re-evaluate their previous judgments. The surveys are frequently repeated until a final answer is reached (Skulmoski, *et al.*, 2007; Ghashat, 2012). The advantages of iterations are that it begins with the developing of a round where a group of experts are presented and describing a subject, cases, or topic of the topic. First, the experts come up with ideas about a specific topic based on individual brainstorming. Secondly, the conductor collects those ideas and presents them to the panellists in the form of a questionnaire for a second round of input. This procedure is usually repeated at least once, but sometimes it may be repeated many more times: it depends on the participants (Geist, 2010).

Controlled feedback: Controlled feedback relates to the dependence of the nature of variation. It is called *controlled* since the facilitator decides on the type of the feedback. However, after each round, the data of the questionnaire is statistically investigated and fed back to participants in aggregated form (Jahns, 2008). Controlled feedback is obtained in a structured format that allows experts to read, comment on, and critique all facets of the case at the same time (Geist, 2010).

Statistical group response: Statistical group response is an aspect of the Delphi method that allows for an interpretation of data and quantitative analysis. Furthermore, it can be obtained either graphically or numerically and generally contains measures of central tendency such as median, mean, and standard deviations (Skulmoski *et al.,* 2007; Jahns, 2008, P.26). However, Yousuf (2007) stated that the minimum number of participants to ensure a good group performance is somewhat dependent on the study design.

5.6.2 Delphi design and process

The typical Delphi method procedure is shown in figure (5-4), and begins with the designing of the questionnaire determined by the experts' panel. The following rounds then provide feedback on the previous ones. This section tries to describe and discuss the ideal procedure and structure of the Delphi technique that will aid in attaining reliable and acceptable outcomes.

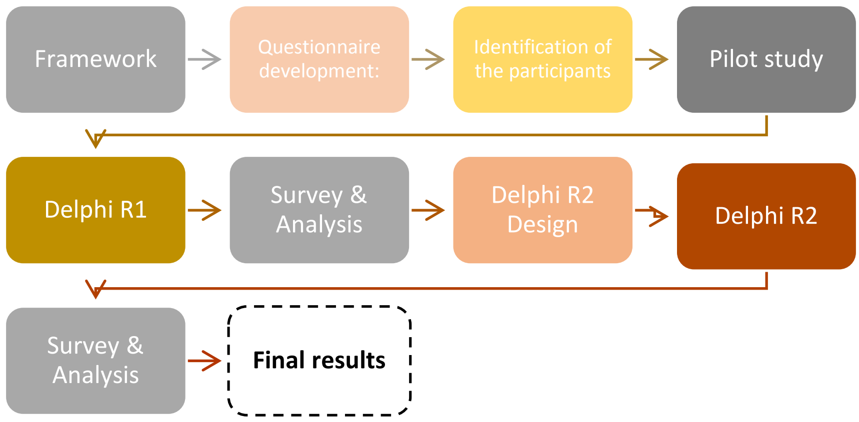

Figure 5-4 the main process of the Delphi questionnaire

Questionnaire development: The questionnaire items can be derived from different sources. Powell (2003) stated that the first round of the Delphi survey is unstructured, in order to allow participants experts to express their views and opinions on the problem area, and then a structured questionnaire is produced by the monitoring team, based on the experts' comments, which is subsequently addressed to the panellists during the next rounds. Ghashat (2012) points out that round one is usually structured to make the application simpler for the monitoring team and panellist. The items for the structured first round are generally derived from the literature on the subject under investigation, or based on the information gathered from another survey.

Procedure for selecting experts: Expert selection is considered one of the most essential fundamentals the Delphi technique. Furthermore, participants should be subject to some important criteria such as interest and knowledge about the subject. However, as the complexity of limiting the criteria for panel numbers is a very difficult task for the researcher, for the purposes of this study, the participants were therefore determined to be those with sufficient knowledge and experience in the LCI and global construction industry. Skulmoski et al (2007) suggest that the Delphi participants should meet four important requirements:

1. Knowledge and experience with the issues under investigation
2. Capacity and willingness to participate
3. Sufficient time to participate in the Delphi
4. Effective communication skills

The success of the Delphi technique is determined largely on the careful choice of the panel. Since the validation of the framework solicited needs in-depth knowledge and sound experience, a purposive approach was adopted to select this focused group of experts. An expert is defined as possessing more data than the average man in the area of expertise possesses and it is suggested that, “an expert may be defined as someone with special skills or knowledge evidence by leadership in professional organizations, holding office in professional organization, presenter at national conventions, published in recognized journals, etc.” (Adnan & Morledge, 2003). The Delphi technique does not need the experts to be representative for statistical purposes; indeed, the quality of the panellists is considered more significant than the number (Thangaratinam & Redman, 2005). Others have suggested detailed guidelines on how to select qualified experts for nominal group which can be used for soliciting experts for Delphi research (Okoli and Pawlowski, 2004), describing an important process whose aims were to ensure the identification of relevant experts and offered them the opportunity to participate in the study. The Delphi technique is not based on a statistical sample that attempts to be representative of any population. It is a group decision mechanism requiring qualified experts who have deep understanding of the subjects. Therefore, one of the most criteria requirements is the selection of qualified experts and as such, the first step in the Delphi procedure is the choice of the expert panel; the two main aspects which need to be considered at this step are the qualifications of the experts and the panel size (Ghashat, 2012). In terms of the experts’ qualifications, they should be defined as a group of informed individuals and specialists in their fields.

Delphi Pilot Study: A pilot study is usually conducted with the aims of testing and adjusting the Delphi survey to increase understanding, and to solve out any technical problems. Further, it is particularly significant for inexperienced researchers who have limited experience in the Delphi survey (Skulmoski et al, 2007).

Number of rounds: The number of rounds used in a Delphi survey differs from one study to another. Usually, the process is continuously iterated until consensus is obtained (Hsu and Sandford, 2007). A summary of the result is extracted from each round and assessed by the researchers before another round is begun. This is done to facilitate the systematic emergence of concurrence of opinion among the panel of participants. The typical Delphi method uses four rounds; however, this has been modified by many researchers to suit individual research aims, and in some cases the process has shortened to two or three round. It can be difficult to retain a high response rate in a Delphi study that has many rounds and it has been mentioned that when the number of iterations increases, the reliability of the Delphi technique increases as well (Gerrish and Lacey, 2010). However, many researchers have used the Delphi technique in only one round, and many others have reported that when ranking is the main concern, one round may be adequate Kuo and Yu, 1999).

Consensus and data analysis: The typical reason for conducting a Delphi survey is to elicit consensus on a predetermined question. One of the challenges facing this method is the interpretation of when consensus has been reached. Across the literature many definitions have been found for consensus. Ghashat (2012, p95), has defined the consensus as ‘the general agreement of the participants in spite of whether they were unanimously for or against the case’. In order to determine consensus a more reliable measurement should be used such as Cronbach’s alpha. However, many criteria have been used by researchers in order to determine consensus in a Delphi study. For example, consensus on an issue can be determined when a specific percentage of the votes have been reached within an agreed range (Miller, 2006). Consensus can also be determined as being achieved when the research question is answered: for example, consensus is reached, theoretical saturation is achieved, or sufficient information has been exchanged (Skulmoski et al, 2007).

5.6.3 Delphi technique in this research

The proposed research on developing framework for improvement of contractor selection procedure in the LCI may be significantly influenced by the particular area of expertise, experience or occupational position of a participant. There is a significant benefit, therefore, in being able to harness subjective judgements of respondents. Delphi method has been found to be a suitable instrument for ensuring that emergent differences between and within key participation groups (that can arise from differences in focus, situation and context) can be accounted for in a systematic way.

A two round Delphi survey was employed as an expert consensus building technique in this investigation. This survey is designed to rank the main criteria and also to express the experts point of view on the suggested framework and finally, to establish the road map for the framework.

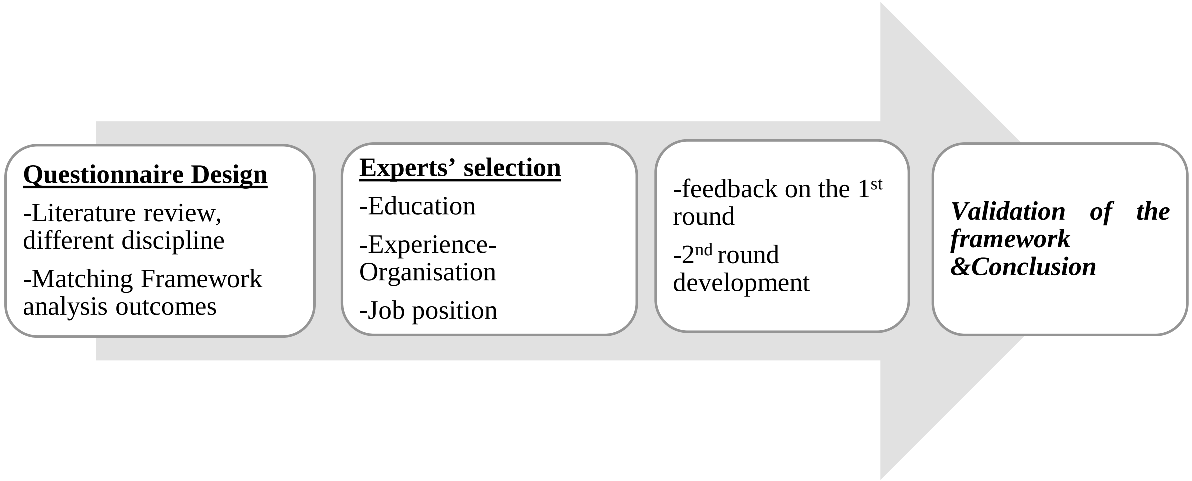

Figure 5-5 the Delphi Process and Stages for this Research

A group of twelve constructions experts took part in the survey to enhance the experts' involvement and to reach to the survey aims. The selected participants were introduced to the current progress of the study, as well as a brief identification of the aims and objectives of the study. Additionally, participants were informed that they were committing to a lengthy procedure. Once the expert panel was identified, each panellist was contacted and the subject of the research and the processes required for it were explained, including, e-mail, fax, or the Web for receiving and returning questionnaires and additionally, the commitment required.

In order to ensure the success of the method, the phases that were built relied on the reviewed literature, and the findings of previous research methods and analysis was applied in this research in order to investigate the factors and procedures that played a significant role in this technique. The process and stages of the Delphi survey of this research are shown in figure (5-3).

An Annex (II) demonstrates the constructed survey which was used for helping and improving the contractor selection criteria in the LCI. The survey included four main parts. Part one contained general information about the participants' profile. Part two sought to rank the main criteria. Part three led to the expression of participants' points of view on the suggested framework. Part four established the road map for the contractor selection criteria framework for the LCI. The Libyan construction representatives selected a team consisting of senior individuals with experience in the field in order to validate the framework for the contractor selection procedure in the Libyan construction projects (see chapter 8 for details).

5.6.3.1 *Delphi population*

It is clear that there is big argument regarding numbers of participants in the Delphi survey. There is a lack of agreement around the expert sample size and no criteria against which a sample size choice could be judged (Akins, et al., 2005). Further, Powell (2003) noted that, there is very little actual empirical evidence on the influence of the number of participants on the reliability or validity of consensus procedures and the numbers of participants is dependent on the scope of the problem and resources available: it should not be less than 10 participants. For example, a panel of only 20 experts were asked to identify potential drivers of change, to position them properly in the wider context of sustainable construction and to outline the progress to be expected in the coming decade in the Greek construction industry. The results demonstrate that the most significant effects on sustainability of Greece construction are energy conservation measures, resource conservation strategies and waste reduction (Manoliadis, et al., 2006). A panel of 12 experienced safety and health experts were employed in the development and initial validation of the sustainable construction safety and health rating system (Rajendran & Gambatese, 2009). Skulmoski et al (2007) note panel sizes ranging from 4 to 171 experts. The Delphi group size does not depend on statistical power, but rather on group dynamics for arriving at consensus among experts. Thus, the literature recommends 10–18 experts on a Delphi panel (Balasubramanian and Agarwal, 2012). Hsu & Sandford, (2007) suggest that if the Delphi study sample size is small, this might not be considered as having provided a representative pooling of judgments regarding the target issue. On the other hand, if the sample size is too large, the drawbacks inherent within the Delphi method such as potentially low response rates and the obligation of large blocks of time by the respondents and the researcher can be the result. Therefore, this study is based on 12 leading experts in the LCI. As the achievement of the Delphi test is based on informed opinion, the experts were prudently selected.

Table 5-3 The panel of experts

Number of Participants	Experience and Current Situation
3	Contractors with experience ranging between 10 to 25 years in the LCI
3	Consultants with experience ranging between 20 to25 years' experience in the LCI
3	Clients with experience ranging between 20 years' experience in the LCI
3	Project Managers with experiences ranging between 10 years' experience in the LCI

The survey concentrates on the ranking of the main criteria, and the validation of the framework for contractor selection in the LCI. Dependent on the factors discussed, twelve various "heterogeneous" professionals (Contractors, Consultants, Clients and Project Managers) in the LCI who are involved and have adequate information in the process of contractor selection process were selected to be part of this survey. Both public and private sectors are represented, with consideration that about 75% of participants is accountable to the public sector.

5.6.3.2 Expert's selection criteria

As the selection of participants is a critical component of Delphi method since it is their expert opinions upon which the output of the Delphi is based, it is considered crucial to the Delphi technique. Thus, participants should be subject to some important criteria such as interest and knowledge about the subject. However, as the complexity of limiting the criteria for panel numbers is a very difficult task for the researcher, for the purposes of this study, the participants were therefore determined to be those with sufficient knowledge and experience in the LCI and global construction industry. For the validations to be satisfactorily sturdy, the experts had to:

- Have an experience range between 10 to 25 years in the LCI
- Knowledge and experience with the issues under investigation
- Sufficient time to participate in the Delphi
- Capacity and willingness to participate
- Have sufficient knowledge of the LCI
- Effective communication skills
- Be professionally skilled in construction management.

In order to provide the most valuable opinions, the above mentioned criteria were used to ensure that only experienced professionals in the Libyan construction sector were included in the validation of the framework.

5.6.3.3 Procedure for selection of experts

In this study the researcher divided experts into panels. In this study, four relevant groups of participants have valuable information about CSP (Contractor Selection Process): contractors, consultants, clients and project managers. See section (5-7) and section for the reason of selection contractor to be part of the validation process. Each panel is dependent on their experience and constitutes three experts, see table (5-2). These panels would potentially have somewhat varying opinions. As it is the purpose to attain a reasonable degree of consensus, it would be best to have panels that separate these groups. This technique would provide a satisfactory number of perspectives between the experts. Stitt-Gohdes and Crews, (2005) stated that the careful selection of the panel of experts is consider the keystone to a successful Delphi survey. Key aspects include panel selection (including experts' qualifications) and size and participant commitment. They suggest that research panel should be knowledgeable about the topic under investigation but open-minded to the findings. Thus, selection of expert panels for this study are subjected to a rigorous process whose purpose was to make certain the identification of relevant experts and provide them the chance to participate in the research.

Table 5-4 the Delphi Process and Stages for this Research

The selection of the panel experts on this research is based on the guidelines developed by Balasubramanian and Agarwal, (2012). The outlined steps of this research process for selecting experts are as follows:

1. Firstly, prepare a Knowledge Resource Nomination Worksheet (KRNW)., the main aim of which is to assist the researcher to classify the experts before identifying them, in order to prevent overlooking any important class of experts. Table (5.5) introduces and describes the Worksheet for the study including the disciplines or skills organisation of the expertise. The selected interviewees indicate that they were familiar with the main topics in the interviews and were highly experienced individuals.

Table 5-5 Sample Knowledge Resource Nomination Worksheet

Disciplines or Skills	*Organizations*
1.Clients 2.Contractor 3.Consultant **4.Project manager**	1. Ministry of Transport 2. Ministry of Water and Electricity 3. The Ministry of Housing, Utilities 4. Organisation Development of Administration Centre 5. University of Sebha 6. The Ministry of Housing, Utilities (Project Management Department) 7. Ministry of Planning 8. The Libyan Group to manage engineering projects 9. The Palace Office for Engineering Consultants. 10.The General Company for electricity 11.The Gesco for general service and training

2. Populate KRNW with names: When the KRNW is populated with classes of experts (contractors, consultants, clients and project managers) personal contacts of experts should be added to each category. This will usually involve a high degree of overlap. However in this thesis it was not possible to have a large list of contacts due to the civil war.
3. Rank experts: This step involves the identification of experts' qualifications which will determine their invitational priority. Four sub lists will hence be made of: contractors, consultants, clients and project managers. Sub lists in each of these sub lists will then be made concerning experts' qualifications and experience and the ties between experts will be noted.
4. Invite experts: Then based on the rankings for each of the four sub lists there will be a panel created consisting of three experts. Each panellist will be sent an invitation letter through email, fax or by post. The amount of time required will be clearly explained to the panellists

5.6.4 Difficulties and limitation of conducting the Delphi methods in this research

Several limitation and difficulties were met in conducting the Delphi method. First, the two rounds of Delphi methods were very time consuming, and the time for each round took longer than expected. Where the achievement of the two rounds of Delphi questionnaires took around four and half months consequently, it is not particularly appropriate to utilize projects with a restricted time frame. Second, it is essential to keep the whole group responding to each round of questionnaire. Any drop out of the participants would influence the final results of the feedback. Because of the extensive commitment of the participation, for each round of questionnaire, reminder calls had to be made to the non-respondents. Third, the choice of the participant is an essential step to achieve the Delphi technique, so it was a difficult to select the panel. Fourth, the wording of the questions and the presentation format of the framework were significant for participants. Therefore, a lot of effort was made to make the framework simple to convey the aims of the research to the panel of experts. It is often difficult to convince people to answer a questionnaire twice or more and incentives and motivation might be required.

5.7 Research Sampling

Determination of sample-size is a significant step in planning a statistical research, and it is considered a difficult one. Among the essential obstacles to be surpassed, are estimating error variances, as well as, identifying the research sample size. However, the best things for statistical research include surveys, experiments, and observational researchers when they are properly planned. Further, the size of the sample must be selected from the appropriate population carefully identified. The processes have to be followed carefully. The study must be of sufficient size, relative to the aims of the research (Lenth, 2001)

Singh and Tiong (2006) studied 102 industry-based contractors’ selection criteria and their perceived importance among the practitioners. They analysed 128 questionnaire responses collected from quantity surveyors, developers, contractors and public and private clients, finding out one of the most important tasks faced by the client in the construction industry is to choose the project executer to reach successful project outcomes. The construction industry has witnessed the failure of many contractors due to varying reasons such as poor performance, financial problems, or accidents arising from the lack of adequate safety consideration at worksites. All these incidents have led to the impression that the current system of awarding the contracts is inefficient in selecting the contractor capable of meeting the demands and challenges of present times and hence needs to be reviewed accordingly.

Doloi et al (2011) utilized a structural equation model for assessing impacts of contractors' qualification criteria on the contractor's performance. The data was collected from medium to large construction companies in Australia. The target population of the survey in the study was contractors, architects, consultants and owners involved mostly in infrastructure, residential and commercial projects. A total of 150 questionnaires were mailed out or hand delivered to target participants involved mostly in the senior management teams and 97 valid responses were received. Among the 97 respondents, 37 are project managers, 31 are contract administrators, 14 are head contractors and 15 are consultants or designers.

Another study (Alzahrani & Emsley, 2013) used SPSS analysis to study 35 criteria that influences contractors and their impact on construction project success for surveyors, clients, contractor and consultant.

Doloi (2009) used a questionnaire survey to analyse pre-qualification criteria in contractor selection and their impacts on project success. The respondents for the survey were selected from a wide range of design and construction teams engaged as contractors as well as clients for developing medium-sized building projects. The findings of this study show that there is a clear relationship between contractor selection criteria and project success measures in the context of delivering successful project outcomes.

An interview and questionnaire survey for evaluation of contractor performance was used for pre-selection in the Kingdom of Saudi Arabi (Al-Otaibi, 2011). The total number of interviews was 15, comprising one official from each ministry, two ministry consultants and two contractors from each ministry; also, one official and two contractors from the Royal protocols were interviewed.

A questionnaire survey was conducted to assess contractor's criteria in Lithuania and abroad. 45 questionnaires were distributed, and 25 completed questionnaires were received. Of the total number of respondents, 23 were private contractor organizations, and 2 of them were public companies. The result shows that the bid price is the most significant factor in the selection of a contractor both in Lithuania and abroad (Banaitiene & Banaitis, 2006).

5.7.1 Fundamental Factors for Determining the Sample Size

The following is a discussion of some of essential factors that have to be taken into the consideration when determining sample size.

5.7.1.1 Error Estimation

Many researchers overlook the issue of sample size and also the issue of sampling, both of which have a huge impact on the accuracy and quality of their research (Fellows & Liu, 2008). According to Bartlett, Kotrlik and Higgins (2001) formula uses two key factors:

5.7.1.2 Margin of error:

According to Bartlett, Kotrlik and Higgins (2001) there are two aspects to the margins of error in educational and social research, which are as follows. In the first level one is concerned with identifying categorical and continuous data. The satisfactory margin of error for identifying categorical data is 5%, whereas for identifying continuous data the satisfactory margin of error is 3%.

5.7.1.3 Alpha of error:

The second aspect is related to the actual alpha value. In most research the alpha value is usually taken as 0.01 or 0.05; however, in some cases some researchers use an alpha level of .10. This happens when the researcher is more interested in identifying marginal relationships, differences, or other statistical phenomena as a precursor to further studies.

5.7.1.4 Variance Estimation

Another factor that affects sample size formulae is the estimation of variance in the primary variables of interest in the research. Cochran (1977) identified four different ways of estimating population variances for sample size determinations. The first way of estimating population variances is to take the sample in two stages, employing the findings of the first stage to decide how many responses are required in the second stage in order to reach the target sample size. The second way of estimating population variances is to utilize pilot study results. The third way of estimating population variances is to apply previous research data from the same population to your sample size calculations. The fourth, and often neglected, way of estimating population variances is to approximate or estimate the structure of the population, and to do so using some acceptable mathematical method.

5.8 Main research instrument

A research instrument is a tool designed to measure the variable, characteristic, or information of interest, an important tool for any research study (Pierce, 2009), the tools for data collection. They include Questionnaire, Interview, Observation and Reading. Basically the researcher has to ensure that the instrument selected is valid and reliable (Godfred, 2015). The research instruments of this research comprised of three main methods; case study, questionnaire and for the validation of the framework, a Delphi survey was used. As previously discussed, case studies are in-depth investigations and are well suited to new areas of research which may have unclear boundaries (Azevedo, et al., 2012) (Limprasert Chai & Igel, 2005).

Therefore, as this research is considered to be the first study carrying out the contractor selection process in the Libyan industry, lack of information regarding in the LCI sector in general and particularly the process of contractor selection, it was very important for the researcher to conduct a case study to collect information about the CSP. This information will help the research to build the research questions and give clear vision about the main reasons behind project failure in the term of contractor selection. The case studies also help the researcher to explore ideas on the subject and can determine principles of contractor selection process which will help the researchers select the most informative subjects to examine in depth. Thus, it can be said that case study is a proper method for providing strong information about the contractor selection process in Libya. The case study does not necessitate a big sample as a case study always deals with one person or sometimes with group of people and the analysis most likely based on qualitative data which is dependent on the interpretation the analyst places on the information (Garger & Gromisch, 2013).

Therefore, case studies were used in the preliminary stages of this investigation to collect more information about the problems of CSP.

This gap in the research will be filled by using a questionnaire survey. Since a significant part of this research was explanatory research a questionnaire was a suitable method to collect quantitative data. Questionnaires tell us what people say, do and think. Consequently, the main goal was to rank criteria, sub-criteria and collect quantitative data regarding the actual practices and operations of the CSP. In this context, it was designed to investigate the 'what' and 'how' questions of the study (see 1.4), and it targeted consultancy, contractor, project managers and the clients of construction projects.

The final instrument for this research is the validation instrument. As matter of fact it was planned to conduct interviews to validate the framework, as the interview is qualitative data which requires analysis. However it was very difficult for the researcher to obtain sufficient responses as a consequence of the civil war in Libya. Therefore the researcher dismissed for the interview and tried to find a suitable validation method for the framework. After exploring many methods, the Delphi survey has been adopted as an appropriate method for validation of the framework due to its many benefits as discussed previously. Summarising in short, the Delphi method, which incorporates a series of iterative rounds, is a technique for exploring divergence and achieving consensus from an expert panel. Validation of framework in utilizing the Delphi method can help in overcoming the limitations concerning with a psychologically issue. For further information see section (5.12).

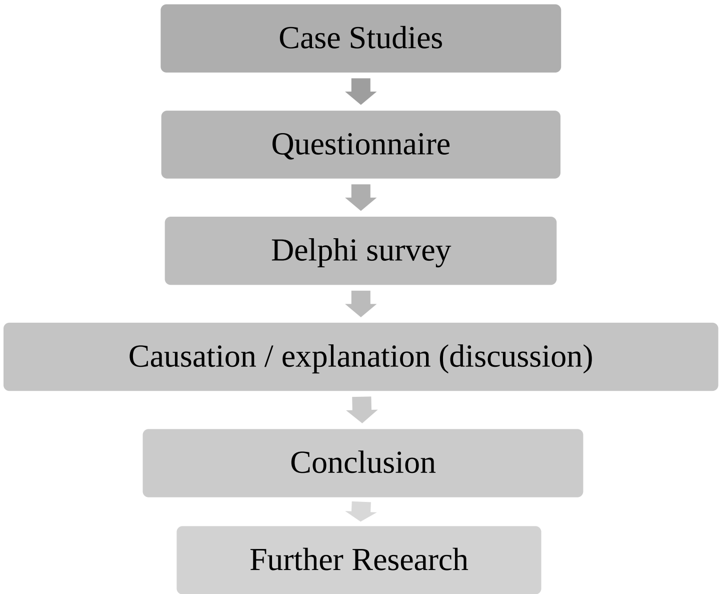

Figure 5-6 Design research instrument

5.9 Data Collection

5.9.1 Secondary Data Collection (Literature review)

The literature review focuses on the research context and background of the research in some detail. The most important sources of literature are journals, records and personal diaries. It concentrates on the findings of previous research and also examines theoretical issues and research methodology. A good literature review ought to be a coherent argument organised around key contributions, themes, trends and controversies. The literature review summarises, synthesises and critically evaluates research and identifies gaps and inconsistencies which provide the justification for further research (Newcastle University, 2012). A summary is a recap of the significant information of the source, but a synthesis is a re-organization, or a reshuffling, of that information. It could provide a new interpretation of old material or combine new with old interpretations or it could trace the intellectual progression of the field, including major debates. Depending on the situation, the literature review could assess the sources and advise the researcher on the most relevant or pertinent (University of North Carolina, 2014).

The main focus of the literature review is to find and compare insights from different authorities on contractor selection procedures in the developed and well developed countries and review the projects and Libya. This has been done by utilizing multiple sources (journals, books, articles, websites conference papers etc.). This assisted in determining problem areas related to contractor selection in Libya as well as in developed and well developed countries. The literature review helped to formulate an initial conceptual framework including framework components such as: the decision maker's team, pre-qualification process the main criteria and sub criteria AHP and TOPSIS.

5.9.2 Primary Data Collection (Pilot study)

A pilot study is an essential task in any study process. It helps the researcher to evaluate the validity and the reliability of the research project before conducting the actual research. Thus, the study will review common practice in contractor selection process in the form of semi-structured interviews with industry participants from the public sector. Therefore, it is essential to conduct a pilot study whenever possible (Arlene and Fink 2006).

Many researchers have defined the pilot study, but the best definition was given by Altman et al. (2006) who said: 'a pilot study is a small experiment designed to test logistics and gather information prior to a larger study, in order to improve the latter's quality and efficiency'.

Pilot studies can use both qualitative and quantitative methods, and large-scale studies sometimes use a number of pilot studies before the main questionnaire is distributed helping to test their potential questionnaire and illustrating any defects in the study by allowing the research to test the data collection technique, discover uncertain questions, expose deficiencies in the questionnaire, and improve the quality of the research and questionnaire design before distribution in large scale studies (Fellows and Liu 2008)

In the pilot study the researcher tries to simulate the ways the survey will ultimately be used in its intended setting. The normal pilot studies for completing the survey are around ten people. The general questions that should be asked to respondents are as follows:

- Does the respondent understand the survey directions well enough to be able to complete it?
- Are they clear about the places where they should mark their responses?
- Is the wording of the questions clear?

In addition to these questions, one of the most important factors that affect the pilot study is the choice of respondents. In order to have an effective pilot study it is important to select respondents who are similar to the people who will participate in the questionnaire in the main study (Fink 2003).

A preliminary pilot study was already done with two research experts with a sound knowledge of the LCI. That preliminary pilot discussed the shape of the questionnaire, as well as adding and revising some questions. After the questionnaire was modified, an official pilot study took place. The pilot study was carried out in September 2011 with Libyan construction professionals who had more than one year's work experience in the LCI. The pilot study was targeted at project managers, clients, consultants and civil engineers. In this study about twelve copies of the survey were distributed to the decision-makers for the pilot study.

In this pilot study, participants suggested that two questions should be modified because they were asking for the same information. Also, many grammar mistakes were corrected to improve the questionnaire for future respondents and some questions were rewritten to make them more understandable.

From results of the pilot study, the questionnaire was amended and revised until each clause and paragraph item achieved a satisfactory level of consistency and validity. Only questions that had exact relevance to the study were kept for the final survey. The final revised copy of the questionnaire can be found in Appendix (II).

5.9.3 Validity

The main point of determining research validity is to demonstrate whether the research truly measures that which it was intended to measure as well as how fulfilled the research findings are. However, validity is usually measured by asking a group of experts for their opinion on the research (Golafshani and Nahid 2003; Mora, 2014).

As Lund (2012) explained, when the survey is designed the researcher must decide whether the field has been satisfactorily covered thus leading to content validity. In order for the survey to have a content validity, all three of the following attributes should be addressed adequately.

First, does the survey have face validity? For example, how does the questionnaire look? Does it seem well done and 'professional' or does it look poorly constructed? Face validity is important because professional-looking questionnaires are more likely to elicit serious responses. Hence, face validity is an essential consideration for the pre-test and the final draft of a questionnaire.

Secondly, does the survey have criterion validity? Criterion validity refers to the effectiveness of a survey in measuring what it purports to measure.

Thirdly, does the survey have construct validity? Construct validity indicates the extent to which the new survey conforms to existing ideas or hypotheses with respect to the concepts and constructs that are being measured.

However, as Horn (2008) points out, it is nearly impossible for a questionnaire to be 100% valid, and as a result, validity is normally measured in degrees. As a procedure, validation involves gathering and analysing data in order to measure the accuracy of the questionnaire. For this reason about ten construction professionals involved as decision-makers in the contractor selection process were given initial questionnaire copies in order to evaluate. Each of the participants was requested to rate the relevance of each criteria of content using a four-point rating as follows:

(A) Relevant, (B) Relevant after minor moderation, (C) Not relevant unless a major change is done, (D) Not relevant. As result of the expert assessment, some items were reworded to be clearer and a new version of the survey questionnaire was prepared.

5.9.4 Reliability

The main idea behind reliability is that any important results should be more than a one-off finding and be integrally repeatable. Reliability is an essential part of achieving overall validity for questionnaire and for improving research results. Other studies should be able to accurately reproduce the same experiment, in the same environment, and produce the same findings. This ability to reproduce the experiment and results will usually support the results and ensure that the wider scientific community will accept the hypothesis being tested. Without this replication of statistically important results, the experiment and investigation will not have satisfied all of the necessities of testability (Shuttleworth 2008).

As discussed by Lawrence and Martin (2012), reliability is how consistently a test measures what it attempts to measure. Consistency is deemed necessary as when one evaluates anything with an instrument more than once they want the measurement it to come out with the same answer (or close to it) every time.

The main concept of reliability is to test and assess the quantitative study, the idea which can be most often used in the major types of study. Therefore, if we look at the idea of experimental test as a way of information elicitation then the most significant test of any qualitative research is its quality. A good qualitative research could help us "recognize a situation that would otherwise be enigmatic or confusing" (Golafshani and Nahid, 2003).

To determine the reliability of the questions used in this research, Cronbach's coefficient alpha test was adopted. Cronbach's coefficient alpha is a statistical model used to test reliability in survey development across various sectors. The degree level of correlation among a set of items and the variance among the items must reach at least 0.70 to be considered adequate (Ryu, 2006; Lund, 2012).

5.9.5 Effect of Validity and Reliability

The sample size is directly affected by various factors and the most important factor is the precision with which things can be measured. The poorer your measurements, the more subjects you require to lift the signal (the effect) out of the noise (the errors in measurement). The concept of validity is significant in expressive studies and it also represents how well a variable measures what it is supposed to measure. Further, the more variables that you measure, the fewer subjects you require in order to see small changes in those measures. The concept of reliability describes how reproducible our measures are on a retest; therefore, you can say that reliability impacts the results of experimental studies. If the reliability of the main variables is poor then you may require thousands, rather than hundreds, of subjects (Hopkins, 2008) .

5.9.6 Administrative Procedures Questionnaire (Data Collection)

Alsulamy (2014) emphasised that questionnaires have be reliable, particularly over time and they ought to give the same outcomes if they tested upon the same respondents at least two-thirds of the time. The purpose of the questionnaire survey was to investigate and evaluate the current practise for contractor selection criteria in the LCI and to help us to build and design a framework for CSP in the LCI. It also attempted to capture an overview of the current level of CSP within the LCI. A questionnaire survey would usually provide a fast and effectual means of gathering information with regards to the respondents' perception about the CSP in this aspect.

However, as result of the pilot study, it was found that the study was advantageous in terms of detecting the level of restriction on access to data and information from participants. In addition, it provided real vision about data sources in terms of accessibility and availability. The process demonstrated that before carrying out the main questionnaire, the following important points needed to be taken into consideration:

1. As the many of respondents were not interested in answering long questionnaires, it was necessarily to make the questionnaire as short as possible.
2. Simple, clear and direct language was used in the questionnaire. Further explanations and colloquial expressions were also utilised to explain the meaning of concepts.
3. Complicated terminology was avoided.
4. Asking deep, personal questions was avoided.
5. Asking questions that require calculations of mind, or that relied on memory, were avoided.
6. Each question was asked in only one paragraph.
7. The page layout was made clear and tidy.
8. The page layout left enough space for the respondent to answer, including personal observations.
9. Questions were asked in logical order.

A significant decision in any survey is the selection of the suitable data collection technique in order to increase the response rate. There are many several different categories of data collection instruments, each with its own definite attributes, thereby obtaining specific utilize. The final decision about the data collection process will depend on the research topic, the study population characteristics, the volume and complexity of the data to be collected, the information available on the sampling frame, the size of the sample. Four main categories of data collection methods have been summarised (Julie, 2007; Cherry, 2011; Denzin and Lincoln 2003):

- *Personal interviews*

In many populations, personal interviews are likely to provide results in the better response rate, especially when experienced and well trained interviewing staff is employed. That is because experienced interviewers are eligible to explain and answer any queries and are able to provide additional information to participants in case of complex questionnaires. Additional information can be collected. Interviewers are also able to probe when respondents give unreliable or insufficient answers and can consequently improve the quality of the data. They are also able to evaluate the apparent impact of the interview on the respondent and encourage them to seek appropriate support if necessary. On the other hand, personal interviews have disadvantages as they require trained, well supported interviewers who are both available at the right time and in the right geographical area for the survey. Also, it is more expensive than other methods of data collection.

- *Telephone interviewing*

This technique is utilized increasingly frequently because telephone interviews have many of the benefits of personal interviews in terms of a skilled individual administering the survey, with the added benefits of both a safe working environment for the interviewer and reduced costs. There is no need for the interviewers to be located near the respondents. A telephone survey is likely to result in a higher response rate than postal surveys. Disadvantages of telephoning interviews include that in some cases, it is becoming harder to get a good response rate utilizing this technique as a result of growing intolerance of telephone salespeople, and the increasing use of answering machines to screen calls. It might also be a less appropriate technique for populations where high levels of hearing loss are expected, such as in elderly respondents. The questionnaire has to be simpler for a telephone survey than for a personal survey, particularly with respect to question wording and response categories as respondents have to be able to hold all the information in their memory, without the help of visual aids, etc. It is also not possible to use self-complete questionnaires within the interview. Together with the fact that the interviewer has no control or knowledge of who can hear the respondent's answers, this may make this mode of data collection less suitable for personal or sensitive questions than other methods.

- *Postal questionnaires*

This method is considered cheaper than telephone or personal interview surveys, and requires fewer staff and facilities. They are usually utilized to survey populations who are widely dispersed, and those who for whatever reason are otherwise hard to reach. It also potentially increases the accuracy of response in terms of collecting personal or sensitive information. However, the achievement of the survey is based on the accuracy of the address list. There is also no interviewer to clarify the purpose of the study so questionnaire design has to be particularly good, with a clear route through the questionnaire and precise, easy to understand instructions for the respondent and to encourage respondents to consider participation. Respondents should also have good skills to participate. There is also no control over who actually completes the questionnaire. Therefore, the levels of missing data are higher than in personal telephone or interviews. Response rates are then lower than for other modes of administration.

- *E-mailed or internet surveys*

Compared to other surveys methods, these surveys are considered less expensive (no cost), but this is based on the number of responses and on the respondents having prior experience of web survey programming, as problems with this can remove any savings. Also, this method has a quick response and as compared to response rates with other methods they found the response rates of the latter to be higher. The biggest problem with this method at present, however, is that as coverage of the population by e-mail and the Internet is limited, this may only be an appropriate method to reach particular populations such as university employees.

From the above, the best way to increase the response rate whilst keeping survey costs down may be to combine data collection methods. In this research the researcher adopted two main methods for collection data. Since this survey was designed to particular populations and to get a quick response, the method adopted to ensure coverage of the population, was for the questionnaire initially be emailed out to the sample thus benefiting from the advantages of this modality whilst at the same time reducing costs compared with other survey methods because some people will have replied to the initial e-mail approach. To get additional information and accurate responses answers, a personal interview method was also used.

The researcher initiated the survey by setting up a field office in the city of Tripoli which was furnished with modern technology such as internet access, PCs, printers, and telephone. The field office allowed the researcher to carry out his research work and make the necessary arrangements regarding the fieldwork activities on a daily basis.

Secondly the researcher had to obtain permission to conduct the survey. The permission authorised the researcher access to different governmental departments, firms and several governmental data sources. The third phase consisted of translating the survey documents into Arabic. This involved essential consultations with linguists, after which the questionnaires were re-worded in Arabic and modified so that they are in harmony with the original English version. When translating documents from English to Arabic it is important to note that, due to the difference of vocabulary some words do not have a similar or exact replacement and therefore idiomatic words were used to explain technical terms.

As an extensive survey was to be carried out, three assistants were recruited and trained to assist with administering the questionnaires. The selection of the assistants was based on the fact that they all have broad experience and ample knowledge of the LCI and its related departments and institutions in the country from their employment history as they were working in the Research Centre for Building Materials and Construction of Libya and for this reason all of them were also well known to the researcher.

The aims and objectives of the study, along with the questions of the questionnaire and techniques of contacting targeted firms and communication were explained by the researcher to the assistants. In addition, advice regarding how to deal with respondents and check the completed questionnaires was provided to the assistants. To make certain that the assistants had the required skills to administer the questionnaire, a pilot survey was carried out, to gather information prior to a larger study, in order to improve the latter survey's quality and efficiency. Each assistant had to administer five questionnaires to senior managers of construction firms, or the directors of consultants firms and to clients of construction projects. From the results of the pilot survey, the researcher found it necessary to write up a list of instructions and advice in Arabic to be used as guidelines when conducting the main survey. Furthermore, the assistants were provided with training to make records of any comments or observations in the survey notebook.

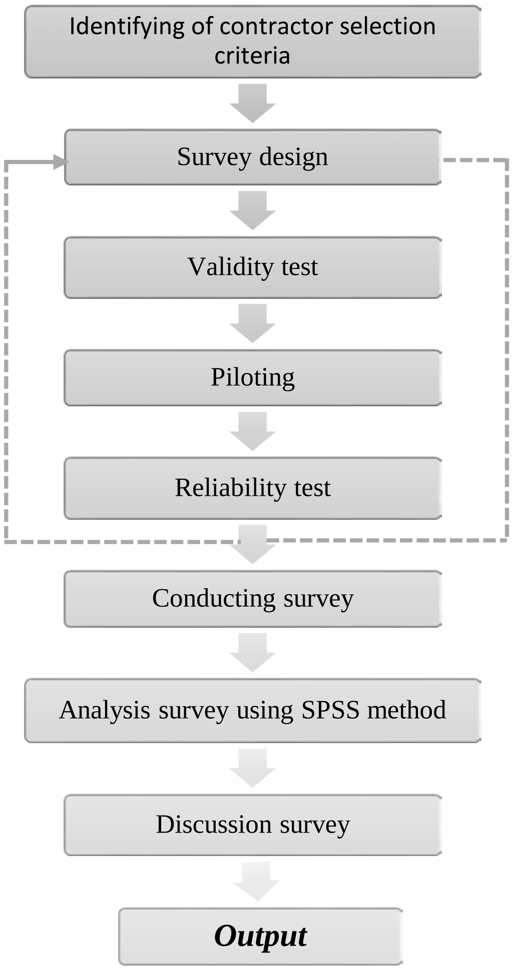

Figure 5-7 shows the survey process

5.9.7 Conceptualisation Theoretical Framework

The conceptual framework directed the researcher to the criterion which needed to be examined. This was done through critical analysis of the literature review and from the pilot study to determine the research problem and formulate the research question and questionnaire.

5.10 Design of research methodology

Saunders et al (2007) referred to this stage as the general plan that determines how a researcher will attempt to achieve the research objective. In other words, the research design is the plan or strategy adopted for linking the theoretical research problem to relevant and practical empirical research that is conducted in order to achieve the research goal.

The research project will be carried out in further detail as follows: In this research, the quantitative technique will be used to find out the needs of the objective. This has been expressed as being very powerful to gain insights and results to aid in making inferences and drawing conclusions (Creswell , 2008).

The project will be initiated by a comprehensive literature review for identification and analysis of contractor selection methodologies, approaches and toolkits currently being used in the construction industries of developed and developing countries.

Following that, case studies well be developed, focusing on in-depth interviews with some selected experts about CS process in the LCI. The outputs from the survey and case studies will be used to design and develop the evaluation framework for the LCI which will represent the main unique contribution of the proposed research programme.

A pilot experiment study will assist in producing a survey, deemed essential, as discussed. (Arlene and Fink, 2006). A preliminary pilot study will be undertaken in this research programme. Thus, the study will review common practice in the contractor selection process in the form of questionnaire survey with industry participants from the public and private sectors.

The findings of the literature review and case studied will inform the development of the questionnaire survey, which will aim to discover the existing contractor selection and tendering processes within the LCI. It is expected that the target groups of the questionnaire will include representatives from major clients (public and private) as well as contractors.

The development of the framework will be followed by its validation through consultation with practitioners from the LCI. The consultation will be in the form of qualitative data collection (either by interviews, or Delphi survey) and will aim to evaluate the feasibility of adopting the proposed framework for construction projects in Libya. The research will conclude with the development of an implementation roadmap, which will educate on the timescales and milestones for a holistic adoption of the framework by the Libyan construction. A flow chart of the envisaged research methodology is illustrated in the figure below. The outcome from the interpretation and the data analysis will be based on the input questionnaire. The appropriate software; Statistical Package for the Social Sciences (SPSS), will be used to analyse the data. Finally, the end product of the research will be the development of a new framework for improving contractor selection procedures on major construction project in Libya. Therefore, this framework can be used to improve the construction project management in Libya. After the framework is ready, a composite technique of AHP and TOPSIS methods is to be used to create new technique for analysing contractor selection criteria. Chapter 6 will show the details of those methods. Figure 5:8 shows the research design flow chart and more detail is illustrated as follows

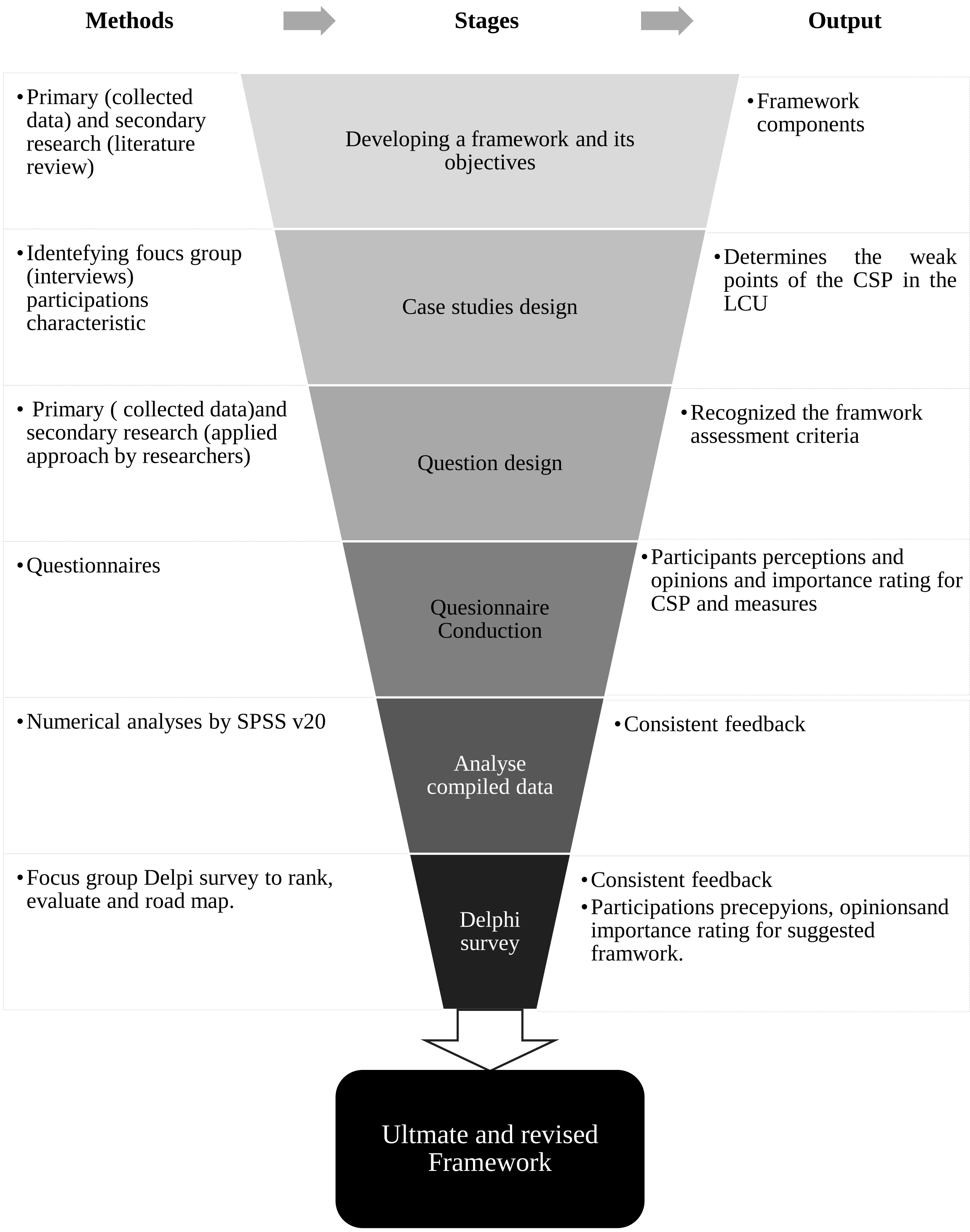

Figure 5-9 Research design method

5.11 Data Analysis

5.11.1 Approaches to Analysis

The first phase in any data analysis is to determine the appropriate statistical tests to analyse data with, based on the study design, the hypotheses or research questions which are being answered, as well as the kinds of variables utilized.

After collection of data through the questionnaire survey, quantitative analysis will be performed using the SPSS software package (Statistical Package for Social Sciences, version 20). The first version of the computer program SPSS (Statistical Package for the Social Sciences) was produced in 1968 and is one of the most widely used tools for statistical analysis in the social sciences. The advantages of SPSS are that it is one of the easiest major statistics package to utilise; comprehensive and flexible, it can be utilised by a variety of research fields including health researchers, survey companies, government, education researchers and others. Furthermore, it can be used to generate tabulated reports, charts, and plots of distributions and trends, as well as generate descriptive statistics and more complex statistical analyses. SPSS provides a user interface that makes it very easy and intuitive for all levels of users (Garth, 2008) (Landau & Everitt, 2011).

5.11.2 Correlation

The correlation statistical technique is considered as one of the most general and most valuable statistics techniques. In addition to this, correlation is a single number that illustrates the degree of relationship between two variables. Additionally, it has the ability to show whether and how effectively pairs of variables are connected and related (Trochim, 2006). Strictly speaking, correlation is not considered as a research method but a kind of analysis of data grouped by other means. The correlation technique permits the explorer to study naturally occurring variables that are possibly unethical or unworkable to investigate experimentally (McLeod, 2008).

Since these methods are the most popular and most commonly used methods for investigating the relationship between two quantitative variables, they will be used as the main techniques in this research. That is because the main data collection of this research is a questionnaire survey fundamentally involving ranking criteria and sub-criteria of contractor selection. Further, one of the main objectives of this research is to compare the outcome between the public and private sectors. Therefore this method is the most suitable for this research.

5.11.3 The Measurement Scale

Measurement is a process by which numbers or other symbols are allotted to experiential properties (variables) according to specific rules. However, before we choose the right method of analysis we should know the method of measurement. Each sort of measurement has a proper method that can be used for analysis. Researchers have identified four main areas of measurement: interval, ratio, normal, and ordinal. The interval measurement is applied to a set of observations or data where the distance between each observation is constant. There is little difference between an interval scale and a ratio scale. The only difference is that the ratio scale involves the kind of numerical scales that have a natural zero such as age, salary, time, and distance Invalid source specified. (Fellows & Liu, 2008), Usually, categories of data are identified in terms of the environment of the scale of measurement utilized. The famous four primary scale of measurement will be briefly described with an example as follows.

- *Nominal scale*

This scale is considered one of the most basic scale measurements as the numbers are utilized only for categorizing or organizing objects, for example, numbers assigned to marathon runners

- *Ordinal scale*

With an ordinal scale the numbers show the relative position of the objective, but not the magnitude of difference between them, for example: the rank order of the winners in a marathon, 1st, 2nd, 3rd and so on.

- *Interval scale*

This scale aims to permit a comparison of the differences between the objects; for example, the performance on a 0-10 scale rating of the time intervals between marathon runners.

- *Ratio scale*

The ratio scale takes into consideration all the properties of the normal, ordinal, and interval scales, as well as an absolute zero point. Thus, using this scale one can classify and rank objects such as age, height, weight, and money.

In this research ordinal and normal scales were utilized with respect to the questionnaire because the questions in the survey included two types of answers: those that could be answered yes or no, and those where the answer was selected from a scale that ranged from relevant to not relevant. The numbering systems in nominal and ordinal measurements are specified for identifying each type of person. Further, normal scale measurement is used for items that belong to as organization and/or classification, or otherwise having specific properties. It does not take into consideration any particular idea of rank or priority. In addition, normal numbering uses conventional positive integers. On the other hand, an ordinal measuring system involves the ranking or rating of data that normally uses integers in either ascending or descending order. The numbers assigned to the agreement scale (i.e. 4, 3, 2, 1, 0) do not indicate that the intervals between the scales are equal, nor do they indicate absolute quantity. They are merely numerical labels (Naoum, 2012).

Due to the fact that the questions in this questionnaire contained both yes/no questions as well as questions that required the participant to rank their response, it can be seen that both nominal and an ordinal scales were used in this survey.

In this research, the participators were asked to classify and rank the importance of the main six criteria include the twenty six sub-criteria of contractor. A statistical scale started from zero to four was utilized to measure the criteria as (0) Not important (1) Low important (2) Somewhat important (3) Important (4) Very important

5.11.4 Numerical values of alpha

George & Mallery, (2003) suggested the following constants of Cronbach’s Alpha coefficient test: _ > .9 – Excellent, _ > .8 – Good, _ > .7 – Acceptable, _ > .6 – Questionable, _ > .5 – Poor and _ < .5 – Unacceptable. Increasing the value of Cronbach’s coefficient usually relies upon the number of factors in the scale. Tavako & Dennick, (2011) confirmed that a low value of Cronbach’s Alpha could be caused by a low number of questions. Therefore, low number of questions among factors could highly affect the value of Cronbach’s alpha. The easiest method to find them is to compute the correlation of each test item with the total score test; items with low correlations (approaching zero) are deleted. If alpha is too high it may suggest that some items are redundant as they are testing the same question but in a different guise. A maximum alpha value of 0.90 has been recommended.

5.11.5 Descriptive Statistics

In this research, to analyse the questionnaire survey, descriptive statistics was utilized and the data analysed include the biographic data collected through the questionnaire. This data is required to explain the research participants' characteristics generally regarding their, job title, experience age, qualification, position or the organisation. Also the key research questions were examined with a descriptive statistical tool to aid understanding of the pattern of the participation's perceptions of the research questions. Additionally, it helps the researcher to explain the current situation of the CSP, including but not limited to how to collect contractor information, qualification process, method and techniques that used for contractor as well as the influence of socio-economic (tribe) and ethnic groups in the contractor selection and the contractor relationship between clients, consultants, supplier and sub-contractor.

5.11.6 Comparison of Mean

The mean, which is the statistical term for average, is a component of descriptive statistics used to summaries properties of a single variable. It is calculated by adding all the value from a data set and then dividing the result by number of observations (Alsulamy, 2014). Therefore, this method will be used to help the researchers for ranking the main criteria and sub criteria. Also it will help the researchers to find out if there are any statistical differences between the private and public sector participants.

5.11.7 Confidence Intervals

Using confidence intervals or confidence limits is a more accessible approach to sample-size estimation and interpretation of outcomes. You simply want enough subjects to give acceptable precision for the effect you are studying. Precision refers usually to a 95% confidence interval for the true value of the effect: the range within which the true (population) value for the effect is 95% likely to fall. Acceptable means it won't matter to your subjects (or to your interpretation of whatever you are studying) if the true value of the effect is as large as the upper limit or as small as the lower limit. A bonus of using confidence intervals to justify your choice of sample size is that the sample size is about half what is needed for statistical significance.

5.11.8 Independent T-test

The t-test process can help us to contrast the mean (average) of a population with a hypothesized value such as a business target. This test is usually used when we have to compare and analyse the means of two samples. The t-test is utilized with variables measured at the interval or ratio level, such as income or age. The most important strength of the t-test is that it was designed to analyse and compares the variances for samples of 30 or less (Israel, 2009). The main idea of the independent t-test is to compare and evaluate the means among two unconnected groups on the same continuous dependent variable (Lund, 2012).

This method was applied in this study in order to know whether there is a difference in the opinion between the private and public sector. This method is usually utilized to test whether there are statistically significant differences between two or more independent groups. Therefore, the independent-samples t-test was conducted to compare whether there are statistically significant differences between private and public group. These groupings were arranged according to levels of independent variables. Indicating bias has assisted the researcher in minimising any bias. The foremost technique for doing so is to analyse each group individually and then to investigate differing perceptions in respect to the issues being examined.

5.11.9 Factor analysis

Factor analysis is usually utilised in data reduction to recognize a small number of factors that illustrate the variance that is observed in a larger number of obvious variables (Norušis, 2007). Factor analysis is a data reduction method. It does this by looking for underlying unobservable variables that are reflected in the observed variables (Bruin, 2006; Coakes and Ong, 2011). In other words, if the data contains many different variables, then factor analysis can be employed to decrease the number of variables. It is a group variable with similar factors attributed together, whereas factor analysis technique has the ability to construct a small number of factors from a huge set of variables. The reduced variables can also be utilised for additional analysis (Newcastle University, 2007).

In the process of factor analysis there are three important stages that have to be taken into the consideration:

- ***Computation of the correlation matrix****:* a correlation matrix is built for all the variables to find out the suitability of the factors- analytic model;
- ***Factor extraction:*** this finds out the number of factors required to represent the data;
- ***Rotation:*** in order to maximize the relationship between various factors, variables factors have to be rotated (Coakes and Ong, 2011).

Factor analysis is a popular multivariate analytical method for determining strong relationship among variables (Albogamy et al., 2013). Regarding construction research management, Alsulamy (2014) suggested the use of factor analysis technique helps to identify a small set of factors that represent the underlying relationships amongst a group of variables. The two main issues need to be examined in order to determine whether a particular data set is suitable for factor analysis. The first is the sample size. The second is the strength of relationship among variables.

In this study, factor analysis is utilized to explore whether or not the variables can be tested to group them under key components for the variables so that the main criteria could be identified. Also, factor analysis and Cronbach's Alpha were used to assess the validity and reliability of using the sub-criteria as a measure of the main criteria of financial stability, technical and management ability, experience, health and safety, quality and weather and cultural considerations. Numerous tests of factor analysis were applied to determine the suitability of the factor analysis for factor extraction utilizing spss v20 software.

- **Principal Components Analysis.** This method is used to form uncorrelated linear combinations of the observed variables. The first factor has a maximum variance. Consecutive components explain progressively smaller portions of the variance associated with it. It is utilized to determine the basic elements of the initial factor solution. Also, it can be used when the correlation matrix is singular.
- **Unweighted Least-Squares Method.** This method is utilized to minimize the squared sum differences between the observed and reproduced correlation matrices (ignoring the diagonals).
- **Generalized Least-Squares Method.** A method of extracting factors is aimed at maximizing the sum of the squared differences between the observed and reproduced correlation matrices. Correlations are weighted by the inverse of

their uniqueness so that variables with high uniqueness are given less weight than those with low uniqueness.

- **Maximum-Likelihood Method.** A method of extracting factors that produces parameter estimates that are most likely to have produced the observed correlation matrix if the sample is from a multivariate normal distribution. The correlations are weighted by the inverse of the uniqueness of the variables and an iterative algorithm is employed.
- **Principal Axis Factoring.** A factor extraction method that uses the original correlation matrix with squared multiple correlation coefficients placed in the diagonal as initial.
- **Alpha**. A method of extracting factors that considers the variables in the analysis to be a sample from the universe of potential variables. This method maximizes the alpha reliability of the factors (Norušis, 2007). .

The expected outcome of this technique is to detect structure in the relationships between sub-criteria that is to classify main criteria, and some of sub-criteria which have lower correlation will drop down their groups.

5.11.10 KMO and Bartlett's test of Sphericity

In this research, many tests of factor analysis were applied to determine the appropriateness of the factor analysis for factor extraction utilizing SPSS v20 software. This includes the KMO and Bartlett's test of Sphericity. TThe Principal Component Factor Analysis was also used to identify a relatively small number of interrelated of the sub-criteria. However, the value of the overall KMO statistic must be between 0 and 1. Large value of KMO test indicates that correlations between variables are quite good and can be explained by the other variables, consequently, factor analysis is likely to be appropriate. According to Lin, Sun, & Kelly (2011) a satisfactory value should be at least 0.5 and if the value is less than that, then the data should to be collected again. This type of test was designed to evaluate sample adequacy by comparing the magnitude between the observed partial correlation coefficients to those of the magnitude of the partial correlation coefficients. The varimax orthogonal rotation of principle component analysis was further applied to interpret these factors. Usually, rotation works on maximizing the loading of all variables on one of the extracted factors at the same time as minimizing the loading on all other factors. It works through changing the total values of the variables whilst keeping their differential values constant. The values in the columns of factor name are the correlation between original variables and common factors. A factor loading indicates the degree of association of a variable with the component and the percentage variance of the component that is explained by the variable. For each factor, all items with a load equal to or greater than 0.50 were assigned to the corresponding factor (Field, 2009), (Alsulamy, 2014). Consequently, this method was used as a method to measure sample adequacy of the factor analysis of this research.

5.12 Validation of the Framework

The main goal of the study project is to develop a framework to enhance the success of contactor selection process in the LCI (Chapter eight provides details of the development framework).

As a final stage of the research design, the validation of the framework was established through feedback from selected professionals in the construction industry in Libya using Delphi survey (details of which are provided in Chapter Nine). There are many different ways to validate such frameworks, which include interviewing and sending the framework to experts or professionals in the construction area, or presenting the framework in workshops and inviting people highly experienced in the relevant arena. However, due to the situation in Libya (civil war) it was hard to obtain accurate answers from the experts. Moreover, this research is an investigation into the framework for CSP that would support selection procedure in in the LCI. This complex issue requires knowledge from experts who understand the different construction, social, and political issues there. Therefore, a Delphi survey can help to validate the framework more appropriately. Further, another reason of selecting this validation technique came from the previous successes obtained by the many of previous researchers in the built environment when using such a system e.g. (Chang, et al., 2010; Okoli and Pawlowski, 2004; Shaw and Manwami, 2013) who recommended the Delphi survey as a good method in validation process. Therefore, this validation technique was adopted in this study because it is commonly utilized, but the use of other systems such as presenting the framework in a workshop or seminar can also give good results, and are not ruled out, simply that no workshops or seminars are presently planned. Therefore, a Delphi survey was conducted by selecting a number of highly experts and professionals people in the construction area and practicing the framework in the place that needs to be improved. This technique can take a long time and is more suitable for modelling than frameworks. The approach utilized an iterative feedback technique through a series of structured questionnaires usually referred to as rounds. Results will be appropriately statistically (SPSS) evaluated and will determine the critical criteria that influence commitment and retention.

The Delphi method has been utilised in many different sectors to evaluate a variety of problems in sectors such as business management, education policies, market, and health care. However, in the case of contractor selection, not many researchers have used the Delphi method. The Delphi method is mainly concerned with utilizing selected expert panels to help in gathering data and information to attain research objectives, by designing a progressive series of questions to which a selected panel of expert responds. In addition, the Delphi technique inherently provides richer data because of their multiple iterations and their response revision due to feedback. Furthermore, Delphi participants tend to be open to follow-up interviews.

In this study the Delphi method was used to validate and confirm the framework which was considered critical from the literature review, questionnaire survey for contractor selection procedure in the LCI, and to reach a consensus on the framework from the expert panel for the final findings. The validation of framework will be useful to support the successful process of CSP in construction projects in Libya.

The use of the Delphi method in this research was to determine the relative degrees of importance of contractor criteria based on the ranking of the experts.

- To rank the main criteria which were extracted from the previous questionnaire
- To investigate the expert’s opinions regarding what can make the implementation of devolution of policy successful
- To seek the validation and experts viewpoint and their opinions regarding the suggested frame work
- To discuss and establish a roadmap for the framework

5.13 Research process adopted for this research

According to Williams (2007) the research process is systematic in that defining the objective, managing the data, and communicating the findings occur within established frameworks and in accordance with existing guidelines. The frameworks and guidelines provide researchers with an indication of what to include in the research, how to perform the research, and what types of inferences are probable based on the data collected. It is stated that "the research process is the overall scheme of activities in which scientists engage in order to produce knowledge; it is the paradigm of scientific inquiry" (Blankenship, 2009). The research process usually contains seven main stages: problem, hypothesis/research question, research design, measurement, data collection, data analysis and generalisation, with each stage affecting the theory and being affected by it.

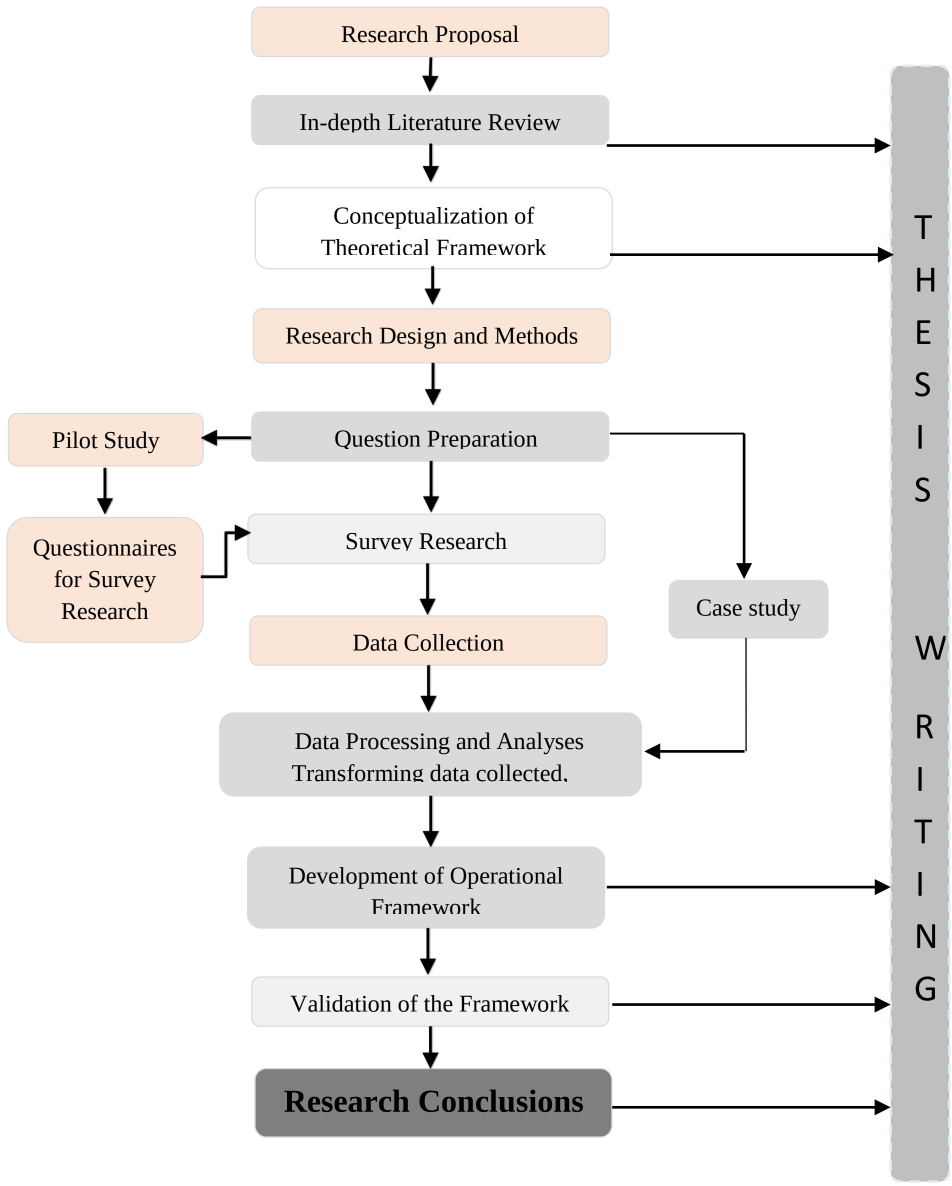

Figure 5-10 Research Process Flowchart

5.14 Summary

The research methods utilised for the purpose of this study have been explained in detail. This chapter has established a sound explanation of the selected research approach and methodology. Further, it has attempted to give a general explanation about the background of the overall research methodology and its relevance to the context of this research. The key character, advantages and disadvantages of quantitative, qualitative and mixed research techniques have also been expressed.

The questionnaire survey is to be conducted in order to identify the current practices of contractor selection in Libya. Qualitative and quantitative data are used. In addition, both public and private sectors are targeted so are decision makers such as contractors, clients, project managers and consultants. The SPSS software is to be used to analyse the data collected. Chapter 7 will provide more description about the use of the SPSS tools and their facilities.

The second step in this study is to rank the selection criteria that have been identified in the first step and design a road map as well as validate the frame work for the established criteria. To achieve this purpose and improve consensus of CI professionals regarding the framework, number rounds of the Delphi technique are to be utilised. The Delphi survey is to be distributed to construction industry experts. The Delphi survey procedures, data collection techniques, steps, and analysis utilised will be briefly discussed and explained in detail in Chapter 8.

The final step in this research is a case study. The data collected from real-life is to be applied to the composed model. This approach is a hybrid structure of AHP and TOPSIS. Because of the lack of technology and unstable political situation in Libya, it is not possible to implement all the established criteria on the hybrid model. Therefore, this researcher will only select the most important criteria to apply to the case study. The applied criteria include experience, financial stability, quality performance and safety record.

The next chapter will describe the proposed method that will be used and help to establish a framework for analysing contractor selection criteria.

CHAPTER SIX: MODEL CONTENT

6.1 Introduction

The main aim of this chapter is to discuss and illustrate the proposed method that will be used and help to establish a framework for analysing contractor selection criteria. The chapter will present the key issues and aspects of this proposed method. The proposed tool is comprised of two composite methods called AHP (Analytical Hierarchy Process) and TOPSIS (Technique for Order Performance by Similarity to Ideal Solution). AHP will be utilised to determine the relative weight of contractor selection criteria and TOPSIS will be used to identify the best contractor and the worst contractor.

Chakraborty and Chakladar (2008) utilized a combined method of (TOPSIS) and an AHP. Both methods were used to determine the most proper Non-Traditional Machining (NTM) process for specific work material and shape feature combinations. In addition an expert system was used based on advanced TOPSIS-AHP-approach. Both of these decision-making methods are designed for the problem of selecting a solution from a finite set of available alternatives.

AHP and TOPSIS approaches were employed by Percin (2009) in his study of the evaluation of third-party logistics (3PL) whereby the Delphi method was modified, the AHP was employed for the weighting of criteria, and then the final ranking was calculated by using the TOPSIS method. The main benefit of AHP and TOPSIS is that it helps decision makers think in a comprehensive way. Moreover, in Percin’s study, the analysis was also performed in order to examine the sensitivity of the results to changes in the weights of main criteria. Lin et al. (2008) also adopted a framework that integrates the AHP and TOPSIS in order to aid designers in identifying customer needs and desirable design characteristics, as well as to secure an effective assessment of the final design solution. However, the research scope of this paper focuses on using the AHP approach to identify the relative importance of customer needs. To do so, the TOPSIS method was utilized to perform a competitive evaluation.

Cheng and Fan (2009) used a combined AHP and TOPSIS approach to assess the research curriculum that was targeted at students in the Department of Risk

Management and Insurance at Taiwan Universities since 2000. First, the AHP is used to find the relative weights of criteria, and then the TOPSIS model is used to rank how universities perform in using this curriculum. Their research recommended using a decision-making method that would assist human resources managers in bank and insurance companies to improve their curriculum design. In Cheng and Fan's research they used an interview based on a combined AHP and TOPSIS technique in order to identify the most preferable bank assurance alliance structure as seen from the perspective of the executive management. The conclusion of their study confirms that the Financial Holding Company model in bank assurance alliance models is preferable for the executive.

Yi-chuan et al. (2009), utilized the AHP and TOPSIS approaches, taking several provinces in China. The conclusion of Yi-chuan's research in China demonstrates that at the provincial landscape the level of construction present is linked to the province's level of economic development. Further, were are able to provide good assessments in regard to the level of provincial construction in China. It has the ability to assist in the evaluation of urban landscape construction level among different areas. Using the combined AHP and TOPSIS methodology offers many benefits (Percin, 2009).

6.2 The Analytic Hierarchy Process and its Foundation

The AHP was developed by Thomas L. Saaty in 1970. AHP is particularly appropriate for helping to solve complex decisions that involve the comparison of decision elements which are difficult to quantify. It relies on the assumption that when faced with a complex decision the natural human reaction is to cluster the decision elements according to their common characteristics (Saaty, 2012).

6.2.1 The application of AHP in the Contractor Selection Criteria

The AHP approach was employed as a decision maker's method to convention site selection (Chen, 2006). There were eight parameters that were utilised to approach this very goal of the study. These were: meeting and accommodation, facilities, costs, site environment, local support and extra conference opportunities. The study found that environment and meeting and accommodation facilities were the highest rated parameter which could have a deep impact in for selecting a convention site. The findings indicate that the AHP approach is a useful tool to help support a decision in convention site selection. The result also shows the suitability of the AHP model to be applied in the meeting, incentive, convention, and exposition industry for site selection by allowing decision makers to structure their unique problems into priority weights, which can reflect their own priority considerations.

The AHP was employed by Al-Harbi (2001), as a potential decision making method for use in construction management, and problems of contractor pre-qualification is used as an example. A group of decision makers were presented by using AHP method. Al-Harbi concluded that pre-qualification criteria can be a descending-order list and prioritization of contractors can be obtained in order to choose the right contractors to execute the project. Thus, AHP is presented as a decision-making method which allows the consideration of multiple criteria. An example of contractor selection was provided to explain the uses of AHP in project management. Contractor pre-qualification involves priorities and criteria that are defined by client requests and preferences in addition to the characteristics of the individual contractors. AHP allows group decision-making. Finally the method can also be employed on computer.

Multiple-criteria decision support system (MCDSS) was described by Mahdi *et al.,* (2002), for choosing the most suitable bidder. The system can accommodate the unique features of a project also to the qualifications and abilities of those determined contractors. At the beginning, the system assesses the list of bidders by matching their qualifications with definite project criteria. After that a short list of appropriate contractors is therefore selected and MCDSS evaluates the recent abilities of the short listed executers and their plans for the project under consideration, to choose the most appropriate contractor. However, to evoke expertise and make a real assessment of values for all measured criteria which related to contractor selection, the Delphi method was utilised whereby different project-specific conditions were assessed by utilizing the analytic hierarchy process (AHP) to evaluate the specific project conditions: (1) project budget, (2) expected quality, (3) project complexity, (4) political factor, (5) project owner's willingness to share project risks, (6) project time schedule, (7) project unique features, (8) sensitivity of design change, and (9) project owner's involvement in the management process (Mahdi, *et al.,* 2002).

An AHP and risk map approach was employed to develop an integrated framework for managing project risks by analysing risk across project, work package and activity levels, and developing responses (Dey, 2010). The result shows that AHP provides a flexible easily understood way to analyse each risk factor with respect to project achievement and it provides a rational basis for probability of project failure. Also, it is a suitable approach for reaching a consensus in controversial decisions. Despite the existence of diverging interests, the AHP evoked collectively held judgements based on a reasonable compromise or consensus.

AHP has been used to aid decision-making for assessing knowledge management tools, and is implemented through a case study tool to meet the knowledge management objectives or requirements of the organisation. Finally, with the aid of the computer tool, Expert Choice, it is confirmed that AHP could easily be applied to assist with and evaluate knowledge management tools. AHP methodology is definitely helpful for decision-making in a multi-criteria context (Ngai & Chan, 2005).

In the Plebankiewicz (2009) research, the AHP and fuzzy sets theory was employed for contractor selection. It takes into consideration different criteria, objectives and evaluations of numerous decisions makers. However in practice a few construction owners are using only the developed models. This exposes the projects to risk as it is impossibile to introduce sub criteria and evaluate many decision makers. One of the best advantages of using an AHP model and fuzzy sets is the possibility to assess unlimited criteria and to take into consideration evaluation of some decision makers.

A multi-criteria decision model for construction contractor selection was also proposed by Beatham, *et al.*, (2004) in the Turkish public sector (Topcu, 2004). The majority of the selection techniques have used the three main concepts: cost, time, and quality. The AHP approach was employed to construct a model to evaluate criteria related to these concepts and has a process with two main stages: contractor pre-qualification and the selection of the appropriate contractor among prequalified contractors. As a result, the final contractor selection using AHP provides owners the flexibility to add or reduce the elements of a problem hierarchy regarding an individual project. In addition the strengths and weaknesses of all qualified contractors are exposed. Thus, AHP is applicable as a model for contractor selection.

6.2.2 AHP's primary functions

According to Saaty (2008), the following are the primary functions of AHP: structuring complexity, measurement and synthesis, as they assist in understanding why AHP ought to be considered as a universal methodology with a wide variety of applications.

- *Structuring complexity*

To deal with complexity, Saaty (2008) created one general theme about the way humans deal with complexity: by building a hierarchical structure of complexity into homogeneous clusters of factors.

- *Measurement on a ratio scale*

Any methodologies such as AHP have to utilise ratio scale priorities for elements above the lowest level of the hierarchy. This stage is important because the weights of the elements at any level of the hierarchy are settled by multiplying the priorities of the elements in that level by the priorities of the parent element.

- *Synthesis*

Analytic is the first word in AHP, which means separating a material or abstract entity into its constituent elements. In contrast, synthesis involves putting together or combining parts into a whole. Complex decisions or forecasts or resource allocations often involve too many elements for humans to synthesise intuitively, therefore there is a need for a way to synthesise over many dimensions. Although AHPs hierarchical structure does facilitate analysis, an equally important function is its ability to measure and synthesise a multitude of factors in a hierarchy.

6.2.3 The basic principles of AHP

Calculations and mathematics are very important steps in the AHP set up. In addition, its essence is to create a matrix expressing the relative values of a set of attributes. In table (6-1) it is shown as being basic and simple to determine pair-wise comparisons, but a sensible assumption is that if attribute A is more essential than attribute B and is rated at 9, then B has to be certainly less important than A and is valued at 1/9, these pair-wise comparisons are represented for all factors to be measured, which are always not more than 7, and the matrix is completed.

The next step of the AHP is the calculation of the relative weights, value, or importance of the factors, for example cost and operability, which are relevant to the problem in question.

The final step is the calculation of the Consistency Ratio (CR), to evaluate how consistent the judgements are relative to large samples of purely random judgements. If the CR is greater than 0.1, the judgements are unreliable because they are too close for comfort to randomness and the exercise is worthless and has to be repeated. It is simple to make a minimum number of judgements after which the rest can be calculated to enforce, perhaps, an unrealistically perfect consistency (Bertolini, *et al.*, 2006) (Pearson, 2010).

Table 6-1Pair-wise comparison scale for AHP preferences

Numerical rating	***Verbal judgment of preferences***
9	Extremely preferred
8	Very strong to extremely
7	Very strong to preferred
6	Strongly to very strongly
5	Strongly preferred
4	Moderately to strongly
3	Moderately preferred
2	Equally moderately
1	Equally preferred

Table 6-2 Average random consistency (RI)

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random consistency	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.79

6.2.4 Applying the approach of the AHP:

As previously stated, analytical hierarchy process (AHP) was developed for solving complex MCDM problems, which contain multi-qualitative and quantitative criteria. The AHP technique is a useful tool in helping a group of decision-makers to reach a decision. However, AHP is distinguished by three basic principles: create hierarchy; decision maker’s evaluations by pair-wise comparisons; finally consistent judgment.

According to a number of researchers, (Crown, 2007; Percin, 2009) the following essential steps should be taken in the consideration of applying AHP model. The main steps of AHP are as follows:

Step 1: Define the problem and determine the objective or focus.

Step 2: Set up a pair-wise comparison decision matrix *(A*). In this step, structure the hierarchy from the top (the objective from a general viewpoint) through the intermediate levels (attribute and sub-attribute on which subsequent levels depend) to the lowest level (usually the list of alternatives).

Let *C1, C2.... Cn* denote the set of elements, while *aij* represents a quantified judgment on a pair of elements *Ci*, *Cj*. The relative importance of the two elements is rated using the typical scale of measurement to express the preference between the two elements is shown as Table (6.1).

$$\boldsymbol{A} = [\boldsymbol{a}_{\mathbf{ij}}]_{\mathbf{n\times n}} = \begin{array}{c} \\ \boldsymbol{C_1} \\ \boldsymbol{C_2} \\ \vdots \\ \boldsymbol{C_n} \end{array} \begin{array}{c} \begin{array}{cccc} \boldsymbol{C_1} & \boldsymbol{C_2} & \cdots & \boldsymbol{C_n} \end{array} \\ \begin{bmatrix} \boldsymbol{a_{11}} & \boldsymbol{a_{12}} & \cdots & \boldsymbol{a_{1n}} \\ \boldsymbol{a_{21}} & \boldsymbol{a_{22}} & \cdots & \boldsymbol{a_{2n}} \\ \vdots & \vdots & \vdots & \vdots \\ \boldsymbol{a_{n1}} & \boldsymbol{a_{n2}} & \cdots & \boldsymbol{a_{nn}} \end{bmatrix} \end{array} \qquad (6{:}\,1)$$

Then normalize the decision matrix and calculate the priorities of this matrix.

$$\boldsymbol{A} = [\boldsymbol{a}_{\mathbf{ij}}] = \begin{array}{c} \\ \boldsymbol{C_1} \\ \boldsymbol{C_2} \\ \vdots \\ \boldsymbol{Cn} \end{array} \begin{array}{c} \begin{array}{cccc} \boldsymbol{C_1} & \boldsymbol{C_2} & \cdots & \boldsymbol{C_n} \end{array} \\ \begin{bmatrix} \boldsymbol{w1/w1} & \boldsymbol{w1/w2} & \cdots & \boldsymbol{w1/wn} \\ \boldsymbol{w2/w1} & \boldsymbol{w2/w2} & \cdots & \boldsymbol{w2/wn} \\ \vdots & \vdots & \vdots & \vdots \\ \boldsymbol{wn/w1} & \boldsymbol{wn/w2} & \cdots & \boldsymbol{wn/wn} \end{bmatrix} \end{array} \qquad (6{:}2)$$

If matrix *A* is consistent, then we have

$$\boldsymbol{a_{ij} = wi/wj \; = 1/a_{ij} \;\; and \; a_{ij} \; = 1 \;\; with \; ij = 1, 2 \, \ldots., n}$$

Step 3: After the matrix has been developed, the next step is to calculate a vector of priorities or weighting of elements in the matrix. In terms of matrix algebra, the decision matrix has to be normalised and the priorities of this matrix calculated. First, all calculations of vectors of priorities in the comparison matrix have to be normalised. In this step, each column has to be summed separately. Then each value is divided by its own column total value. Finally the typical average rows are determined and the relative weights are obtained.

Step 4: Once the priority vectors have been determined, it is then necessary to calculate the consistency ratio of the estimated vector. As decision makers are often inconsistent in their judgements, the AHP technique incorporates managerial inconsistencies into the model and provides the decision maker with a measure of these inconsistencies. The consistency ratio is derived from the ratio of the consistency of the results being tested to the consistency of the same problem evaluated with random numbers. The empirical upper limit suggested by Saaty (2012), is 10 per cent. If the consistency ratio is less than 10 per cent, then the consistency of pair wise comparison is acceptable. The consistency ratio is determined by the following steps:

***Step 4-1*:** Do consistency checks. The relative weights, which would also present the eigenvalues of criteria, should verify:

$$A * wi = \lambda_{max} * w_i, \quad i = 1, 2 \dots n \qquad (6:3)$$

Where $\boldsymbol{A}$ is the pair-wise comparison decision matrix, and $\boldsymbol{\lambda_{max}}$ is provides the maximum eigenvalue.

Step 4-2: Calculate the consistency index (*CI*), which measures the inconsistencies of pairwise comparisons this is determined as follows:

$$CI = \frac{(\lambda_{max} - n)}{(n - 1)} \qquad (6:4)$$

Where (*n*) is the matrix size.

Finally the judgment consistency is determined by taking the consistency ratio *(CR)* of CI with the suitable value in Table 2. Generally the judgments are consistent and acceptable, if *(CR)* is less than 0.10. If it is more, in this case the judgment matrix is inconsistent and judgments should be reviewed and bettered.

$$CR = \frac{CI}{RI} \tag{6:5}$$

6.2.5 Determination of weights in AHP models

In recent years, various different software packages have been used and efficiently developed for applying multi-criteria decision making methods. However, the most important software packages that have been invented to operate the Analytic Hierarchy Process (AHP) are as follows:

- Criterion Decision Plus
- Expert Choice
- Web-HIPRE
- Logical Decisions
- CGI tool

In this section, an overview about implementation, advantages and disadvantages of obtainable software for applying the Analytic Hierarchy Process (AHP) is specified.

6.2.5.1 Criterion Decision Plus tool

Criterion Decision Plus (CDP) decision management model, was created in 1993 as a new tool for contracture and solving complex decisions between alternatives. It is a graphical Windows Desktop application that embodies two multi-criteria decisions – the Analytic Hierarchy Process (AHP) and Simple Multi-Attribute Rating Technique (SMART) analysis and uncertainty handling. Further, both qualitative and quantitative data can be used into the CDP (Carr, 2011).

The selection of the preferred alternative using a structured decision process begins with the creation of the decision hierarchy. The hierarchy is the clear organisation of the goal, listing the categories of criteria, listing the criteria, and generation of the sub criteria finally, and alternatives under consideration. In the CDP, all used data can be saved including both a clear rationale and record of each decision. This benefit allows for revisiting past decisions when needed or present recommendations with confidence, knowing that the tools are available for justification. It also assists with visually organising any decisions in order to avoid costly mistakes (InfoHarvest, 2014).

6.2.5.2 *Logical Decisions*

Logical Decision is multi-attribute decision tool that uses the Analytical Hierarchy Process (AHP) technique. It assists decision-makers in assessing and choosing the best selection from a set of alternatives. Logical Decisions for Windows (LDW) allows the user to assess selections by providing multiple choices at once, separating facts from value judgments and illuminating the options available to others. LDW utilises systems from the field of decision analysis to aid excellent and more logical decisions. Moreover, Logical Decisions give modern solutions for hard selections. Logical Decisions assist evaluate decisions needing many evaluation criteria and critical preference and value judgments. LDW's many advantages and graphic displays make it one of the strongest and most flexible software in its class. This tool can be used in both individual and group technique. This model has been utilised for wide multiplicity of decisions by various professional academics, military personnel, planners, managers, civil servants, engineers and other decision makers (Cart, 2011).

6.2.5.3 *Web-HIPRE*

It is the decision analytical method that implements the Analytical Hierarchy Process (AHP). The Web utilises the previous HIPRE 3+ software, providing group decision support services through the Web. Web-HIPRE, the decision analytical software, was presented in 1998 and since that time, the model has been utilised in different real applications and decision investigative courses. Web-HIPRE is widely used and it is designed to support participatory environmental decision making. Further, Web-HIPRE is considered as one of the most general software packages available and can be easily utilised for on-line use on the Web. The Web-HIPRE gives a way to structure a complex problem visually and analytically. If there are numerous alternatives with some varying types of effects, in this case it will not be easy to choose an alternative typically in accord with the decision maker’s judgments and principles which is one of the big disadvantages of this software (Mustajoki and Hämäläinen, 2006). The Web-HIPRE organises an issue problem into goal and criteria and sub-criteria then alternatives that assist the decision makers to glean more knowledge with regards to improved planning conditions. Also by using the Web-HIPRE new alternatives can be easily generated or the group of possible alternatives extended (Watersketch, 2007).

6.2.5.4 *Expert Choice 2000*

Expert choice was developed in 1980 by Dr. Ernest Forman, D.Sc. Professor of Management Science at George Washington University's School of Business and Public Management. Since then, Expert Choice software has been helping the decision-making process of businesses and government organisations by adapting AHP for the selection of the best alternative solutions around the world. Also Expert Choice has been credited with leading through a variety of critical decisions. For example, in the 1980’s, it left a perfect imprint on the commercial market by guiding leading companies such as Rockwell International and Xerox through complex strategic planning initiatives (Forman, 2007).

Expert Choice software constructs a decision into smaller divisions, starting from the goal to criteria to sub-criteria and finally to the alternative courses of action. Decision makers then make simple pairwise comparison judgments throughout the hierarchy to identify overall priorities for the alternatives. The advantages of Expert Choice software are that it is a flexible and powerful decision making tool and that it assists the user to set priorities and make the best decision when quantitative and qualitative criteria of a decision require to be considered. Additionally, it gives a structured method and proven procedure for prioritisation and decision-making. Also, Expert Choice not only assists decision-makers with reaching the best decision, but also gives a clear visualisation of rationale for that decision. Furthermore, Expert Choice software can be involved in many types of problems such as social, management, political, economic and technical factors and finally, it is also intuitively graphically based and designed for easy use in order to be meaningful for conceptual and analytical thinkers (Choice, 2009).

6.2.5.5 *AHP (Analytic Hierarchy Process) calculation software by CGI*

The CGI allows group decision making, where group members can utilise their experience, values and knowledge to break down a problem into a matrix and solve it by the AHP steps. The CGI tool is considered a very powerful method to turn assessment generated results into positive successful business projects. It is applied for decision-making with dependence and feedback. It utilises the same basic prioritisation method based on obtaining priorities through judgments from direct measurements or on pairs of elements (Takahagi, 2005). When CGI is applied in a group session, the decision makers can expose a matrix that has been prepared in advance. Further, they can change and modify their answers in line with their understanding of the problem. A group with widely varying perspectives can feel comfortable with a complex issue, when the issue is broken down into different levels. Each decision maker can present his own concerns and definitions. Then, the group can cooperate in identifying the overall structure of the issue. In this way, agreement can be reached on the higher-order and lower-order objectives of the problem by including all the concerns that members have expressed. The group would then provide the judgments whilst the calculations are computer generated. The programme is divided into main steps (inputs and outputs). To create the CGI programme, some importance steps needs to be taken as follows:

- ***Size of Pairwise Comparison Matrix***

The main purpose of utilizing verbal judgments is to compare criteria using the words *Equal, Moderate, Strong, Very Strong, and Extremely Preferred*. Each word is equal to a specific number, for example the number 1.0 indicated they are equal, number 3.0 indicated moderately, number 7.0 indicated very strong to preferred or seven times much important and 9.0 incubates nine times as much. Fundamental Scale for judgments is shown in the figure (6.1). This step illustrates how to construct the simplest decision model, make judgments (paired comparisons), and calculate the results to determine the best alternative.

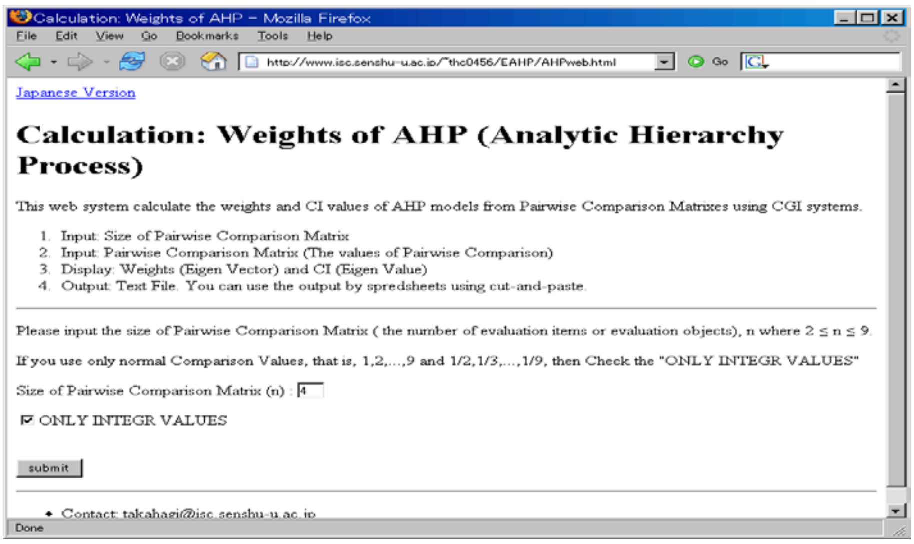

Figure 6-1 Size of Pairwise Comparison Matrix

Sources: adopted from. AHP (Analytic Hierarchy Process) Calculation software by CGI (Takahagi, 2005)

- ***Input: Pairwise Comparison Matrix***

This step defines the size of the pair-wise comparison matrix and of evaluation items or alternatives, where $2 \leq n \leq 9$. In case the number is bigger than 9, it suggests inconsistency in checking. This indicates that the gathered criteria are considered disparate, but in this case it may be necessary to re-organise the criteria so that kind of comparison is not necessary. Whilst this would cause minimal damage to the results, to avoid problems the number should not go much beyond 12 or 13.

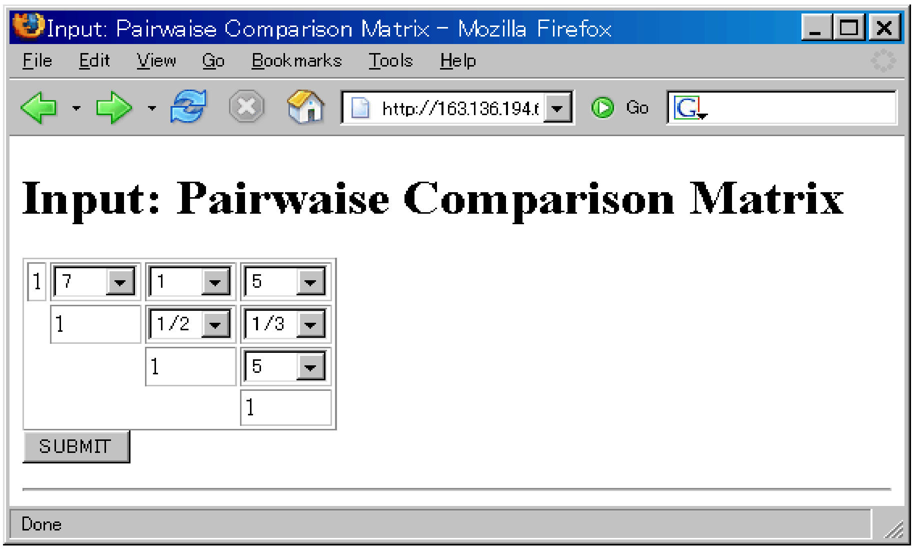

Figure 6-2 Input: Pairwise Comparison Matrix

Sources: adopted from. AHP (Analytic Hierarchy Process) Calculation software by CGI (Takahagi, 2005)

- ***Input: Pairwise Comparison Matrix***

The following step of **CGI** will illustrate the pairwise comparisons for criteria. Numerical judgments in this mode on a matrix utilise a stander scale, usually containing a nine point scale that illustrates how often one criterion is more important than another. To see the equivalent matrix comparison on the screen click on the matrix bottom as it shows in the figure (6-3).

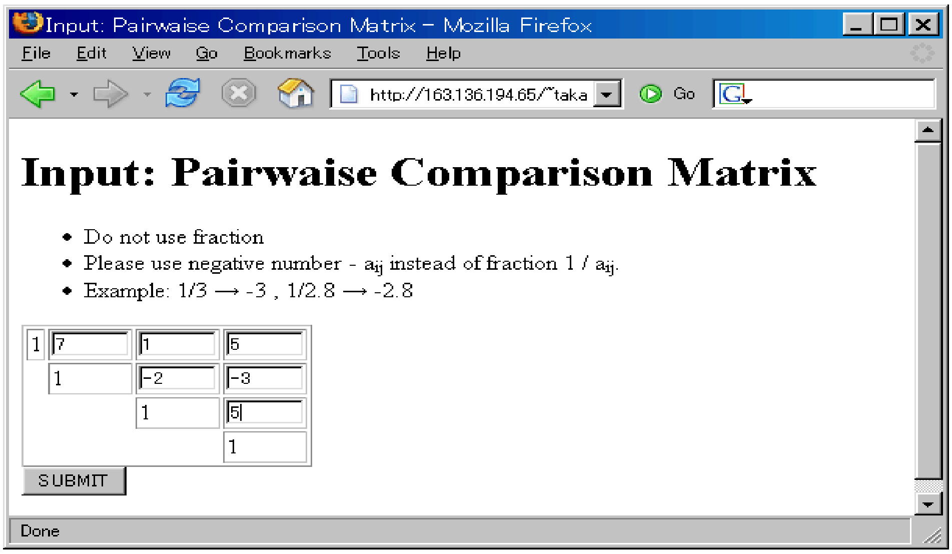

Figure 6-3 Input: Pairwise Comparison Matrix

Sources: adopted from. AHP (Analytic Hierarchy Process) Calculation software by CGI (Takahagi, 2005)

- ***Output of CGI***

The final step is whereby the criteria have to be weighted according to their value. The decision score for each alternative is an aggregate of all the weights entered in the tool. The calculations of the system's results take places automatically once the decision score is chosen. The decision score is viewed from the results windows by choosing the SUBMIT button result from the main menu. The results of the decision model are presented in the decision scores window as it showing in figure (6-4). The result is included in the screen window:

- C.I. (Consistency Index): If the value is greater than 0.1 or 0.15, we recommend you to retry the Pairwise Comparison.
- Weight (Eigen Vector): Weights of Evaluation Items or Individual Scores of Alternatives
- Pairwise Comparison Matrix

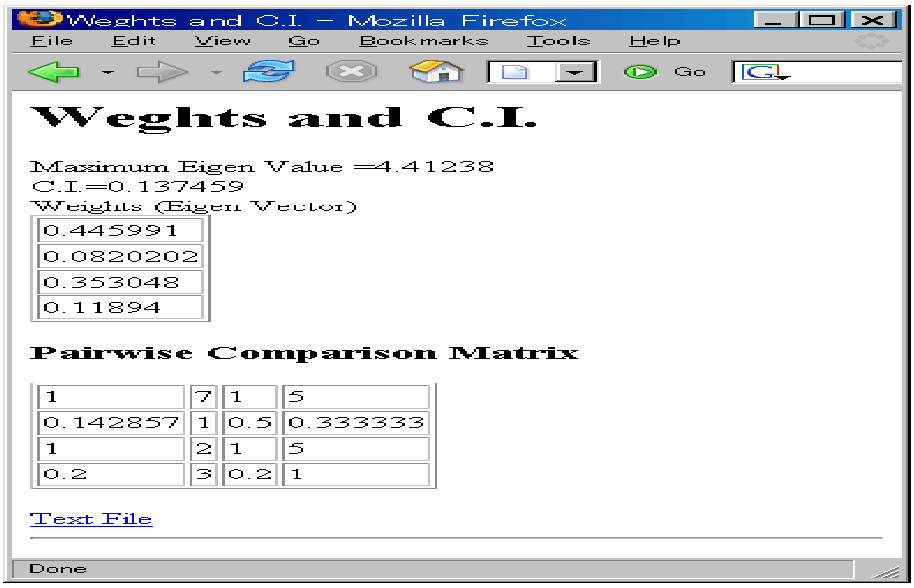

Figure 6-4 Showing the final results of Consistency Index, Weight Eigen Vector and Pairwise Comparison Matrix

Sources: adopted from, AHP (Analytic Hierarchy Process) Calculation software by CGI (Takahagi, 2005)

6.2.6 Comparison between the software implementing AHP

Abu-Shaaban (2008) made a simple comparison between some of the most important decision analysis software programs. This comparison was aimed at recommending or adopting the best programs that can be utilised for decision making processes. The examination included lots of different software such as Criterium Decision Plus, Logical Decisions, Web- HIPRE Expert Choice 2000 and CGI. However the table of comparison was improved and developed by researchers by adding a new multi criteria decision making tool which is CGI. Table (6-3) shows a summary of the technical scoring of the decision software.

Table 6-3Comparison between the Software Implementing the AHP

	Criterion Decision Plus	Logical Decision	Web-HIPER	Expert Choice 2000	CGI
Functions	Structuring and solve complex decisions	Logical Decisions provides innovative solutions for hard choices	problem structuring, and multi criteria evaluation and prioritization	Expert Choice software provides structured method and confirmed process for prioritization and decision-making	problem structuring, and multi criteri evaluation and prioritization
Decision analysis methodologies	SMART, AHP and Direct Trade-offs	AHP	Web-HIPRE s AHP,SMART,SWING , SMARTER	AHP	AHP
Utilizes	Single user	Single-user	Multi-user	Single/multi-user	Multi-user
Web technology	No	No	Java-applet	Yes	Yes
To run System	Windows 95/98/2000/ NT 4.0 SP3 or higher	Windows 95/98/2000/XP	Web-based	Windows 95/98/2000/XP	Web-based
Availability	The Student License for CDP provides you a fully functional version of CDP but one that can only load small models. The price of the academic License for Criterium Decision Plus is $ 895.00 Shipping & Handling	The student version of Logical Decisions is available for use in approved courses at colleges and universities. The student version is a complete working copy of LDW The price of the for the License is $789.00	Internet	The License cost is £ 950(ex-vat) for an Expert Choice version that takes input up to 25 decision participants in each model.	Internet
Web Sites	www.infoharvest.com	www.logicaldecisions .com	http://www.hipre.hut.fi/	http://www.isc.senshu	http://www.isc.senshu-u.ac.jp/~thc0456/EAHP/AHPweb.html

Sources: adopted from, PhD thesis, Development of multi-criteria decision analysis models for bidding and contractor selection **Abu-Shaaban, (2000)** There is not one best or worst software package as all the tested software was designed for complex decision making process as well as to carry out the computation adopting the AHP. As it shows in table 6.4, adopting the best software is dependent on many factors such as availability, operating systems, user capabilities and ease of use etc. For this research, CGI software version is adopted to implement the AHP analysis. However, the reason behind this choice of model is because it has many advantages such as:

- Easy to build
- Easy to understand
- Free of charge

6.3 TOPSIS method

Both Tsai *et al.,* (2008) and Wu and Yang (2008), have described the TOPSIS method as a sort of statistical analytical method where the TOPSIS model can determine the order preference of assessment objects by the Ideal Solution and the Negative Ideal Solution. Basically, the Ideal Solution is the set of alternative evaluation objects optimal for each attribute (profitable attributes the maximum, cost attributes the minimum). On the contrary, the Negative Ideal Solution, is the set of alternative evaluation objects worst for each attribute (profitable attributes the minimum, cost attributes the maximum). The selected evaluation object is simultaneously the closest to the Ideal Solution and the farthest from the Negative Ideal Solution.

Choosing a project is an important task. It is often not an easy task because usually there is more than one dimension for evaluating the impact of each project, especially when there is more than one decision maker. However Mojahed and Dodangeh (2009) confirmed a real application of project selection for telecommunication projects by using the judgment of experts via one of the group's decision making models, namely the TOPSIS method.

Liaudanskiene, *et al.,* (2009), utilised the TOPSIS method to discuss and solve the safety employee problems, which often occurred in the construction site. The research demonstrated that the most prevailing accidents are: collisions with vehicles, high falls, stumbling and falling. The consequences are often lethal or severe. The study emphasised that safety in a construction site cannot be attained only by collective and individual means, assessment of professional risk, worker briefing on safety measures, but also via efficient work organisation and working environment. The conclusion of this research was to highly recommend the use of the TOPSIS approach as it allows companies to better assess in terms of time and expenditure, as well as making possible the best organisation of safe construction activities on the project site.

6.3.1 Principle of TOPSIS Method

TOPSIS is a multiple criteria tool to clarify a solution from a finite set of alternatives. The basic principle of the TOPSIS method is that the chosen alternative has the shortest distance from the Positive Ideal Solution (PIS) and the farthest distance from the Negative Ideal Solution (NIS). In the procedure system of the TOPSIS method, the criteria weights and ratings of the attributes have to be given. However, usually the highest ranked alternative by the TOPSIS tool is considered the best, and the lowest ranked alternative by the TOPSIS tool is considered the worst (Opricovic and Tzeng, 2004; Jahanshahloo, *et al.*, 2006; Li, 2007). The process of TOPSIS could be expressed in a series of steps;

Step 1. Normalize the decision matrix. The normalized value $\boldsymbol{rij}$ is determined as:

$$\boldsymbol{rij} = \frac{\boldsymbol{f_{ij}}}{\sqrt{\sum_{j=1}^{J} \boldsymbol{f_{ij}^2}}} \quad \boldsymbol{j = 1, 2, 3 \ldots\ldots\ldots\ldots\ldots, J}; \ \ \boldsymbol{i = 1, 2, 3, \ldots\ldots\ldots\ldots\ldots, n}. \qquad (\mathbf{6{:}6})$$

Step 2. Determine the weight of the decision matrix. The weighted normalized value $\boldsymbol{vij}$ is calculated as:

$$\boldsymbol{vij = wi * rij} \qquad \boldsymbol{j = 1, 2, 3 \ldots\ldots\ldots, J}; \ \ \boldsymbol{i = 1, 2, 3, \ldots\ldots, n} \qquad (\mathbf{6{:}7})$$

Where $\boldsymbol{wi}$ is the weight of the $\boldsymbol{i}\mathbf{th}$ attribute or criterion, and $\sum_{i=1}^{n} \boldsymbol{w_i} = \mathbf{1}$

Step 3. Calculate the ideal solution and negative ideal solution. The ideal solution and the negative ideal solution are calculated via the following equations:

$$\mathbf{A}^{*} = \{\boldsymbol{v}_{\mathbf{1}}^{*}, \dots, \boldsymbol{v}_{\boldsymbol{n}}^{*}\} = \left\{\left(\max_{j} \boldsymbol{v}_{\boldsymbol{ij}} \mid \boldsymbol{i}\boldsymbol{\epsilon}\boldsymbol{I}'\right), \left(\min_{j} \boldsymbol{v}_{\boldsymbol{ij}} \mid \boldsymbol{i}\boldsymbol{\epsilon}\mathbf{I}''\right)\right\} \qquad (\mathbf{6}:\mathbf{8})$$

$$\mathbf{A}^{-} = \{\boldsymbol{v}_{\mathbf{1}}^{*}, \dots, \boldsymbol{v}_{\boldsymbol{n}}^{*}\} = \left\{\left(\max_{j} \boldsymbol{v}_{\boldsymbol{ij}} \mid \boldsymbol{i}\boldsymbol{\epsilon}\boldsymbol{I}'\right), \left(\min_{j} \boldsymbol{v}_{\boldsymbol{ij}} \mid \boldsymbol{i}\boldsymbol{\epsilon}\boldsymbol{I}''\right)\right\} \qquad (\mathbf{6}:\mathbf{9})$$

Where ***I'*** is associated with benefit criteria, and ***I''*** is associated with cost criteria.

Step 4. Calculate the distance between idea solution and negative ideal solution for each alternative.

$$\boldsymbol{D}_{\boldsymbol{j}}^{*} = \sqrt{\sum_{\mathbf{i=1}}^{\mathbf{n}} \left(\mathbf{v_{ij}} - \mathbf{v_{i}^{*}}\right)} \quad \boldsymbol{j} = \mathbf{1}, \mathbf{2}, \mathbf{3} \dots \boldsymbol{J} \qquad (\mathbf{6}:\mathbf{10})$$

The negative ideal solution is given as:

$$\boldsymbol{D}_{\boldsymbol{j}}^{-} = \sqrt{\sum_{\mathbf{i=1}}^{\mathbf{n}} \left(\mathbf{v_{ij}} - \mathbf{v_{i}^{*}}\right)} \quad \boldsymbol{j} = \mathbf{1}, \mathbf{2}, \mathbf{3} \dots \boldsymbol{J} \qquad (\mathbf{6}:\mathbf{11})$$

Step 5. Calculate the relative closeness to the ideal solution and rank the preference order.

The relative closeness of the alternative a_j with respect to $A*$ is defined as:

$$\boldsymbol{C}_{\boldsymbol{j}}^{*} = \frac{\boldsymbol{D}_{\boldsymbol{j}}^{-}}{\left(\boldsymbol{D}_{\boldsymbol{j}}^{*} + \boldsymbol{D}_{\boldsymbol{j}}^{-}\right)} \quad \boldsymbol{j} = \mathbf{1}, \mathbf{2}, \mathbf{3} \dots \boldsymbol{J} \qquad (\mathbf{6}:\mathbf{12})$$

Where, $\mathbf{0} \leq \boldsymbol{C}_{\boldsymbol{j}}^{*} \leq \mathbf{1}$

6.3.2 The basic concept of TOPSIS model

The basic concept of TOPSIS tool is that the chosen design options have the shortest distance from the ideal solution and the farthest from the negative-ideal solution (in a geometric sense). Further, TOPSIS assumes that each Design Option wants to either be maximized or minimized, so the positive-ideal solution for a Criterion that wants to be maximized is the maximum value of all the design options considered and the negative-ideal solution is the minimum values of all the design options considered.

Requirements

1. Microsoft Windows XP, Vista, or 7
2. Microsoft Excel XP (2002), 2003, 2007, or 2010 (32 or 64 bit)
3. Administrator rights required to install software

TOPSIS approach*:*

1. Create matrix with design options and criteria
2. Assign importance to criteria
3. Enter design option data for each criteria
4. Assign goal direction (minimize or maximize)
5. Compute and evaluate scores

How does the TOPSIS works

The main idea of this approach is to choose the design alternative which is the shortest distance from the ideal solution and the largest distance from the negative ideal solution (in a geometric sense). However, the Euclidean distance technique is utilised to assess the relative closeness of all design alternatives to the Ideal solution. To see how the TOPSIS method works, some simple steps need to be made as follows:

The first step is to create the matrix and determine the criteria then determine the importance for each criterion. After that, decision data for all the criteria needs to be entered. Next, the goal direction (Minimise or Maximise) is defined. Finally scores are evaluated and computed.

The single most interesting aspect of TOPSIS is that the decision alternative sometimes needs to be maximised or minimised, where the maximum value of the design option is presented by the positive-ideal solution and the minimum values of the design options are presented by the negative-ideal solution.

TOPSIS Selection Matrix

Title: Cooling System Selection
Project: MRI Gradient Driver
Name: Garron Morris
Date: 03/11/2011

	Criteria	Options 1: Aluminum Heat Sink	2: Copper Heat Sink	3: Cold Plate	4: Heat Pipe	Goal	- Ideal	+ Ideal
1	Reliability	50	50	5	20	maximize	5	50
2	Cost	70	300	200	200	minimize	300	70
3	Engineering Difficulty	2	2	10	4	minimize	10	2
4	Relative Performance (1-10 Best)	2	4	10	7	maximize	2	10
5	Estimated Design Time	2	2	6	5	minimize	6	2
		0.66	0.60	0.37	0.52			

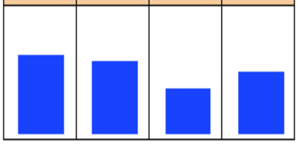

Figure 6-5 showing TOPSIS Matrix Worksheet

6.4 Summary

This chapter shed light on the most crucial research methods used in this study. The chapter is divided into two main sections. The chapter also presented the proposed tools: AHP and TOPSIS. The advantages, disadvantages and limitations of each method have also been presented in this chapter. The next chapter identifies, evaluates and validates the suggested contractor selection criteria for construction projects in Libya.

CHAPTER SEVEN: ANALYSIS OF FINDINGS

7.1 Introduction

In the process of choosing particular variable criteria, the required main criteria and sub-criteria must be clearly predefined in order to permit the decision-makers to choose the right solution. This specific multi-criterion selection problem has to do with the ability to choose the best and most appropriate contractor for the job: one who has the ability to drive the project forward so that it reaches its aims. An integrated approach to multi-criterion contractor selection has been developed through this study. To develop this approach took two preliminary steps:

- The first step was to investigate the existing contractor selection processes that are currently used in both developed and developing countries, and then to identify the attributes within the different systems that are most useful for evaluating contractors.
- The second step was to carry out a questionnaire survey aimed at identifying and evaluating the current state of contractor selection processes in the LCI.

7.2 The Operation of the Survey

Once the administrative procedures were completed and the representative sample was determined, the survey process was commenced in the following manner:

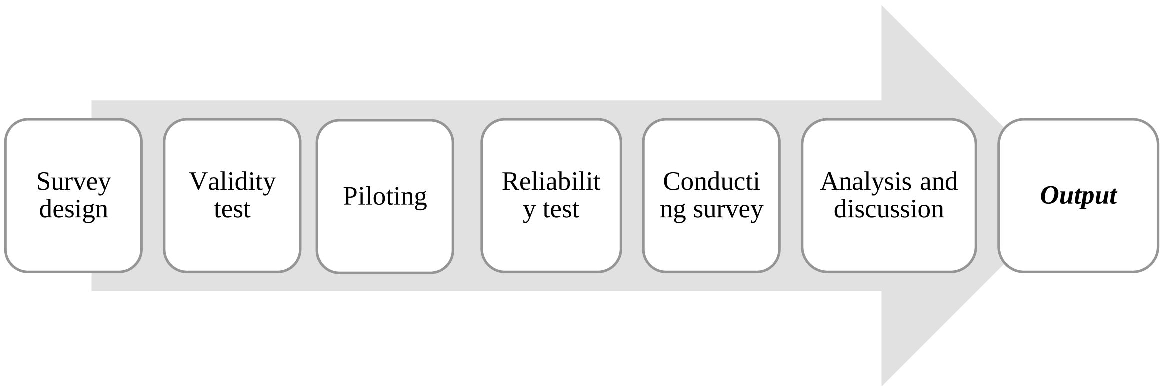

Figure 7-1 showing the questionnaire construction

7.2.1 Determination of the sample size

In order to develop and build a framework for contractor selection process, the study required a large amount of data on completed projects. Owing to the unstable situation in Libya and non-possibility of interviews, therefore a questionnaire survey approach was considered as the most efficient tool. However, the main aim of sampling is to enable the investigator to collect data that reflect the population. Sampling is an important issue and ought to be measured before distributing the study survey to reach an effectual collection of data (Alsulamy, 2014). Since this study is considered to be the first study to investigate and build a framework for contractor selection procedure in the LCI, a comprehensive investigation has taken place in the LCI. This investigation included the current practice for CSL in the LCI, measurement methods for contractor selection. Also, the participants were asked if they adopted any system for contractor pre-qualification. Moreover, investigation also included the influence of political and social environment in the selection process, such as, procurement method, the socio-economic (tribe) and ethnic groups. In addition, the participants were also asked about the pre-qualification systems. The questionnaire focused on the contractors, clients, consultants, sub-contractor relationship.

Public construction in LCI is mainly overseen by three main public organizations namely: Ministries: includes, Ministry of Education, Ministry of Health, Ministry of Housing Utilities, and Ministry of Transportation. Public companies includes: The General Construction Company, the General Company for Electricity, the Electrical services company, the General Postal Company, the Gesco for general service and training. The final group is General Authority: includes, Development Authority and the development of management positions, the Libyan Social Security Administration, Savings Bank and Real Estate Investment of Libya. There are many other public projects implemented by other different Ministries, but the number of their projects is comparatively small compared with the number of the projects that implemented by Ministries and organization that mentioned above. They mostly deal with a large number of local and international contractors to achieve their works. Those organizations chiefly appoint project managers and consultants to monitor and supervise the project and contractors progress. The information about these participants was obtained from databases provided by their workplaces such as municipalities. Selection in this group depended on the experience, skills, ability and the likelihood to participate in the research.

Since this study proposes building a framework for CSP, respondents on this study consisted of top construction management group, including client, project manager, consultant, contractor and engineering companies known to have experience in delivering large scale projects or in the provision of management services. The selection of contractor to be a participant for the study was based on their knowledge and experience. Contractors were included because none of the other participants could accurately obtain information about the cooperation and relationship between contractor, project teams (clients, subcontractors, suppliers and consultants). Also, the contractor can assess the influence socio-economic (tribe) has in the contractor selection process. It is then obvious that the data collected for analysis are reliable enough to form a good basis for this research work as can be seen from the qualities of the respondents in terms of their vast experience in the contractor selection process. The main reason for the selection of respondents was to have a large number of responses from people with different responsibilities in projects, and with different job status.

Ali, (2011) reported that the official number of construction professionals in the public and private sectors of the LCI are 4000 professionals cutting across construction firms, academic institutions, clients, contractors, and project managers and others.

Determination of sample-size is a significant and difficult step in planning statistical research. However, for statistical research that includes surveys, experiments and observational researchers is most important for these methods to be properly planned. Further, the size of the sample must be selected from the appropriate population and participants must be carefully identified. The processes have to be followed carefully. The study must be of sufficient size relative to the aims of the research (Lenth, 2001). To determine a suitable sample size, the following formulas from Baartt et al. (2001) and Cochran (1977) were used to calculate the necessary sample. The following formula was used to calculate the sample size which represented the population: -

$$n_o = \frac{(t)^2 * (p)(q)}{d^2}$$

Where:

t = value for selected alpha level in each tail = 1.96

(p)(q) = estimate of variance = 0.25

d = acceptable margin of error for proportion being estimated = .05

Therefore,

$$n_o = \frac{(1.96)^2 * (0.5)(0.5)}{(0..5)^2} = 384$$

The following correction formula will be used to determine the final sample size. These calculations will utilize the follow equation:

$$n_1 = \frac{n_o}{(1 + n_o/Population)}$$

Where:

n_o = required return sample according to Cochran's formula

$n_1 = n_1$ = required return sample size

$$n_1 = \frac{384}{(1 + 384/4000)} = 351$$

Therefore, a representative sample size of the questionnaire should not be less than 351. Thus, to increase the chance of finding a significant difference among the variable larger samples of 400 were sent out. The reason larger samples increase the chance of significance is because they more reliably reflect the population mean. To account for a percentage of non-return questionnaires, a total of 400 questionnaires were distributed. Only 112 were returned. This number represents a 28% total return rate, which is acceptable. According to Krejcie and Morgan (1970), a return rate between 20-30% is considered standard. The questionnaires were sent to professional groups comprised of consultants, academic lecturers, construction managers, clients, contractors, project managers, contracting organisations, universities, and other people working in the private and public construction sector.

The questionnaires were divided into three main parts. The first part of the survey included some items for collecting background information of the respondents and their projects, such as the respondent's position, experience in the construction industry, and types of firm organisation. In the second part of the survey the respondent was asked about the current practice of the CSP in the LCI. The third part of the survey required participants to rate the main criteria and sub-criteria of CSP. Blank space was provided for the participant if they had their own suggested criteria that had not been mentioned in the survey.

7.2.2 Administering the Questionnaire Survey

Before the distribution of the questionnaires, in-depth contact and communication with the selected companies, ministers, contractors, clients took place mainly by telephone and fax. In order to arrange appointment times with interviewees, personal face to face contact was also made. It was aimed to distribute 400 questionnaires to a representative sample consisting of senior managers of construction firms, or the directors of consultants firms and clients of construction projects.

The questionnaires were distributed, where the direct face to face method was utilised to administer the questionnaires. Before the respondents began to fill in the questionnaire, an explanation was given by the assistants regarding the survey to clarify any ambiguity that the respondents may have. Most of the time during the administration of the questionnaire survey, the researcher was present to explain and simplify any questions that were unclear to the respondents. Some questions had to be paraphrased into the informal idiomatic form of Arabic.

Many respondents took the questionnaire from the assistants and asked to fill it in their own time. This was due to the fact that the respondents had to go through and check files of paperwork in order to extract information and provide answers regarding numbers of projects, workers and contracts, turnover etc. Therefore, in these cases, the questionnaire was left with the respondents to be answered and collected later at an arranged time and date. Thus as a result, it would be correct to say that the responses to the questionnaire survey came from documented sources, giving credibility to the gathered data. Additionally, all comments and remarks concerning the investigation were recorded in the survey notebook during the process of distributing and administering the questionnaires.

The next step was to move on to contact the next firm in the sampling framework. It was also observed that a number of questions were being overlooked or disregarded by respondents especially those that were related to the annual income and expenditure of the firms. This led to a high number of questionnaires being discarded. Comments regarding the respondent’s attitudes in relation to the survey were documented in the survey notebooks. The comments included points about the characteristic and distinguishing language and speech of respondents along with the respondent’s body language, the impression of the personal appearance of the researcher on the respondents and the method of interaction the researcher used with the respondents as well as the influence of social and cultural factors on the survey's progress and findings, and many other points.

The questionnaires were checked at the end of each working day by the researcher and his assistants to ensure that questionnaires had been completed successfully in order to achieve the objectives of the survey. In some instances the researcher and his assistants had to contact the respondents with the intention of encouraging them to answer the questions which were simply ignored or omitted and to ask for explanations for unclear answers. Additionally, a high number of incomplete questionnaires were discarded due to incomprehensible responses and missing data. Every question was given a code and numbered; the responses were converted and interpreted into numerical data, which was then input into the computer database on a daily basis all the way through the survey period. This procedure was constructive and effective in enhancing the reliability of the data, in addition to saving time and uncertainty or misunderstanding.

The initial step in administering the survey questionnaire was to distribute the questionnaire amongst construction companies and firms for the simple reason that a considerable proportion of the representative sample consisted of them. It was thought that starting the survey with this representative sample group would in fact present the opportunity to pay a visit to construction firms in order to assemble information regarding client’s requirements and consultancy firms the construction companies work with, and especially their addresses.

The questionnaires were mostly administrated during the working hours of between 7.30 am and 2.30 pm, and in some instances working during the evening was necessary. This took place over a period of six weeks during which time the survey was suspended for five days because of technical difficulties (locating the changes of addresses of some of the representative sample). The assistance and cooperation of local government officials, government departments, and acquaintances all helped to overcome this hurdle. It is important to mention that some respondents declined to take part in the questionnaire survey and many of the respondents lacked seriousness in their answers.

After spending substantial time and effort conducting the construction questionnaire survey with construction firms, the next step was to administer the consultancy firm's questionnaire. Here the questionnaires were mainly administered during the evening between the hours of 4.00 pm and 7.00 pm. The reason for this was due to the fact that the majority of the directors and managers of consultancy firms worked as government employees during the day and worked in consultancy firms and engineering offices as part time employees in the evenings. Due to the higher level of education of these respondents, an adequate amount of questionnaires were completed with the minimal amount of inconvenience. Moreover, some informal interviews were conducted with staff members who took an interest in the subject of the study.

The last phase of the survey consisted of distributing and administering the questionnaire for the ministries clients of construction projects. The main difficulty faced during this phase of the survey was gaining access to respondents. One questionnaire was administered to a client of a construction project, who was then asked to recommend another client from the list of the clients of construction projects in Libya. Thus this sequence was repeated many times to increase the number of respondents for this questionnaire and slow progress was made for this phase of the questionnaire survey, overcoming the difficulties in gaining access to respondents who were or had been clients of a construction project especially public sector clients. Many clients of construction projects, who were approached by the research team declined to participate in the questionnaire survey, due to the fact that they did not want to put themselves at risk by answering the questionnaire. In total one hundred and twelve questionnaires were completed by the end of the survey.

7.2.3 Survey tool

A questionnaire survey was designed as demonstrated in Appendix (II). The questionnaire was presented to a group of decision-makers within the construction industry including contractors, civil engineers architects, consultants, clients, and project managers. The questionnaire was utilised to allow the participants to add new criteria and give their opinions of the initially suggested criteria. The questionnaire consisted of three main parts, however, some personal and undesirable information was neglected to encourage respondents to feel free answering the questionnaire, specifically, respondent wages, time of work and the treatment.

In the first part of the questionnaire, the respondent was asked some general information such as: name, organisation business name, contact number, telephone number, and the length of time that the respondent had been in his/her job.

In the second part of the questionnaire the researcher sought to clearly identify and evaluate the current state of the contractor selection processes in the LCI. In this part, the respondent was asked many important questions such as: the types of criteria he would find useful, the kind of process he currently uses for contractor selection, what style he uses in the collection of pre-qualification information, what sort of information he collects, and what methods he uses for the evaluation and the classification of the prospective contractor.

In the third part, the respondent was asked to choose the most important criteria and sub-criteria from a list. It was the information provided by the respondent in the third part that forms the essential core of this research.

For each question, an explanatory sheet was given that was designed to provide the respondent with extra detail so that they would better understand the goal of the study. Moreover, brief descriptions of the meaning of criteria were included in the questionnaire in order to explain the purpose and combined meaning of each criterion.

7.2.4 The location of the questionnaire survey

It was planned to conduct the survey during the spring season, as at this time of year the weather is much more suited for outdoor fieldwork. This survey was carried out in both the private and public sectors of the LCI in Tripoli. It started in September 2011 and ended in February 2012.

As discussed in Chapter 2, Tripoli city is the capital of Libya and is located in the middle of the Tripoli region, playing a key role in government administration, politics and economics with the majority of prominent ministries, embassies, and establishments, main offices of public companies, factories and institutions located there. Consequently, the vast majority of construction works will be concentrated in urban areas (Grifa, 2006).

7.2.5 Gender and Age of Respondents

As expected, most participants in this research study were men, with women represented by low levels of participation. Just four women were involved in the study, all architects. This implies that the LCI is mainly run by men. Ali (2005) reported that in 1980, the total percentage of women in the LCI was just 0.6%. The percentage has gradually decreased so that in 1984 women were only 0.5% and in 1999, they were only 0.4% of the LCI (Grifa, 2006). Nevertheless, it can be stated that there are many women working as professionals and consultants in construction companies and government departments. Thus, the phenomena of low appearance of women in the construction field, is not only in Libya but also in other developed and well developing countries especially Islamic countries. The low participation of women in construction could be the result of the general nature of the construction field, challenging weather conditions, and cultural circumstances (Worrall, et al., 2010), (Arslan and Kivrak, 2008). Additionally, trend is identified in other cultures and countries, for example, Worrall (2012), has stated that, in the UK, the recorded percentage of female labour within the construction industry has remained comparatively unchanged at between 10 and 13% of the workforce since 1990 due to male dominance in organisation. Negative perception and attitudes that embrace low expectations of female talent and aptitude, also negatively affects women’s confidence levels and self-esteem. As a minority group, furthermore, they face isolationism and a lack of networking resources, support, mentoring, and job-shadowing opportunities. In addition, women usually face work–life balance penalties, and there is a general lack of awareness regarding areas of potential future career options and growth opportunities.

7.2.6 Characteristics of Completed Questionnaires

To confirm that the survey responses were in harmony with statistical principles, the responses were categorised into three main classes: responded successfully; wrongly classified; couldn't contact and unwilling to respond. Those classifications clearly demonstrate the feedback of the quality of participation.

The cases that were classed as responded successfully cover the questionnaires where the respondent answered the questions completely and conformed to the survey criteria. The wrongly classified cases cover those questionnaires where the respondent did not complete all of the survey. The cases categorised as unwilling to participate and could not contact were where respondents were reluctant to answer parts of the survey or answered those using unreasonable or playful answers. These answers were usually in response to those parts of the survey related to personal questions. Also some participants were not contactable because of difficulties in finding the right address, or when a company no longer existed because it had amalgamated with another company.

Table 7-1 The description of the completed and uncompleted questionnaires

Organisation		**Responded successfully**	**Wrong classification**	**Could not contacted & Unwilling to participate**
Contactor	Public	11	12	39
	Private	9	9	20
Civil Engine	Public	42	36	51
	Private	14	15	12
Project managers	Public	12	2	19
	Private	1	6	11
Clients	Public	17	15	24
	Private	6	6	11
Total		**112**	**102**	**186**

The above table 7:1 demonstrates that out of the total questionnaire sample (400 samples), 112 samples, (28%) were successfully responded, whereas 102 samples (25.25%) were considered wrongly classified, and finally, 186 samples (46.5%) involved respondents unwilling to respond or who could not be contacted to participate in the questionnaire. Many questionnaires samples could not be distributed and were discarded. This was for a number of reasons. One reason is that a large number of roads and streets in Libya are without names and numbers, so in some cases it was hard to identify the addresses and/or actual locations of a respondent or company. Another reason is that there was a lack of experience by many respondents in dealing with questionnaires which is the result of a lack of confidence in sharing personal opinion. This has cultural roots because in many empirical studies of society in the

Arabic world, particularly in countries lead by political regimes, the governments do not permit people's views and opinions to be stated and tested. Many earlier studies faced the same technical difficulties. For instance, the Ministry of Planning of Libya (1983, 1968; p.1-3) conducted an annual survey of large construction units in Libya. The study failed because of an absence of clarity, changing of companies' addresses and missing data (Grifa, 2006).

- **Profile of the Survey and Response Rates**

Both public and private sector construction professionals were selected to participate in the questionnaire about contractor selection. One hundred and twelve valid questionnaires out of 214 were returned. Eighty-two public sector questionnaires were returned, for a completion rate of 73.21%, and 30 private sector questionnaires were returned, for a completion rate of 26.78%. Figure 1 illustrates this further.

1. ***Public sector***

The Libyan public sector is the considered the major source of work in the LCI as it undertakes nearly 85% of the total construction projects in Libya (El-Hasia, 2005). The public sector includes firms such as the General Construction Company, the General Company for Electricity, the Electrical services company, the General Postal Company, and the Gesco for general service and training. The government ministries that have the strongest relationship with the public construction sector includes the Ministry of Education, the Ministry of Health, the Ministry of Housing, Utilities, the Ministry of Transportation, the Audit Bureau, as well as the Development Authority and the development of management positions. In addition to the government ministries listed above, the Libyan Social Security Administration, Libyan public universities, the Savings Bank, and the Real Estate Investment of Libya are also public sector organisations that work closely with the construction industry.

Table 7-2 shows the questionnaire survey sample. It was planned to administer 290 questionnaires to the public sector as follows: 70 questionnaires (24.14%) to public companies, 22 (7.58%) to clients, 30 (10.34%) to the Savings Bank and Real Estate Investment of Libya, 88 (30.34%) to the various government Ministries, 50 (17.24%) to the Development Authority and the development of management positions, 15 (5.17%) to the Libyan Social Security Administration, and 15 (5.17%) to Universities.

Table 7-2 Profile of the Survey and Response Rates for public sector

No	Public sector	Distributed	Rate	Received	Rate
1	▪ ***Public companies*** The General Construction Company The General Company for electricity The Electrical services company The General Postal Company The Gesco for general service and training	70	24.14 %	18	22%
2	***Clients***	22	7.58%	10	12.20%
3	***Savings Bank and Real Estate Investment of Libya***	30	10.34 %	9	10.97%
4	***Ministries include*** • Ministry of Education • Ministry of Health • Ministry of Housing, Utilities • Ministry of Transportation • Audit Bureau	88	30.34 %	25	30.48%
5	***Development Authority and the development of management positions***	50	17.24 %	15	18.29%
6	***The Libyan Social Security Administration***	15	5.17%	2	2.43%
7	***Universities***	15	5.17%	3	3.65%
	Total Public Sectors	**290**	**100%**	**82**	**100%**

Out of the 290 questionnaires administered to respondents in the public sector only 82 were returned. The breakdown of returned questionnaires in the public sector is as follows: 18 (22.00%) were returned from public companies, 10 (12.20%) were returned from clients, 9 (10.97%) were returned from the Savings Bank and Real Estate Investment of Libya, 25 (30.48%) were returned from the various government Ministries, 15 (18.29%) were returned from the Development Authority and the development of management positions, 2 (2.43%) were returned from the Libyan Social Security Administration, and 3 (3.65%) were returned from the various public universities.

1. Private sector

Compared to the public sector, private sector involvement in the construction industry is very small, representing about 15% of the total construction projects in Libya. Additionally shown in Table 7-3, 110 questionnaires were to be administered to the private sector as follows: 41 questionnaires (37.27%) to construction companies, 31 (28.18%) to consultant offices, and 38 (34.54%) to contractors out of the 110 questionnaires administered to respondents in the private sectors only 30 were returned. The breakdown of returned questionnaires in the private sector is as follows: 10(33.33%) construction companies, 14(46.67%) consultant offices, 6 (20.00%) contractors. The total percentages of all participants are, public sectors 72% and private sectors 28%.

Table 7-3 Profile of the Survey and Response Rates for private sector

No	Private sector	Distributed	Rate	Received	Rate
1	Construction Companies	41	37.27%	10	33.33%
2	Consultant offices	31	28.18%	14	46.67%
3	Contractors	38	34.54%	6	20.00%
Total Samples		**110**	**100%**	**30**	**100%**

The second section of the survey investigated the current contractor selection process in the LCI. As illustrated in Table 7-4, most respondents had been working in the construction industry for 6 - 10 years (30.4%). The next largest group of respondents had been working in the construction industry for between 11 and 15 years (26.8%). Those working 5 years or less were only 18.8% of the respondents, and those working longer than 25 years in the construction industry were 11.6% of respondents. Respondents working between 16 and 20 years in the industry made up 7.1% of the survey population and the fewest number of respondents, at 5.4%, were those who had worked between 21 and 25 years in the construction industry. This result gives an indication that about 70% of people working in the public and private sectors of the construction consulting sector have work experience between 6 to 25 years. This makes the average age of a worker in the construction industry between 25 to 40 years old.

Table 7-4 showing the respondents experience edge and job title

Years of Experience	Type of sector	Job title				Total
		Contractor	Civil Eng.	Architect	Clients	
0-5	Public	2	7	0	7	16
	Private	2	1	0	2	5
6-10	Public	4	16	3	2	25
	Private	3	5	0	1	9
11-15	Public	3	9	6	5	23
	Private	2	2	1	2	7
16-20	Public	0	3	0	0	3
	Private	1	4	0	0	5
21-25	Public	1	1	0	2	4
	Private	1	1	0	0	2
25=+	Public	1	6	3	1	11
	Private	0	1	0	1	2
Total						112

This indicates that in the last ten years the Libyan government has achieved an increase in the numbers of professional and managerial staff in the construction industry. As a result, it can be confirmed that the employees aged between 25 to 40 years old have better experience, reduced occupational injuries and illness, better job performance and this usually leads to increase work efficiency. However, in spite of these developments, the LCI still depends mainly on foreigners for both the labourers and professionals in the field. As a result, it can be concluded that training courses and skill development courses need to be given to Libyans working in the construction industry so that people will have adequate skills and confidence to be self-reliant and build a strong, local, foundation for this sector

Table 7-5 showing the current practices utilised for contractor selection procedure

Sector	Yes	Percentage	No	Percentage	Total
Public	68	83%	17	19%	82
Private	23	76%	7	24%	30
Total	**91**	**81%**	**21**	**19%**	**112**

Table 7-5 illustrates the current practices utilised for contractor selection procedure. It also shows that approximately 83% of the public sector and 76% of the private sector in the construction industry are adopting specific rules for contractor selection process. Around 81% of respondents in both the private and public sectors are using decision maker criteria. This means most of the Libyan public and private construction sectors are familiar with contractor selection procedures, and it can be said that the Libyan government has taken further steps in developing a process of contractor selection to be more extensively used in the construction industry. This means that participant's responses to the questionnaire will be more reliable as they will already have an idea about the process of contractor selection because of recent government efforts to popularise a standardised process. In addition, a lot of decision makers will benefit from the findings of this study.

The following table shows the rates of response to the following question, which was posed in the questionnaire. "If contractor selection processes are adopted in your organisation, could you explain why your organisation does so?"

Table 7-6 showing the most important reason for contractor selection

Reason	Public sectors		Private sectors		
	Yes	%	Yes	%	
For selection the most appropriate contractor	54	48.2%	19	17%	65.2%
To comply with the organisation roles and regulation	40	35.7%	18	16.1%	51%
For the transparency and credibility purpose	19	17%	7	6.3%	23.2%
To fulfil the sponsor or other stakeholders requirement	17	15.2%	7	6.3%	21.4%
To accomplish clients' interests	9	8%	5	4.5%	12.5%
For other reasons, please specify	6	5.4%	4	3.6%	8.9%

In order to identify and rank the reasons why an organisation had adopted a contractor selection process, the participants were asked multiple questions. The most frequent answer chosen for an organisation adopting a contractor selection process was, "for selection of the most appropriate contractor." The results showed that among the 73 (65.2%) respondents, 54 (48.2%) from the public sector and 19 (17%) from the private sector chose this answer. This indicates that the majority of organisations in the LCI see the contractor selection process as an essential tool for choosing the best contractor. In addition, the above results showed that a large proportion of the respondents' organisations had also adopted processes of contractor selection in order "to comply with the organisation rules and regulations." The questionnaire results show that among 58 (51%) respondents, 40 (35.7%) from the public sector and 18 (16.1%) from the private sector chose this answer. The third most popular reason respondents chose was "for the purpose of transparency and credibility" with 23.2% choosing this answer. The fourth most popular answer was "to fulfil the sponsor or other stakeholders requirement," which was chosen by 21.4%. The fifth most popular answer was "to accomplish clients' interests," and the least popular answer was "other," which was chosen by 8.9% of respondents. Unfortunately none of the respondents who selected this answer gave an explanation or elaboration.

The next table shows the most popular methods used by clients for collecting contractor information. As the results of the statistical analysis, table 7-7 shows that about 50.9% of respondents in the public and private sectors were collecting contractor information through applications made by clients while 49.1% of the public and private sectors were collecting contractor information by applications made by the contractor. This indicated that the most popular methods used to collect contractor information are traditional methods where contractor information is collected through forms prepared by the contractors themselves. Compared with the other, more modern methods, this can be considered a primary method. In more modern methods, information such as the contractor's CV is usually collected through a proper application form created by the clients.

Table 7-7 showing contractor selection information collection formats

Sector	Type of application				Total
	Application made by client	%	Application made by contractor	%	
Public sectors	42	51.2%	40	48.8%	82
Private sectors	15	50%	15	50%	30
Total	**57**	**50.9%**	**55**	**49.1%**	**112**

It can be seen from table 7-8 below that a significant proportion of the respondents in both the public and private sectors were in agreement that the most general information usually obtained from a contractor could be divided in to three groups. The first group, chosen between 80-90% of the respondents, was *experience and financial stability.* The second group, chosen between 10-25% of respondents was *reputation, technical and management, and health and safety record*. The third group, chosen by respondents was *cultural experience.*

Table 7-8 showing the most important of information about contractor

Type of in formation	Public sectors		Private sectors		Total
	Yes	%	Yes	%	
Experience	65	79.26 %	25	83.33 %	80%
Financial stability	71	86.58 %	27	90%	90.2 %
Reputation	22	26.82 %	7	13.33 %	25%
Technical & management ability	11	13.41 %	1	3.33%	10.7 %
Health & safety record	13	15.85 %	1	3.33%	12.5 %
Culture experience	3	5.4%	1	3.6%	3.6%

Table 7-9 shows that 53 respondents from the public sector, which is about 64.6% of the total public sectors participants, and 29 respondents from the same sector (35.4%) were unwilling to answer this question. Seventeen respondents from the private sector (about 56.7%) said that they were using professional judgement as the main method of contractor selection process. Seven respondents from the private sector (13%) were unwilling to answer this question.

Table 7-9 showing the current method used for contractor selection processes

Type of Sector	Method type					Total
	Pre-defined model	%	Professional Judgment	%	Others please specified	
Public Sectors	00	00	53	64.6%	00	85%
Private Sectors	00	00	17	56.7%	00	76%
Total	**00**	**00**	**70**	**62.5%**	**00**	**00**

Thus, we can conclude that the contractor selection process suffers due to a lack of experience and shortages of technology among the decision makers. So far no specific method or models have been developed in the LCI that can be adopted to improve the contractor selection process while the old methods of contractor selection are the primary means for decision-making but have often failed miserably to choose an appropriate contractor. These failures have indicated that a great deal of research needs to be done in this field. It also means that the aims of this research are to produce a useful tool for the LCI. The results of this research will help build a useful framework for the process of contractor selection that can, hopefully, be fundamental to the Libyan government. It is particularly important to create such a tool for the use of the construction industry in Libya. As the result of the recent war and government change means that a great deal of infrastructure needs to be reconstructed in the country.

Table 7-10 the competent authorities for contractor selection process

The competent authorities	Sector type		
	Public Sectors	Private Sectors	Percent
Technical engineering department	15	8	20.5%
Project management team	18	9	24.1%
Independent consultants	3	1	3.57%
Financial department	5	1	5.35%
Director	36	10	41%
A committee consist of (1,2,3,4)	5	1	5.57%
Total	**82**	**30**	**100%**

The results presented in Table 7-10 show that for both the public and private sectors, almost 20.5 % of respondents (23 individuals), were authorised to carry out contractor selection by their technical engineering department. 24.1% of the overall survey respondents were authorised by the project management team to carry out contractor selection and 3.57% of the overall survey respondents (6 individuals) were authorized to carry out contractor selection by independent consultants. The questionnaire results also show that about 41% of the overall survey respondents were authorised by the director to carry out contractor selection and finally a committee consist of (1, 2, 3, 4).

Table 7-11 Shows the groups ethnic of awarding contract

Type of Sector	Separate ethnic groups	%	Specific ethnic groups	%	Others ethnic	Total
Public Sectors	50	44.6%	32	28.5%	00	82
Private Sectors	24	21.4%	6	5.3%	00	30
Total	**74**	**66%**	**38**	**34%**	**00**	**112**

The results presented in Table 7-11 show that for both the public and private sectors, almost 66 % preferred to award work to companies belonging to separate ethnic groups. Also, the questionnaire results show that about 34% of the overall survey respondents preferred to award work to companies belonging to specific ethnic groups.

The results presented in Table 7-12 show that the majority of both the public and private sectors, almost 91% of the total respondents (101 respondents), thought that the socio-economic (tribe) has influence in the process of contractor selection. Whereas, the results show that only 11% of both sectors (11 respondents) felt that the socio-economic (tribe) has no influence in the process of contractor selection. This result indicates that Libyan society is a tribal society. Therefore, this factor should be taken into consideration in terms of contractor selection.

Table 7-12 showing the influence of the socio-economic (tribe) in the CSP operation

Type of Sector	Yes	%	No	%	Total
Public Sectors	75	91%	7	8%	82
Private Sectors	26	87%	4	3%	30
Total	**101**	**91%**	**11**	**9%**	**112**

The result from table 7-13 below shows some unusual results in that the majority of respondents, 60% of all contractors in public and private sectors, were never reassessed once placed on a list. The result also confirms only 7% of respondents of public and private sectors were reassessed on an annual basis. Surprising also, was the fact that 1% of contractors were reassessed more than once per year and 32% stated they were reassessed less than a once a year.

Table 7-13 How often contractors re-qualify?

Classification	Never	Annually	More than once per year	Less than once per year	Total
Public Sectors	45	3	1	33	82
Private Sectors	22	5	0	3	30
Total	**67**	**8**	**1**	**36**	**112**
%	**60%**	**7%**	**1%**	**32%**	**100%**

To investigate the classification of the contractor, the respondents were asked if their organizations undertook contractor classification. Figure 7-2 shows that there were three main classes of contractor qualifications that could be identified in the LCI; however, about 58% of public sector and 42.8% of private sector respondents believed that the contractor should be classified by four classes. About 30% of respondents in both the private and public sectors believed that contractors should be classified into three classes. Finally, about 13% of respondents in the public sector, and 25% of respondents in the private sector believed that contractor classification should be divided into five classes.

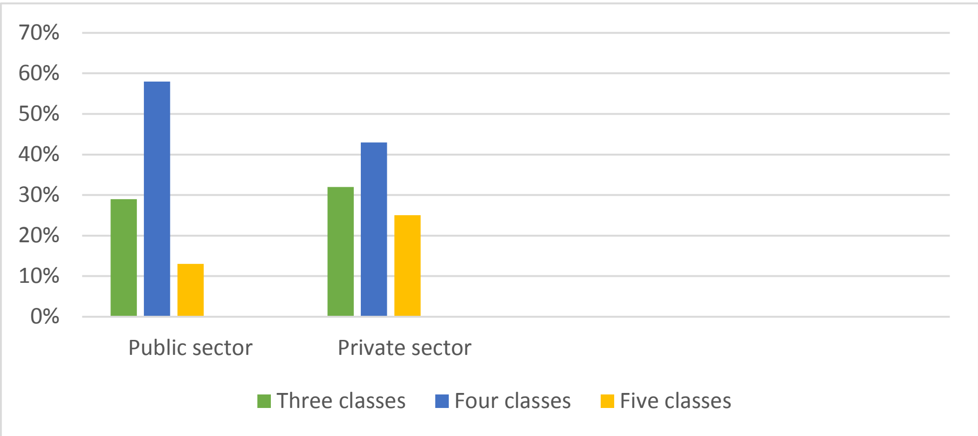

Figure 7-2 Showing the categories of contractor classifications

The next table illustrates that about 52.4% of the public sector and about 56.7% of the private sector used low price for selection of sub-contractor, while 30.5% of the public sector and about 33.33% in the private sector used experience factor for selection of sub-contractor. Just 12.2% Public Sector and 3.3% of private sectors used reputation factor for selection of sub-contractor. Only 3.65% of the public sector and about 6.66% in the private sector used culture experience factor for selection of sub-contractor.

Finally, only 1.3 % of the public sector and none in the private sector used health & safety record factor for selection of sub-contractor.

Table 7-14 showing the main criteria of sub-contractor process

Type of information	Public sectors		Private sectors		
	Yes	%	Yes	%	
Low price	43	52.4%	17	56.7%	53%
Experience	25	30.5%	10	33.33%	36.6%
Reputation	10	12.2%	1	3.3%	9%
Culture experience	3	3.65%	2	6.66%	4.46%
Health & safety record	1	1.3%	0	0%	0.9%

The next table shows the most popular methods used for selection of project manager and consultant. It can be seen from table 7-15 that about 78% of respondents in the public and private sectors were using traditional method for selecting the project manager and consultant while 22% of the public and private sectors were using standard criteria for selecting project manager and consultant. This indicated that the most popular methods used to appoint project manager and consultant are traditional methods, where selection through social relationships are seemingly randomly methods without specific criteria.

Table 7-15 showing contractor selection project manager and consultant

Type of sector	Type of selection				Total
	Traditional method		Standard criteria		
Public sectors	66	80%	16	20%	82
Private sectors	22	73%	8	27%	30
Total	**88**	**78%**	**24**	**22%**	**112**

The result demonstrates the procurement methods types illustrated in the service offered by different clients. The result shows that about 62% of the total public and private sectors participants were using Separated and Cooperative (Traditional) method, 33% of the total respondents were using Integrated Procurement (D&B) Systems, and only 5% of the total respondents were using management contract procurement method.

Table 7-16 Type of procurement in Libya

Procurement Type	Sector		Percent		Total
	Public	Private	Public	Private	
Traditional procurement System	52	18	63%	60%	62%
D&B Procurement Systems	26	10	32%	33%	33%
Management Oriented Procurement Systems	4	2	5%	7%	5%
Total					**100%**

Thus, it can be concluded that the traditional procurement method is still the main procurement technique in practice in LCI. This is because the Libyan government is still the main client in the construction industry. The government has still not fully embraced novel and modern procurement methods, such as management contract, turnkey etc. Also, this approach is possibly affected by social pressure, nepotism and administrative corruption, which are considered the main shape of the LC operation.

As the government is considered a major client of projects, the respondents from construction and industry were asked whether the Libyan government involvement affected the implantation of the procurement policy system or not?

Table 7-17 showing the influence on the implementation of the procurement system

	Sector		Total	%
	Public	**Private**		
Yes	57	26	83	70%
No	25	4	29	30%

Table 7.17 shows that~~,~~ nearly seventy per cent (83 respondents) indicated that the Libyan government has influence on the implementation of the procurement system, such as payment, design etc. while thirty per cent (87 respondents) indicated that the Libyan government has no influence on the implementation of the procurement system.

This indicates that the estimating procedure for the time, cost and quality of construction projects might be deficient owing to changes in design, delay of the payment and bad selection of the employees. These findings from table 7:18 above show that the contractual and the procurement systems require additional development and improvement in order to comply with international standards and liabilities. Accordingly, it can be concluded that there are a number of inadequacies in the current construction procurement methods in the LCI. Recommendations to improve procurement methods are presented in chapters nine and eleven.

Part Three: The importance of the selection criteria

The results of the data collected by questionnaire have been documented in tables whilst statistical methods are used to analyse those results. However, this part of the questionnaire is considered the most essential part of this research study. As discussed in the literature review (see chapter four) the factors to be considered in the contractor selection criteria are divided into six main categories as depicted in Table 7-18 and twenty-six sub-factors.

Table 7-18 the importance of the selection criteria

criteria	Sub-criteria
▪ **Financial stability**	▪ Positive credit rating ▪ Financial status ▪ Banking arrangements ▪ Tender price
▪ **Technical and management ability**	▪ Staff experience ▪ Staff qualification ▪ Project manager qualification ▪ Past performance ▪ Company equipment
▪ **Experience**	▪ Experience edge ▪ Size of project ▪ Current workload ▪ Experience in the region ▪ Type of project
▪ **Health and safety**	▪ (OSHA) incidence rate (points) ▪ Safety record ▪ Company safety policy ▪ Experience in noise control
▪ **Quality**	▪ Quality work ▪ Quality policy ▪ Quality management ▪ Quality assurance
▪ **Weather & Culture consideration**	▪ Relation with local working culture ▪ Relationship with (Employees, Suppliers, sub-contractors, consultant and client) ▪ Claims and dispute ▪ weather consideration

- ***Analysis of the part three***

For the purpose of this research the respondents were asked to rate the importance of each sub-factor for contractor selection independent of the main criteria. The importance rate was measured on a Likert scale where: (0) Not important (1) Low importance (2) Somewhat important (3) Important (4) Very important. This was done in order to help validate the reliability of the classifications presented in the literature as well as in developing new frameworks for contractor selection criteria that keeps the situation and the condition of the Libyan market in mind.

- ***Ranking of main criteria***

Table 7-19 shows six main criteria selected for contractor selection. In spite of the fact that there is no statistical difference between the private and public sector in respect to the importance given to each of the factors, the results presented are not highly in agreement between the selection of public and private sectors.

Table 7-19 Ranking of main criteria

Main Criteria	Case Processing Summary							
	Public Sector			Private Sector			Total	
	Mean	Std. Dev.	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
Experience	3.44	1.067	1	3.73	0.583	1	3.52	0.968
Financial stability	3.30	0.842	2	3.17	1.053	2	3.27	0.900
Technical & management ability	2.85	1.167	3	2.70	1.119	3	2.81	1.151
Quality	2.72	1.240	4	3.17	1.053	4	2.84	1.205
Health and safety	2.52	1.199	5	2.40	1.192	5	2.49	1.193
Weather & Culture consideration	1.72	1.510	6	1.57	1.357	6	1.68	1.466

The highest ranked factor is experience followed by financial stability as the second most important then, technical & management ability third by both sectors. However, quality was ranked as the fourth ranked main criterion by both sectors. Both sectors agreed that health and safety was fifth in rank, while the last rated criterion was considered weather and culture in the region.

- ***Ranking of Sub-criteria***

Table 7-20 shows twenty-six sub-criteria selected for contractor selection. Each cluster of sub-criteria was classed according to their importance. In spite of the fact that there is some statistical difference between the private and public sector in respect to the importance given to each of the sub-factors, also, it can be seen that some of the sub-factors are scattered and dispersed. The results are presented sepearately in tables below which show that there is insufficient agreement between the selection of public and private sectors.

Table 7-20 Ranking of sub-criteria

Main Criteria	Attributes	Case Processing Summary							
		Public Sector			Private Sector			Total	
		Mean	Std. Deviation	Rank	Mean	Std. Deviation	Rank	Mean	Std. Deviation
Financial stability	Positive credit rating	2.80	1.094	4	3.10	.960	3	2.88	1.063
	cash Flow	3.21	1.097	1	3.23	.935	1	3.21	1.052
	Banking arrangements	2.65	1.082	3	2.67	1.155	4	2.65	1.096
	Tender price	3.10	1.085	2	3.17	1.085	2	3.12	1.046
Technical and management ability	Staff experience	2.95	0.993	4	3.03	1.066	5	2.97	1.009
	Staff qualification	2.88	1.104	5	3.10	0.94	4	2.94	1.076
	Project manager qualification	3.24	0.897	2	3.43	0.961	2	3.29	0.917
	Past performance	3.22	0.832	3	3.10	0.995	3	3.19	0.875
	Company equipment	3.34	1.080	1	3.53	0.860	1	3.39	1.025
Experience	Experience edge	3.18	0.957	3	3.20	0.887	1	3.17	0.935
	Size of project	3.27	0.861	1	2.93	0.868	3	3.18	0.872
	Current work load	2.65	1.058	4	2.43	1.165	4	2.59	1.087
	Experience in the region	2.62	1.096	5	2.40	1.248	5	2.56	1.137
	Type of project	3.27	1.078	2	3.00	1.390	2	3.20	1.169
Health and safety	Safety record	2.84	1.071	1	2.57	1.104	2	2.77	1.082
	Company safety policy	2.51	1.157	3	2.83	1.206	1	2.60	1.174
	Experience in noise control	2.57	1.054	2	2.23	1.194	3	2.48	1.099
	(OSHA) incidence rate (points)	1.96	1.409	4	2.13	1.655	4	2.01	1.473
Quality	Quality work	3.24	1.049	1	3.10	1.348	1	3.21	1.132
	Quality policy	2.82	1.389	2	2.77	1.305	2	2.80	1.361
	Quality management	1.93	1.531	4	1.83	1.704	4	1.90	1.571
	Quality assurance	2.06	1.494	3	2.00	1.619	3	2.04	1.521
Weather & Culture consideration	Relation with local working culture	3.04	1.071	1	3.30	1.095	1	3.11	1.043
	Relationship with(Employees, Suppliers, sub-contractors, consultant & client)	2.34	1.307	2	2.34	1.251	2	2.37	1.287
	Claims and dispute	2.09	1.450	4	2.17	1.440	3	2.11	1.442
	weather consideration	2.28	1.363	3	2.07	1.520	4	2.11	1.374

7.2.7 Synthesis of sub-criteria ranking

Table 7-20 shows twenty-six sub-criteria for contractor selection, grouped under six main criteria, where each sub-criterion is ranked according to its importance. However, the findings in relation to each criterion are presented in the following sections.

1. ***Financial stability***

Both the public and private sectors were in agreement regarding their ranking of cash flow, which according to the SPSS results, is ranked first by both sectors. Indeed, it is perceived as being the most significant of all financial stability sub-main criteria. In addition, tender price is ranked second by both sectors,

There are no large differences between the two sectors, private and public, on ranking positive credit rating, where it were ranked fourth by the public sector and third by the private sector, in terms of its importance in contractor selection. Finally, while banking arrangements is considered an essential criterion for contractor selection (Huang, 2011), it was ranked third by the public sector and fourth by the private sector, in terms of its importance in contractor selection.

2. ***Technical & management ability***

There is a high degree of agreement between public and private sectors on ranking technical and management ability. The highest ranked factor describes the company equipment, followed by project manager qualifications as the second most important. These are considered to demonstrate the skills and capability of the contractor to control and finish the work within a specific time and budget. Past performance is ranked third by both sectors. Staff experience and staff qualifications were ranked fourth and fifth in opposing order by the two sectors in terms of their importance in contractor selection.

3. ***Experience***

On the issue of contractor experience, both public and private sector agreed, but with some differences. For example, differences appeared in ranking experience edge and size of project in terms of importance in contractor selection. For experience edge, the public sector ranked it third, while the private sector ranked it as first in importance. On the other hand, size of project was ranked first by the public sector, whereas, the private sector ranked it as third in importance among the other sub-criteria. However, type of project was ranked as the second ranked sub-criterion by both sectors. Both sectors concurred that the length of time in business was fourth in rank, while the last rated sub-criterion was considered experience in the region.

4. *Health and safety*

There was a large degree of disagreement between the public and private sectors on ranking the sub-criteria under the main heading of health and safety. For example, dissimilarity appeared in ranking safety record, whereby the public sector ranked it first, while the private sector ranked it as second in importance. For company safety policy, the public sector ranked it second, while the private sector ranked it as third in importance. On the other hand, experience in noise was ranked third by the public sector, whereas, the private sector ranked it as first in importance among the other sub-criteria. However, in agreement finally, (OSHA) incidence rate (points) control was ranked as the fourth ranked sub-criterion by both sectors.

5. *Quality*

Both public and private sector agreed on rating the sub-criteria making up quality with only slight difference. The four main significant sub-criteria in descending order are quality control, quality work, quality assurance and finally quality management.

6. *Culture experience*

There is moderate agreement between public and private sectors in rating the cultural experience sub-criteria. Both public and private sectors ranked relations with local working culture as the most important sub-criterion. Moreover, both sectors considered the relationship with suppliers, sub-contractors, consultant and client as second most important among these sub-criteria. However, differences appear in the rating of the last two factors, where claims and dispute were ranked fourth by the public sector, and third by the private sector. Finally, weather climate consideration, is rated third by the public sector, and fourth by the private sector.

7.3 Independent samples t -test

In order to test whether there was a difference in the views between the public and private sector an independent samples t –test was applied. This technique is commonly used to test whether there are statistically significant differences between two or more independent groups. These groupings were arranged according to levels of independent variables. Indicating bias has helped the researcher in minimising any bias. The foremost method for doing so is to analyse each group individually and then to investigate differing perceptions in respect to the issues being examined.

As results from appendix (IX) indicate, by running the Independent samples t -test we found no statistically significant difference between the groups' responses which means that there is no bias. This means that the average value of the statistics from each group is no different from the value relating to the population as a whole. This was the case for each single factor except for the size of the project when P value <0.05.

7.4 Validating the Criteria

Factor analysis and Cronbach's Alpha was used to assess the validity and reliability of using the sub-criteria as measure of the main criteria of Financial stability, Technical and management ability, Experience, Health and safety, Quality and Weather and cultural considerations.

- ***Financial stability***

Financial stability contains four important sub-criteria as follows: positive credit rating**,** cash flow**,** banking arrangement and turnover. Applying factor analysis, these sub criteria grouped into one dimension but explained only 36.1% of the original variation. However congruence between the variables was supported by an adequate Kaiser-Meyer Olkin measure (KMO = 0.515. The use of the sub components to explain Financial Stability is further supported by an acceptable Cronbach's test value of 0.609.

- ***Technical and management ability***

Technical and management ability includes five important sub-criteria: staff experience, staff qualification, project manager qualification, past performance and company equipment. Using factor analysis two dimensions appear explaining 64.6% of the variation. These dimensions comprise of past performant, project manager qualifications and company equipment (explaining 35.4 of the variance) and staff qualification and experience which explains 29.2% of the original variation. The KMO statistic was 0.656 indicating that the factor analysis was reliable.

The Cronbach's Alpha score to the measure the congruence of the variables was 0.617 indicating that the sub criterion was measuring a common theme.

The first factor score loaded strongly on factor one, which is composed of *staff qualification and skills and staff qualification training course*. We suggested naming this group *human resource criterion.*

The second factor score loaded strongly on factor two, which includes, *project manager qualification, past performance and company equipment*. This group will remain holding the same old name that is, *technical and management ability.*

- ***Experience***

Experience criterion contains five essential sub-criteria as follows: type of project, size of project, length of time in business, experience in the region and experience age. From factor analysis two dimensions appeared explaining 32.7 and 23.1 of the original variation. The KMO was low at 0.595 but still suggests that factor analysis was safe to apply. Only the variable experience age loaded in to the second factor score and on groups of parsimony this variable was dropped. The Cronbach's Alpha score on the remaining four variables was 0.528 suggesting that it is reliable to use type of project, size of project, length of time in the business and experience in the region as measures of experience.

- ***Health and safety***

Health and safety criterion contains OSHA incidence rate (points, safety record, company safety policy, and experience in noise control. Using factor analysis two dimensions appeared but the value of KMO was 0.470 was low. Consequently, we can be certain that factor analysis is not suitable for these data. The rotated factor scores are displayed in Table 7-21

Table 7-21 Rotated Component Matrix

Sub-criteria	**Component**	
	1	**2**
(OSHA) incidence rate (points)		0.937
Safety record	0.600	0.597
Company safety policy	0.901	
Experience in noise control	0.566	0.343
Variance explained	37.3%	34.7%

However by applying Cronbach's Alpha score to assess scale reliability showed that if the OSHA criterion was removed then suitable congruence among the remaining variables arose, so allowing the reliable measurement of health and safety. The Cronbach alpha score obtained after removal of OSHA was 0.561. Removing OSHA and re-running factor analysis gave one factor score, which explained 54.3% of the original variation.

- ***Quality***

Quality factor contains four main sub-criteria: quality policy, quality assurance, quality control and quality work. Applying factor analysis to the sub-criteria was not very secure as the KMO was only 0.495. Using Cronbach's Alpha to investigate the congruence of the sub-criteria indicated that Quality policy was not measuring the same concepts as the other criteria, see Table 7-22

Table 7-22 Item-Total Statistics

Sub-criteria	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item Total Correlation	Cronbach's Alpha if Item Deleted
Quality policy	6.75	11.288	0.085	0.621
Quality work	7.15	9.175	0.265	0.512
Quality management	8.05	6.610	0.512	0.268
Quality assurance	7.91	7.253	0.449	0.341

As a result, we can see that removal of the category of quality policy results Cronbach's Alpha rising to an acceptable value of 0.621.

Re-running the factor analysis after the removal of quality policy, the KMO test coefficient increases to an acceptable value of 0.508.

This gave one factor score, which explained 58.4% of the original variation

From this one concludes that *quality work, quality management and quality assurance* sub-criteria as suitable measures of the concept of quality

- ***Culture and weather consideration.***

This contains relation with local working culture, supplier relation, claims and disputes and weather consideration. Appling factor analysis resolves these variables into two dimensions which explain 38.3% and 31.7% of the original variation. The KMO score of 0.522 suggests that applying factor analysis is appropriate.

The table that follows, table 7:23 demonstrates the rotated component matrix of two components. The first component correlates with Relationship with (Employees, Suppliers, sub-contractors, client) at 0.837 and Claims and dispute 0.883. The second component correlates with relationship with local working culture at 0.852 and weather consideration at 0.721.

Table 7-23 Rotated Component Matrix

	Component	
	1	**2**
Relation with local working culture		0.852
Relationship with (Employees, Suppliers, sub-contractors, consultant & client)	0.837	
Claims and dispute	0.883	
Weather consideration		0.721

The application of Cronbach's Alpha test gave a score of 0.556 indicating that the sub-criteria can be used to measure the concept of culture and weather.

After the items were tested by applying factor analysis and reliability statistics a new group was generated in which the culture experience criterion was divided into two groups as follows:

The first sub-grouping of the culture experience criterion included the sub-criteria of *relationship with employees, suppliers, consultant, sub-contractors, and client, claims, and dispute*. The suggested name of this group is Reputation.

The second sub-group includes the sub criterion of *Relation with local working culture and weather consideration*. The suggested name of this group is local *culture and weather consideration.*

7.5 Questionnaire synthesis and discussion

Part one identified respondent profile. This part highlights that out of the total sample of 400, 28% successfully responded which accounts for 112 samples. 25.25% of the samples were considered as wrongly classified which accounts for around 102 samples and 46.5% (186 samples) consisted of respondents who could not be contacted to participate in the survey or were reluctant to respond to the questionnaire. The most common form of criticism which a questionnaire survey faces is a very low response rate, especially in the field of construction industry where, in the heat of managing projects, no one has time to respond to survey questions. Further, the low questionnaire respondent rate was expected because of the civil war and unsettled back home.

The research had a very high number of men participating in the research study and women participating in low levels in these surveys. In the whole survey, just four women were involved in the study and they all were architects. This survey is consistent with the concept that the construction industry in Libya is being run by men.

In the LCI, the public sector is considered to be the provider for the majority of the work, as it is the source of almost 85% of construction projects in Libya. The involvement of the private sector in the construction industry is very small and as per the surveys, it is evident that around just 15% of the total construction projects in Libya is held by the private sector. The aforementioned survey has established that approximately 51% of people who work in both the public and private sectors are civil engineers by profession. The results provide an indication that almost 76% of people that work in both the public and private sectors of construction consulting have been working for just a few years. This gives workers in the LCI the average age of between 25 to 45 years old.

The above facts demonstrate that in the last decade there has been exponential growth in the number of professional and managerial staff hired by the Libyan government in the construction industry. Thus, in spite of the major changes and developments seen in the LCI, it is known to depend on foreigners for both labourers and professionals in the field. As such, it can be concluded that suitable training courses should be held for the Libyan working class and thereby develop individuals who have a proper knowledge of the above.

Part two, identified the current practice for contractor selection in Libyan construction industries. The survey also highlights that around 83% of the public sector and 76% of the private sector which are employed in the construction industry are known to adopt a specific sort of rule for the contracting selection process.

The majority of organisations within both the public and private sectors use criteria set by the decision maker for contractor selection which the Libyan government has taken steps to implement. As the participants will already have an awareness of these processes, this is positive and should be taken into consideration in developing a model for contractor selection which can be relied on and be useful to the contractor and meets the standards demanded by the industry.

1. ***Decision criteria***

The result shows that the public sector has a totally different approach towards a project and criteria and other decisions methods. A difference in attitude is not expected in public sectors as it is usually known to consist of Ministries and Municipalities which have specific guidelines which are known to be used by those Municipalities and are laid down by the ministers. This provides reasons to why such variations exist.

The results demonstrate that both the public and private sectors are adopting a similar strategy for selecting a contractor. Thus it is clearly evident that in the LCI the selection procedure of the contractor plays a very essential role. They have their own procedure for hiring a contractor. In addition, the above results showed that a large proportion of the respondents' organisations had also adopted processes of contractor selection in order “to comply with the organisation roles and regulation”.

Table 7-7 highlights the following methods which are used by clients for collecting contractor’s information. From the results it can be seen that in both the public and private sectors, more than half of the Libyan construction associations collect information regarding contractors from the applications made by clients. The rest of the Libyan construction associations collect information regarding contractors from applications made by the contractor.

Thus, the most common form of method to gain information is the traditional method where contractor information is collected through forms prepared by the contractors themselves. In comparison with modern methods, this method is considered to be a primary method. With modern methods, important information regarding the contractor such as their work portfolio is generally gathered by the use of an appropriate application form produced by clients.

Table 7-8 also highlights that a significant number of respondents in both the public and the private sectors can be obtained from the contractor could be divided in to three groups. The first group, chosen between 80-90% of the respondents, was experience and financial stability. The second group, chosen between 10-25% of respondents was reputation, technical and management, and health and safety record. The third group, chosen by respondents was cultural experience.

It is noted that the selection process of the contractor is known to suffer if he is not experienced enough or due to shortage of technology among the decision makers. Up to now in the LCI, there are no precise and detailed methods which have been put into use that could be applied to enhance the contractor selection process. Decisions made by using old methods of contractor selection, more often than not, fall short of providing good results.

Thus a great deal of research needs to be done before making a decision on any contractor. This also means that the research carried out here is to produce a useful tool for the LCI. A useful framework for the process of contractor selection can be built up which will help develop good and effective results, which can potentially be fundamental to the Libyan government. As a result of recent war and the change in government it has been essential to create a tool which would look after the construction industry in Libya as the infrastructure of the country needs to be reconstructed.

Whilst Libyan society contains many different ethnic Arabs, Toubou, Tuareg and Amazigh, the results presented suggest that two thirds of both the public and private sectors preferred to award work to contractors belonging to separate ethnic groups. This could be because the Libyan society has been affected by the conflict (civil war). Accordingly, and in order to avoid dispute, it is advised to the decision-makers that a contract should be awarded to separate ethnic groups rather than to specific ethnic groups.

The results also illustrate that the majority of both the public and private sectors thought that the socio-economic tribe has influence in the process of contractor selection. The result indicates that the Libyan society is a tribal society. In the light of these circumstances, the result of this research supports the argument of Grifa (2006) who described Libyan society as one which is closely organized around kinship and tribes. Further, in Libya's tribal society, "loyalty to the state, if awareness of the state exists at all, is minimal". Hence, the attitudes and behaviours of individuals and groups reflect to a large extent a strong loyalty to their tribes. Therefore, tribalism and its associated relationships factors should be taken into consideration when dealing with the contractor selection operation in Libya.

As mentioned in the literature review, personal attributes such as attitudes, traits, management abilities and experience are needed when choosing a sub-contractor project manager to help enable the project manager to complete projects effectively. Unfortunately the results of the questionnaire show that in Libya, sub-contractor project managers are often appointed without being qualified to do the job.

The results demonstrate the procurement methods types illustrated in the service offered by different clients. The result shows that about 62% of the total public and private sectors participants were using Separated and Cooperative (Traditional) method, 33% of the total respondents were using Integrated Procurement (D&B) Systems, and only 5% of the total respondents were using management contract procurement method, finally. Thus, we can conclude that the Separated and Cooperative procurement method is still the main procurement technique in practice in LCI. This is possibly because the Libyan government is still the main client in the construction industry. The government has still not fully embraced new and modern procurement methods such as management contract, turnkey etc.

The results show the main procurement systems types used in the service offered by different clients. The result shows that about 62% of the total public and private sectors participants were using Separated and Cooperative (Traditional) method, 33% of the total respondents were using Integrated Procurement (D&B) Systems, and only 5% of the total respondents were using management contract procurement method, finally. Thus, we can conclude that the Separated and Cooperative procurement method is still the main procurement technique in practice in LCI. This is possibly because the Libyan government is still the main client in the construction industry. The government still has to fully embrace new and modern procurement methods such as management contract, turnkey etc.

2. ***Contractors' classification levels***

The contractor should be classified into three classes based on the results of the private and public sector, as per the statistics stating 58% of public sector and 42.8% of private sector. Due to poor government policy in the infrastructure construction sector, most of the projects in Libya are considered small and medium projects which impose the need of contractor of small and medium capacity rather than major companies. In hope of major development processes taking place in Libya, there may be need to broaden the range of contractor classes.

Part three showed that the main criteria for selection are: financial stability, technical and management ability, experience, health and safety, quality and cultural experience. This result is consistent with the ranking given to those criteria by construction professionals. Financial stability was ranked the highest followed by experience, quality, technical and management ability, health and safety quality and cultural experience.

In order to see whether there was a difference in the views between the public and private sector, an independent samples t –test was applied. As in the results appendix (III) by running the independent samples t –test, we found no statistically significant difference between the groups' responses, which means that there is no bias. This means that the average value of the statistics from each group is no different from the value relating to the population as a whole.

Factor analysis and Cronbach's Alpha was used to assess the validity and reliability of using the sub-criteria as measure of the main criteria of Financial stability, Technical and management ability, Experience, Health and safety, Quality and Weather and cultural considerations. This will enable each cluster to reorganise the criteria and sub-criteria for contractor selection. As a result of the factor analysis test modified structure for sub-criteria, the factor loading for all the factors to be included were found significant above (0.5). Some necessary amendments to what was proposed by factor analysis were adopted justified and new criteria were generated. This will enhance the accuracy of the proposed model.

3. *Financial stability*

As per the SPSS results, arrangement was done according to the ranking of the financial stability both in public and the private sector. The main criteria are listed below in descending order as follows: financial statue, tender price, positive credit rating and finally banking arrangement. Hence after the Cronbach's Alpha coefficient test for internal consistency was conducted, it was assured that the results will produce a reliable scale. After implementing the factor analysis process, following sub-criteria were grouped under the Financial Stability criterions which are as follows: positive credit rating, financial statue, banking arrangement, and tender price and a good correlation which was found among of the financial stability's sub-criteria.

The expected result was due to the shortage of technologies in the Libyan construction industry and their inability to get hold of or track the financial history of the contractors. By investigating the contractor's financial statues and banking arrangement criteria is the only way for a client is to trust the contractor. Furthermore, the tender price is highly correlated as the majority of work is won via completion. Consequently, the final sub-criteria of Financial Stability are *positive credit rating, cash flow, banking arrangement, and tender price.*

4. Technical & management ability

There are certain criteria which need to be looked at for technical and management ability and are as follows: company past performance, project manager qualification, staff experience, staff qualification and company equipment.

In terms of ranking technical and management ability, there is high degree of agreement between both public and the private sectors. The companies' equipment is described as the most important factor which is usually followed by the project manager qualifications, which is termed as the second most important. A skill of the contractor is usually known to be defined by the capacity of the contractor to control and manage the work within budget are the specified timeframe. Thus it becomes necessary to implement the analysis process and prior to its application the technical and management ability criteria were comprised of, company past performance, project manager qualification, staff experience, staff qualification, company equipment. After applying factor analysis and Cronbach's Alpha tested the items, a new group was generated. That indicates that the technical and management ability criterion is divided into two groups as the following:

The first group comprises of factor one which is highly loaded and strongly correlated which is composed of *staff qualification and skills and staff experience training course.* This group was named as *Human resource criterion.*

The second group comprises of factor two, which further includes, *Project manager qualification, past performance and company equipment*. The name of this group was not changed and named as *Technical and management ability*.

5. Experience

The most significant issue was the experience of the contractor and both the public and the private sector had certain difference on this topic but agreed after making certain changes. This factor was ranked as the highest criterion by both sectors. The experience of the contractor was known to be the major issue in the selection process and also there were differences in terms of ranking the project. There was difference in opinion in terms of size of the project as the private sector was ranked third and the public sector ranked it second in importance. Again there was difference in opinion in defining the experience edge as it was ranked second by the private sector, whereas, the public sector ranked it as third. Though both the sectors had similar opinions in defining the length of time in and it was ranked fourth in rank.

Prior to implementation of the factor analysis, five essential sub criteria are known to be present in the criteria of experience, namely experience edge, size of project, length of time in business and experience in the region and type of project. After the test was finished, it was found that a very low correlation was seen and the number of sub-criteria was reduced. However, a very good correlation was seen for the test which was conducted in Cronbach’s Alpha test and the results were acceptable. As such, the final group of experience criterion that should be adopted are: *type of project, size of project, length of time in business, experience in the region*.

6. Health and safety

A large degree of negotiation was done between the public and the private sector on ranking the sub-criteria under the main heading of health and safety. The four foremost crucial sub-criteria ranked in descending order are (OSHA) incidence rate (points), safety record, company safety policy and experience in noise control.

From Table (7-21) the value of KMO can be seen as 0.470. This is not accepted to be exceptional. Therefore factor analysis is not appropriate for this type of data. The weakest correlation test has to be taken into account in order to remove the KMO test which is for OSHA.

It was expected that the results of the OSHA criterion to have a low level of correlation within both sectors. As *OSHA* is the abbreviation for “*Occupational Safety and Health Administration*”, which is the main federal agency of the United States that regulates workplace health and safety. As Libya was at siege with the United States of America for about 30 years, this disadvantaged Libya by being unable to access numerous imperative and essential services and OSHA was one such service. It is for this reason alone that many of the younger generations have no understanding of this criterion. Nevertheless, the results reveal that in the last group the health and safety criterion consist of; *safety records, company safety policy, and experience in noise control*.

7. Quality

Both the sectors highly agreed on rating the sub-criteria making up quality. The four most important sub-criteria for quality in descending order are; *quality management, quality work, quality assurance and quality policy*. This group has a high level of correlation despite table 7:49 displaying the value of KMO as 0.495. This coefficient is unacceptable. As a result, it is certain that factor analysis is not appropriate for this type of data. Therefore as a consequence, the weakest correlated factor is quality control which should be removed.

8. Culture experience

To rate the cultural experience sub-criteria, there is high agreement between both the sectors in rating the cultural experience. Both sectors considered the relationship between the suppliers, contractors and sub-contractor as second best by both the sectors. The sectors concur on weather which is considered as third by both sectors. The last criterion in the important contract selection process was claims and dispute and was selected by both sectors.

Prior to the factor analysis process being applied, the criterion for culture experience consisted of the following four sub-criteria: relationship with (Supplier sub-contractors, client and local working), claims and dispute, culture, and weather consideration. After testing the items after applying factor analysis and reliability statistics a new group was generated in which the culture experience criterion was divided into two groups as follows:

The initial sub-grouping of the culture experience criterion consisted of the sub-criteria of: *relationship with (Supplier sub-contractors, client and local working), claims and dispute*. It was suggested to name this sub-group the *Reputation.*

The second sub-group consists of the sub criterion of relationship *with culture, and weather consideration.* It was suggested to name this group cultural and weather culture consideration.

- ***Private and public sectors***

In this research, by investigating and comparing the results between private and public sectors, it can be said that no difference has been found between the two sectors in the contractor selection procedure. That may be because the public sector represented about 85% of the LCI and the private sectors only represented 15%. That means the vast majority of construction conferences, training courses and human resources have been demonstrated by the public sectors. Also, most of those in the private sector are also working in the public sectors as the Libyan government has no real system to control their employees. Therefore, both sectors are using same techniques and utilising the same methods for contractor selection. This result is supported by applying an independent sample t –test, factor analysis and Cronbach's Alpha test for all the criteria and sub-criteria.

Previous studies consider how different processes of contractor selection are utilised. All of these processes intended to select a competent contractor in a competitive environment, but the final decision relies mostly on the proposed service's price and financial stability (Chau, et al., 2003), whereby financial stability of contractors is the most important criterion for selection best candidate contractor. However, in contrast, the results of this study found that this criterion is not the best factor for selecting the best contractor and that the contractor experience has been selected as the most significant factor. The results demonstrated that the highest ranked criteria are experience, financial stability, quality, technical and management capability, reputation, health and safety, human resource and cultural and weather consideration. Conducting the Cronbach's Alpha test for the main criteria of the suggested model indicated that there is a good relationship among the criteria used.

However, it is interesting to compare the results of this rating for contractor selection criteria with another pertinent study. Darvish, et al. (2009) found that the main ranked criteria in the Iranian construction industry are: experience, management capability, financial stability, quality and reputation. In a survey of UK contractors by Topcu (2004), candidates are first assessed and scored with respect to four key pre-qualification factors: ability to complete projects timely; organisational expertise; availability of experienced technical staff and availability of resources especially plant and equipment

CHAPTER EIGHT: PROPOSED FRAMEWORK

8.1 Introduction

The previous chapters dealt with some of the results and findings based on answers acquired from the questionnaires survey. On the basis of data recorded an important framework of how contractors working on major constructions in Libya can be selected and has been illustrated. Thus, it gives a combined picture of all the various kinds of issues faced based on the questionnaire survey. Several of the main factors related to the selection process have been discussed in detail using various sources of data collection. Also, the chapter includes the most serious problems that one faces while selecting a contractor and talks about appropriate solutions for these problems. The chapter ends with a short summary of all the topics.

Table 8-1 gives a set of criteria that can be used for the contractor selection. The advantages of these guide criteria are that they will help:

1. Ensure that contractors will be suitably selected
2. Ensure that contractors will be able to execute projects successfully
3. Enhance the success of projects in relation selecting the wrong contractors
4. Overcome the limitations apparent in the current situation

8.2 Sources of data for the framework

Primary as well as secondary research methods were used for collecting data. Collection of secondary data was carried out by a number of literature surveys which made it possible to pick out apparent causes for a selection procedure and based on the related issues that sprung up; the questionnaire survey and Delphi survey were designed as primary research methods. This study was carried out among many participants including Consultants, Contractors, Construction Managers, Project Managers, Clients/Top Management, and other Construction Professionals in the same field of expertise, Government Departments, Universities and Academic Lecturers. Case studies were also employed as a second source to confirm the existing problems faced during selection processes and also to explain some of the results of the survey. A framework similar to a guide was produced after these data sources were reviewed using quantitative data analysis technique as an external aid for Libyan construction (Fig. 8-1).

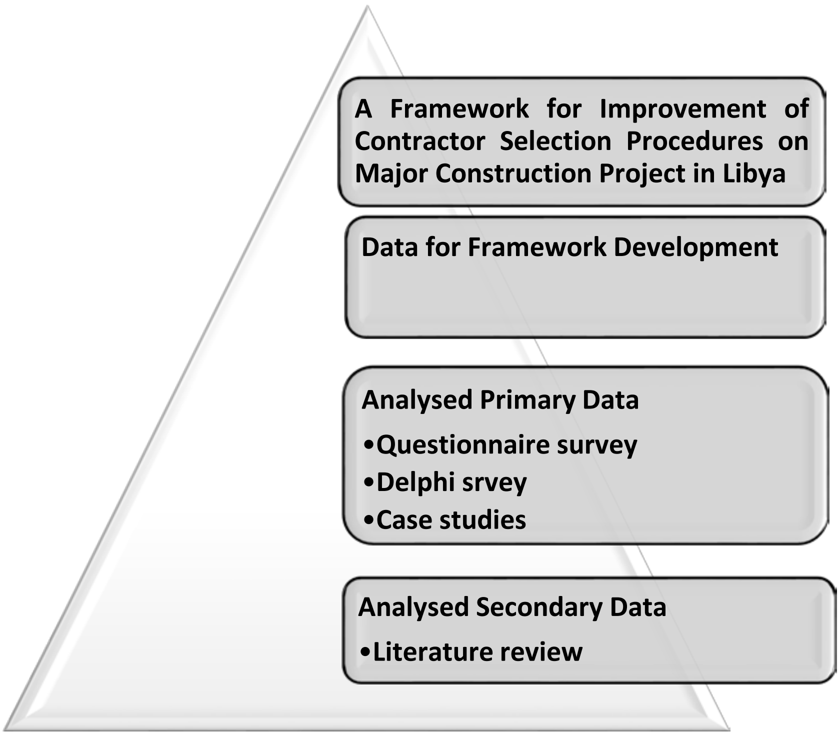

Figure 8-1 Sources of Data for Construction Projects' Framework Development

8.3 Introduction to the framework

The literature review, questionnaire survey, case studies and Delphi survey, all contribute to the formation of the framework and the research. Using these frameworks, one is able to find suitable approaches in order to improve the contractor selection process in Libya as it shown in figure 8:9. The framework can be illustrated as follows:

Selection procedure in Libya is not carried out on a formal basis but by committees indicating that contractors with a poor financial record and lack of knowledge and relevant backgrounds are likely to be appointed causing failure of the projects due to delays or overruns. Many times, the contractor’s workforce fall short of the essential knowledge and expertise which is directly linked to the construction sector dedicated policy of the Government. No evidence of compulsory training schemes for workers has been found and thus there are not many well qualified workers.

Economic and political related issues have brought about hindrances to the selection of contractors, e.g. rise or fall in prices, shortages of raw materials, companies facing restrictions and bans on foreign workers. These kinds of factors also lead to a gradual development of selection process instead of a rapid one, especially in Libya. Furthermore there is a lack of support from parties, the construction companies, as well as the implementation companies, which contributes to the slow growth of contractor selection process.

Finally, no procedures are followed whereby the contractors can be monitored and reasons for failure of some projects can be deciphered. This has a negative effect with respect to time, cost and quality because, due to shortage of time, some of the projects are unable to reach acceptable limits in quality and several others can overrun. These can be avoided by providing proper training to the contractors.

8.4 Political environment

Political environment factor is where the basic regulatory guidelines need to be clearly defined and invariable. A continuous strategy should implement any change in the government’s policy. The policy should be able to take care of the clients and contractor’s needs. Further, as the government is the main artery of the construction industry in the country, the government should adopt a strict policy to improve and implement the procurement policy. All these factors must be taken into consideration before onset of any construction project. It is recommended that the public and private sectors adopt a long term plan which will greatly improve and develop the Libyan selection process. Over the past few years, poor planning in the construction sectors has led to the slow development through short term plans adopted by individuals in higher posts and major planning done by the inexperienced. Hence the frameworks need to be improved so that the selection process is perfected by following the solutions below:

8.4.1 Training

Of paramount importance is the need for decision makers to be well trained so as to achieve an acceptable quality in the overall construction project. Thus, it is implied that training centres and departments should be initiated by the Government. Moreover, they must work in collaboration with other more technologically advanced countries so that the efficiency rate of decision makers is improved. Certification of decision makers in construction skills could prove beneficial to the selection process as technical as well as management skills are developed. The achievement of this would help provide a professional workforce and make sure that all selection assignments are accomplished successfully.

The training programmes should include all those participating in the construction project planning, management and operations at national and local levels. These must also be investigated and assessed so that the results are used to improve the overall system in Libya.

8.4.2 The Policy of the Sector

In Libya, one of the very important reasons contributing to the poor selection of contractor is the climate for the construction sector. It is not just the construction climate but even the unstable government policies that are a hindrance to the procedure; lack of planning on the part of bureaucracy, constantly changing policies in the area of construction also hinder the selection procedure. In addition, if the personnel in charge of the project changes during the process of contractor selection, the procedure is bound to slow down. One must keep the following points in mind while making these decisions:

- A comfortable working environment for selection process should be created which will in turn create competition. This is a positive effect on this sector as competition in the field will lead to better results. This can be achieved by stable policies of the Government, clear standards and regulations.
- Application and implementation of the contractor selection procedures must be carried out seriously by committees consisting of eminent professional persons. Divisions of these committees into sub-committees like financial, management and technical sub-committee can share responsibilities for monitoring and implementing the sector's plans.

8.4.3 The Private and Public Sectors

As the public sector dominates about 85% of the LCI, the framework suggested that the implementation of public and private partnerships in Libya enables both private and public sectors to get better value for work in delivering public services. Furthermore, the possible formation of a knowledge pool among them, which could contribute and improve the progress in the selection procedures of contractor, brings about a competitive atmosphere.

8.5 Management methodologies

An approach that can be applied that can surely bring about success in improvement of the selection process is the use of correct methodologies related to management. The management methodologies that are in use among construction organisations are quite variable and complicated. Changes made during the course of a project, like change in personnel, affects the success of contractor selection where wages and administration are concerned. Also, development of the contractor selection procedure is reflected by the traditional administration methods utilised in Libyan construction sectors such as exchange of interests and social relationship. Lucidity level in the areas of contractor selection is a huge impediment in the development of selection procedures. Development also faces obstacles like monitoring without the aid of computers, using conventional means which are outdated. Integration between various departments lacks a computerised interface making it difficult to develop at a higher rate. Some recommendations that can be made in this framework are as follows:

- Firstly, education and training in construction should be given a higher priority. More focus must be added to organisation and management of people in the contractor selection process.
- Secondly, stress should be given to integrate a computerised system in the CI.
- Thirdly, the management approach in the LCI should move towards a new open market approach. Working atmosphere will change by design when this change is made.
- They should also be in line with the latest regulations and policies adopted by this sector.
- Fourthly, all aspects regarding the understanding and knowledge of the construction industry must be strived for.

8.6 Investment in human resources, training and education programmes

Two major hurdles are faced when it comes to human resources with LCI. The first problem is poor quality as well as quantity of available human resources. Even though the training provided in the construction field has been of great importance, Libya has not been able to both increase the number of workers in the LCI and increase the number of indigenous people to work in construction, although, currently, there is a growing dedication among the population to train in construction which will help impact management and efficiency. By this framework it is obvious that the courses must undergo review on a regular basis to keep on par with the current scenario of the global sector.

8.7 Contractual management

Contractual management are methods that are outdated and thus contractors bear the brunt of the consequences of it making interruptions in payments and finances. Most companies do not find contracts favourable to their needs and hence avoid getting into such agreements. Contractors must thus be able to see eye to eye with every party included in the contract. These contracts must be assessed, updated and enhanced whenever the need arises.

The contract must be in line with the international standards set for the same. There have been cases where the contractors did not match the international requirement. Hence, the contract had to be passed on to local contractors with little or no experience. This resulted in too many good local and international contractors rejected for tender for contracts which were then awarded to local small construction contractors with little experience and a poor record of actual implementation. Therefore, it is unsurprising that many projects accomplished were not very successful.

The contract, at the moment of signing, must clearly mention that any policy decisions that come into being after a particular contract is signed will not be applicable to the project. Hence, neither party is affected due to a good or bad decision once a project has already been undertaken. Thus, in order to avoid any conflicts between the two parties, the framework highly recommends that both parties seek professional guidance for the same. Also, the kind of project and also the amount and type of work that is to be done must be taken into consideration.

8.8 Tendering

The tender process is considered to be mainly reliant on subjective judgment of the decision makers especially when cost is not the only criterion utilised. Tender evaluation and contractor selection for the delivery of major projects and services is acknowledged as a complex undertaking that embodies many uncertainties. Occurring early in the project life cycle, it is perhaps one of the most critical undertakings performed by clients, the effectiveness of which is directly related to project success and the achievement of specified objectives

The results provide an important contribution to the topic of contractor evaluation. In particular, this research emphasises the importance of common criteria used in an actual choice of contractor and draws on novel techniques used by other discipline as tendering is a difficult point for the contractor selection. This framework suggests that transparency is the key feature in the tendering selection process, with obvious agendas and standards laid down for contractors and subcontractors, that the lowest and the highest two prices tendered must not be given priority in selection processes.

8.9 Procurement system

The choosing of appropriate procurement technique is one of the most important factors which would decide whether or not a project will successfully meet its end. Improper procurement systems for a construction project and the lack of clarity in procurement and systems is a criterion that will affect the process of contractor selection and considered to be one of the chief reasons of project failure. The findings of the literature review demonstrates that the procurement systems should be understandable and obviously defined before the contract is signed. Also, the Libyan procurement system consists of traditional and D&B. Recently, those methods do not appear to have well-established contractor selection procedures. There is a necessity to decide which procurement systems are appropriate for the operation of construction projects. In order to adapt to any changes in requirements of the construction sector, the procurement systems should be upgraded and developed from time to time. Libya has seen a lot of conflicts and disputes between contractors and clients as the contractors have failed to employ skilled labour and modern technology to accelerate the process. This framework highly recommended that a modern procurement system is imperative to ensure desired results in terms of quality. Some key defects of Libyan procurement technique are recognised:

- lack of buildability in designs
- inaccurate estimates of bid and incomplete documents
- poor communication and information systems

- delays of the payments to contractors
- unclear and vague contracting

8.10 Ethnic group

As the Libyan society contains many different ethnic Arabs, Toubou, Tuareg and Amazigh it can be said that tribe is the backbone for the Libyan society. Based on the results of the literature review, it was suggested that the award of a contract to joint owners of a company belonging to separate ethnic groups had more chances of success than from individual owners who belonged to specific ethnic groups in the Libyan context. Hence, this framework recommends that this factor might need to be considered as a hypothesis in further research and consequently tested.

8.11 Pre-qualification process

8.11.1 Classification levels

The main goal of contractor pre-qualification process is to reduce the opportunity of contractor default and bidding by restricting the numeral of eligible contractors involved. Contractor pre-qualification process is an essential task carried out by a contract administrator or clients due to the complexity involved in this process to avoid, reduce risks of contractor failure and improve client satisfaction and to optimise the contractor selection in terms of attaining a better balance between price and performance parameters. Furthermore, the aim of contractor pre-qualification is not only contractor capability assessment but also control of potential bidders. In some cases, it is required not only to judge whether the contractor fulfils the essential criteria, but also to what degree they are fulfilled. Additionally, not all criteria are similarly important for the owner. The basic issue is assigning the right weights to the criteria. In considering the current scenario, Libyan industry predominantly employs small and medium range contractors over major ones. It is also necessary to keep in mind that Libya feels that there should be a different and modern set of criteria in order to prequalify and register a proper contractor. Therefore, the framework highly recommended that contractor pre-qualification procedure should only require contractors on the approved lists to have the ability to tender for contracts. The lists of approved contractors are in four groups (A, B, C and D), based on their financial capacity. Small contractors are designated as those with ability of less than $1M;

medium sized contractors are those with ability between \$0.5M± \$1M; and large contractors in between \$1M± \$5M; and largest contractors in between \$5M± \$50M. Each category should be classified into five categories (site formation, buildings, roads and drainage, port works, and waterworks) according to their relevant expertise and managed by the relevant Works Departments.

8.11.2 Contractor collection information

Employing the correct method for collecting contractor's information is one way of improving the contractor selection. The use of traditional methods of collecting contractor information has to be done away with to give way to modern and more appropriate approaches. It is management who is responsible for ensuring correct information is collected and used for the best. There are some areas in communication and information systems which need to be developed. Hence, this framework recommends that the strategies of collecting contractor's information should be based on modern methodologies. Some key points that need to be kept in mind at this stage are listed below:

- Firstly, there should be a link between decision makers and contractors that should be increased as well as the cooperation and collaboration among all participants.
- Secondly, due to problematic geographical distributions, information technology and wireless communication systems should be improved and applied in the operation of the pre-qualification and contractor selection procedure. A concerted effort needs to be made in this regard by the Government.
- Thirdly, tribalism and administrative corruption should not have a hold over communication and information systems and should be eradicated.

8.11.3 Frequency of reviewing contractor criteria

The aim of contractor pre-qualification is to create a small list of contractors who are able to meet the performance requirements of the project. The selected list is usually decided on though evaluation from which the long list of potential contractors is reduced. This process is often based on contractors' responses and a short list will include only the best-qualified contractors. From the selected list, the client will choose a formal bidder. Tender lists should be reviewed on a regular basis to exclude firms that have performed unsatisfactorily or become unsuitable due to corporate decline. It has been shown that contractor pre-qualification processes are rarely reassessed more frequently than annually or more worryingly, not at all. This is in spite of the fact that one of the main concerns of pre-qualification is the long term confidence attributed to it by many clients. Therefore, there is an inconsistency not just in the demand for contractors but also in the time and frequency of pre-qualification. This might be due to an absence of any local governmental regulatory policies. Therefore, this framework highly recommends that the reviewing of the contractor should be reassessed annually at least once a year for small contractors two to five times for the big contractor.

8.12 Contractors selection criteria

Successful selection of a good contractor has consistently shown a successful completion of the project in Libya. It thus becomes one of the most important stages in this process. It is implied that the choice of a bad contractor can hinder the progress of a project. The wrong selection of contractors can be attributed to the absence of any selection criteria for the same. Hence, in this framework, it is strongly recommend that there should be a set of criteria to be used as a guide when selecting and appointing contractors. One must do extensive primary and secondary research before selecting a contractor for a project and should also include the codes of practices used in some countries. This research has revealed that the most important selection criteria for contractors are financial stability, technical and management ability, performance of contractors, experiences of contractors, health and safety concerns, quality assurance, and availability of resources. Comprehensive selection criteria by different researchers are presented table 8.1.

Also, the already unofficially existing criteria are equally important too. It is important to look at the ability of contractors to work in different climatic conditions. For example, a contractor who takes up a project in Libya should be able to survive and work in those climatic conditions. He must be bilingual and should be able to communicate in English as well as in Arabic. He should also be sensitive to the needs of the local people and plan his work sites accordingly. The lack of these abilities could cause delay and/or failure of the project and dissatisfaction on the part of the client. Keeping the cultural and climatic set up of Libya in mind, a set of guidelines has been proposed in Table 8.1 that must be kept in mind while selecting a contractor. These guidelines are not only expected to simplify and ameliorate the selection of contractors but also overcome the currently existing problems.

Origin and cultural background become an important factor when the task is to be given to a foreign contractor. Although a foreigner may have the technical knowhow for a given project, lack of knowledge of the local culture could result in a failure of his project. In order to determine the background and the possibility of a contractor succeeding in a Libyan construction project, his past experience could be taken as a reference. His success ratio and ability to adjust to local settings in the past could induce that the contractor might succeed in the future too.

Based on the results of the questionnaire, which reveal that the contractor experience is the most important factor in the prospects of the decision makers, the frame work suggested that the process is implemented in three stages: First, assessment of the contractor's experience. Second, rejecting the highest two and the lowest two; third bargaining for and selecting the contractor that offers a price closest to the average.

There is some variation in the second stage worldwide with some examples to illustrate; for example, Denmark rejects the highest two and the lowest two and selects the contractor that offers a price closest to the average. South-Korea, Portugal and Italy reject the highest one and the lowest one and select the contractor that offers a price closest to the average. In France, the highest one and the lowest one are rejected before selecting the contractor. In Turkey, Canada, USA, Lithuania and Iran, the lowest bidder is selected. All these processes aim to choose a capable contractor on a competitive basis.

As a result, it can be concluded that, in this framework, contractor selection depends on various factors and the procedure is utilised in two-stages: At the beginning, the contractor's experience is assessed and then comes bargaining for a price and financial stability.

Table 8-1 Merged list of Selection Criteria for Contractors

Main Criteria	Attributes
▪ **xperience**	▪ Size of project ▪ Current work load ▪ Experience in the region ▪ Type of project
▪ **inancial Stability**	▪ Tender price ▪ Banking arrangements ▪ Cash flow ▪ Positive credit rating
▪ **uality**	▪ Quality work ▪ Quality management ▪ Quality assurance
▪ **echnical & management ability**	▪ Project manager qualification ▪ Past performance ▪ Company equipment ▪ Management structure ▪ staff experience ▪ Staff qualification
▪ **eputation**	▪ Relationship with(Employees, Suppliers, sub-contractors, consultant & client) ▪ Claims and dispute ▪ Past completed and uncompleted projects
▪ **ealth and safety**	▪ Safety record ▪ Company safety policy ▪ Experience in noise control ▪ Occupational Safety and Health Administration (OSHA)
▪ **ulture & weather consideration**	▪ Culture consideration ▪ Weather consideration

To conclude this, the general contractors' selection criteria, which are used for standing list criteria (table 8-1), are confirmed as good for use in selecting contractors in Libya and discussed further below. These criteria were collected from the literature review, questionnaire survey and Delphi survey. Thus, the framework highly recommends that the following criteria and sub-criteria should be utilised as a method to choose the most proper contractors, in order to overcome any hindrance that might disturb the success of construction projects and enhance the development and contribute to the selection process.

1. Contractor Experience

Based on the literature review and data analysis, it was found that the experience of the contractor is considered the most important factor utilised in the contractor selection procedure. The experience of contractors are usually evaluated depending on project size, current and completed contracts, type of the projects and experience in region. Moreover, experience in the tender sum and determining the contractor's profit margin is also essential, thus avoiding a comparatively outrageously high or ridiculously low tender sum.

The result also indicated that contractor experience is a critical issue nationally for the contractor selection procedure due to a lack of experience among both the Libyan contractors and decision makers.

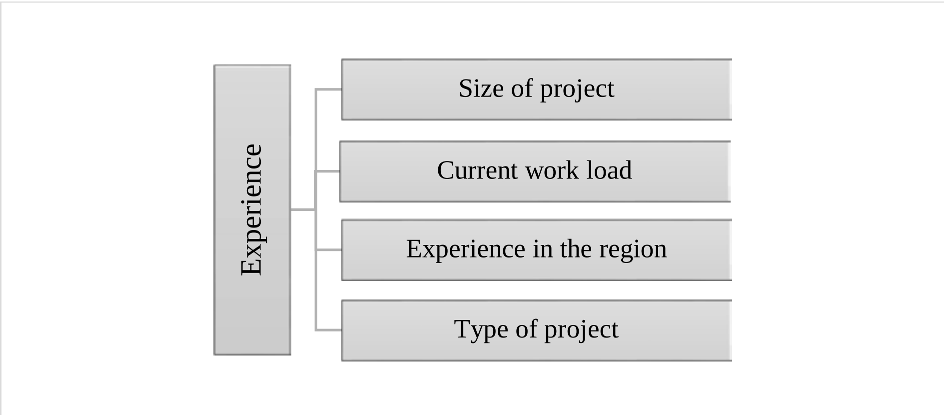

Figure 8-2 Main criteria and its sub-criteria of Contractor Experience

- ***Type of project***

The results strongly indicate that the project type undertaken by a contractor highly contributes in identifying that contractor's capability. Moreover, the result also confirmed that the vast majority of project delays in Libyan construction projects are caused by lack of experience in the line of work. That is because of poor classification and pre-qualification of the contactor in the organisation prior to project tender. Therefore, the results emphasised that experience in a same type of project usually gives the contractor a competitive edge in the construction market. Furthermore, a high proportion of well-qualified staff working in the same line of project as the company should be employed.

- ***Similar size projects***

The literature review and questionnaire survey stated the significance of the number of similar sized accomplished projects. This has also been identified as a significant sub-criterion which is critical in the contractor selection procedure. The size and number of similar accomplished projects reflects the contractor's experience and capability to finish the projects. This information can be obtained by asking the contractors to provide the history of completed projects of similar size on the evaluation framework form. Consequently, the framework emphasised that the candidate contractor should provide a list of the projects they have completed in the past ten years according to size. This would indicate to owner many essential things such as:

1. Competency to allocate sufficient resources to a big project. Further, this criteria informs whether the candidate contractor has previously struggled in the previous projects or not, especially in financial requirements.
2. The experience of accomplished projects in different area.
3. Maximum work load which can be carried out.
4. Size of the contractor.

- ***Current workload***

The contractor's current workload and competence was explored in the literature review and questionnaire as a significant sub-criterion. The result emphasised the significance of revealing the contractor's present workload and competency, and the commitment to support the new project. The capability of the contractor can maturate dependence on available resources, and current workload. Further, it can be used to sieve out and reject those contractors who are overloaded. The framework identifies the main determining factors and their important weights for the contractor selection. The current workload is considered as one of the most significant sub-criteria in the decision procedure.

- ***Experience in region***

The results, literature review and the questionnaire survey data analysis agreed on the significance of assessing the contractor experience in region in the contractor's selection process. As stated before, Libya is geographically located in the central north of Africa in the hot dry area, with the vast majority of the total area of the country categorised as desert and semi-desert lands. These factors influence the current shape of the CSP. These factors can be evaluated by identifying and investigating the number and nature of the projects in the region with both the company's past completed and uncompleted projects.

2. **Financial Capability**

Based on the literature review and data analysis in Chapters 3, 4 and 7, it was found that a contractor's financial stability is considered the second most important factor utilised in the contractor selection procedure. This section discusses the key financial stability's sub-criteria which were found from the literature review and data analysis. This section also illustrates a model for financial stability criteria (Figure 8.3). The model is dependent on a set of sub-criteria that necessary in use to determine the contractor's financial ability.

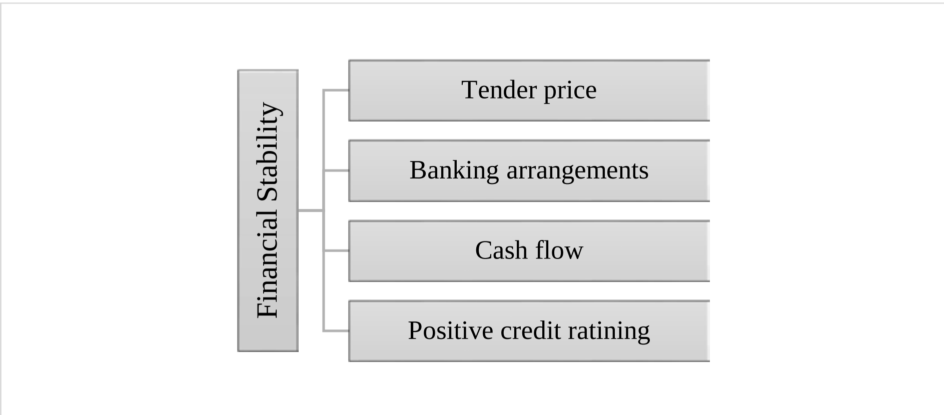

Figure 8-3 Main criteria and its sub-criteria of contractor Financial Stability

- ***Tendering***

For a contractor, it is difficult to approximate his margin of profit amount and that is one of the most important reasons for a contractor to fail, due to contractor competition. The tender procedure is considered to be mainly based on the subjective judgment of the decision makers, especially when cost is not the only criterion utilised. Tender assessment and contractor selection are complex undertakings that embody many uncertainties. Furthermore, it needs a highly qualified team to estimate margin of the profit added to the construction material, equipment renting, taxes, insurance, subcontracts and cost of labour. However, in many projects, a reduction in profit might not be considered by the decision makers because due to the special nature of some kinds of projects which may require specific skills. Adding a small profit margin could lead the contractor to failure whilst on the other hand adding a high margin of profit to the bid might make the contractor lose the project. Therefore, this framework suggests that transparency is the key feature in the tender selection process, with obvious agendas and standards laid down for contractors and subcontractors. The framework suggests that the lowest and the highest two tender prices must not be given priority in selection processes.

- ***Cash flow***

Cash flow is considered the lifeblood of the contractor and relates to the incoming or outgoing of money to or from a company. It directly impacts a company's ability to fulfil its financial responsibilities. Further, it plays a critical role in financial capacity of contractor and in the financial strength of the contractors for running the business. Also, it gives an estimate that might be utilised as an indicator of the contractor's capability to cope with the financial activities and commitment required of a project.

Because of the deterioration of the banking services in Libya, the majority of Libyan contractors' expenses are paid in cash. Consequently, many delays and failures have been caused in the LCI due to a lack of contractor's liquidity to support daily commercial activities. Thus, in order to avoid a cash flow problem, the construction contractor must maintain a satisfactory and adequate cash flow level.

- ***Bank Arrangement***

Public construction projects in Libya usually involve high financial commitment due to their size and type. The contractor needs to prove financial competence to cope with the financial commitment necessary to complete the public project as well as evidence of their banking arrangements as part of the measure of financial ability. This involves bank financial facilities and statements. The literature and fieldwork indicated the importance of contractors' banking arrangements to secure a contractor's financial activities in a project and also need to be identified and assessed to ensure that the banking arrangements comply with the project requirements. This outcome agreed with the questionnaire outcomes on the importance of adding the banking arrangements to the contractor selection evaluation framework. The banking arrangements can be assessed by the contractor providing evidence from the bank to show the contractor's arrangements as part of the criteria evaluated. Finally, the framework needs to evaluate the source of the financial arrangement. This is mainly to identify the bank or the financial organisation to ensure the reliability of the source.

- ***Positive Credit Rating***

Contractor positive credit rating is one of the criteria explored in the literature survey and the fieldwork data analysis. The literature review and fieldwork stressed the importance of identifying the contractor's credit rating in the selection process. The result confirmed that the credit rating can provide an insight of the contractor's financial ability to cope with the project and fulfil its commitment to the project and to the contractor's financial stakeholders. Further, the credit rating is the most critical and important criteria in the contractor's selection process. The outcomes strongly agreed with the questionnaire analysis. The result stated that the most appropriate method for finding out the contractor's credit rating was by asking the contractor for a bank reference and bank credit rating certificate.

3. Quality

The literature review and the data analysis emphasised and agreed on the significance and necessity to assess the contractor quality in the contractor's selection procedure. More recently, selection of the cheapest contractor has received many criticisms by researchers due to it causing many problems in projects, such as poor performance, shoddy construction, low quality, delays and claims and disputes. Because of that, this framework is designed to directly avoid the lowest two competition bids. Therefore, the candidate contractor has to provide proof of his past completed projects and quality record of contractors within the past 3 years. Long-term quality of the contractors ought to likewise be sought during the tender assessment procedure. This criterion includes quality of work control, quality of work and quality assurance of the contractor's in the last three years. The contractor's quality can be evaluated by assessing the quality and number of the past projects completed by the contractor. The contractor quality model is presented in Figure8-4

Figure 8-4 Main criteria and its sub-criteria of contractor Quality

- ***Quality of work***

The criterion of contractor quality of work was discussed in the literature and was identified as a significant factor to be included in the contractor selection procedure list in the last three years. Based on the study outcomes, the quality work of contractors in the past 3 years is a critical factor in contractor success. Incapable financial stability of the contractor and lack of experience of the staff and labour force usually leads to late achievement and inacceptable quality of work. Consequently, to reach the required standard level quality of work, clients should not select the contractor with a low tender price and the candidate contractor must be financially capable as well as employing a well-qualified labour force. This factor can be evaluated by identifying the financial capability of the contractor, as well as the experience history of the staff and employees, plus number of the past projects completed.

- ***Quality assurance***

The literature and data analysis found out that quality assurance increased the contractors' capability to consistently deliver a project to the necessary specifications of time, cost and quality. It is the key system for how a contractor can avoid errors or faults in the project especially in huge projects. Usually, this criterion evaluates the number of sample tests of materials that have been done by contractors to meet the required quality.

- ***Quality management***

At the first stage of the projects, the client has to select an appropriate contractor in order to reach to the required quality of construction project. The quality management system for the contractor is essential for all project parties especially clients and contractor to reach to the required quality and avoid any unexpected hazards. The quality management systems seek to determine the most effective record of the quality of work to reach the client's needs by using one of the International Organization for Standardization, ISO 9000, which deals with the fundamentals of quality management system. Therefore this framework considered it as the best operative system to use it for quality managing program of any contractor.

4. **Technical and management capability**

Contractor technical and management capability cannot be unattached from human resource. Both play a significant role in controlling capability and the project efficiently. Therefore, the expert groups stressed the need to re-join technical and management capability with human resources management.

Contractor technical and management capability was identified by the literature review and questionnaire survey as one of the most essential criteria that must be involved in the contractor's selection process. This factor can be assessed by investigating the competence of senior manager's technical capability and project manager, as well as the company management structure and company equipment. Figure 8-5 presents the contractor technical and management experience capability sub-criteria.

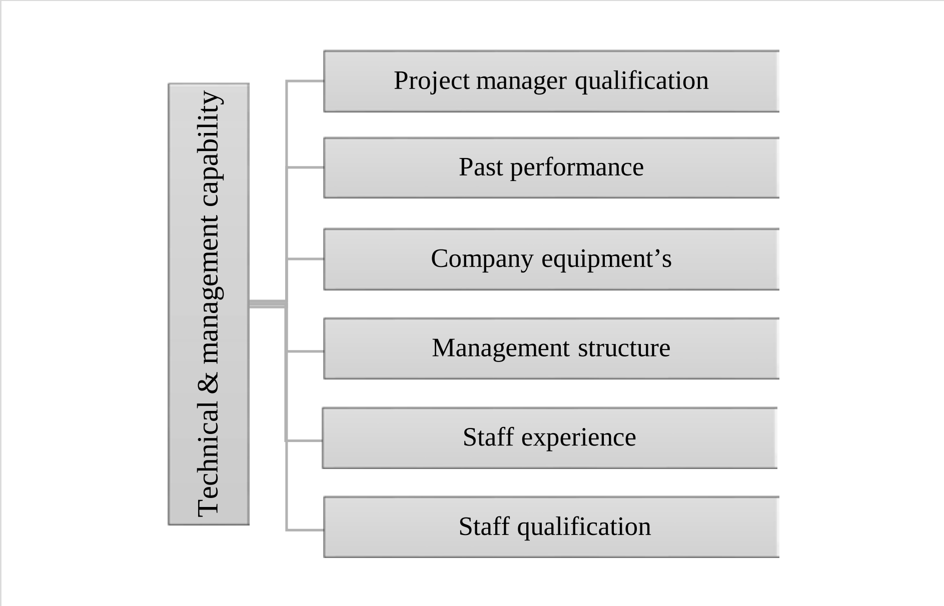

Figure 8-5 Main criteria and its sub-criteria of Technical & management capability

- ***Company equipment***

The literature review and the data analysis emphasised and agreed on the significance and necessity to assess the contractor company equipment in the contractor's selection process. The situation of the LCI's market, especially in part of construction equipment and materials, can be identified as unsteady. This usually causes increases in prices of the equipment and materials which leads to an increase in the project's cost. This sub-criterion is focused with the contractor's capability to provide appropriate and effectual equipment to accomplish the work and could be evaluated by the number of equipment to be used in the project. The expert group stated the significance of the quality of equipment on achievement of the work.

- ***Project Manager***

The relationship between contractor and project manager is of utmost importance and is taken to be the key factor for the success of any project. They are the ones who are directly responsible for any outcome of the project and thus it is natural that enough care should be taken when choosing a project manager.

Good communication within a project team serves as a road to success as it helps each one to understand the other and also the demands that need to be handled. Communication is an important criterion in projects but in Libya, it is not unusual that the project manager carries out a number of other odd jobs at the same time, causing problems relating to the achievement of projects as scheduled. Such managers are overloaded with tasks of variable natures and are therefore destined to falter and lead to failure of projects. As a result, there is no certainty that any communication by a project manager can be projected to others engaged with the same task confidently. Generally project managers in Libya have very little basic language skills while some of them cannot speak any other language apart from Libyan causing problems in communication and misunderstanding between the project manager and others in the team. Occasionally, the selected project manager has weak English language skills and may require the use of an interpreter to facilitate communication with other members of the project. Therefore, language and culture should be also taken into the consideration especially for a country such as Libya with its special customs, traditions and culture, and the weather which is considered very hot in most months of the year. Therefore, this study framework recommends that there ought to be standard factors to be utilised as a guideline when choosing and specifying the project manager, to improve the level of achievement within construction projects. Thus for a project to be successfully implemented, it is necessary to take all the above discussed things into consideration while choosing a project manager.

- ***Previous Project Performance***

The literature review and the data analysis emphasised and agreed on the significance and necessity to assess the contractor past performance in the contractor's selection process. This factor has been regularly utilised for the contractor selection procedure. The performance history of a contractor needs assessing to define whether or not the contractor has undertaken similar projects in the past or currently. This indicates that having experience in similar type, size and degree of complexity projects is considered an essential assessment criterion in terms of accomplishment to a predetermined time schedule, within specific budget and required quality.

- ***Staff experience and skills***

The literature review and data analysis confirmed that the skills and experience of project management staff are indispensable to successful running of the project. The experience and skills of staff need to be determined and illustrated before project commencement. Finishing the construction project needs high skill, competence and experience of project management staff. Contractors need to provide proof of staff experience in project management as this will reassure the client in the contractor’s capability before awarding the contract. Prior experience and skills in the management administration signifies the contractor's project management ability, capability and skills to manage and control a project efficaciously. To identify the strengths and weaknesses of this sub-criterion, past experience edge and CVs of staff should be checked and investigated.

- ***Staff qualification and training course***

Staff qualification and training courses are a significant part of any construction company. In addition, construction staff should be well qualified and have attended sufficient training courses, developed language and technical skills and experience in project management. Furthermore, staff should have exceptional skills in other areas such as problem solving as well as technical background, sound knowledge of project management implementation processes, administration and supervision skills and ability of risk management assessment. This can be reached by evaluating staff CVs.

- ***Contractor management structure***

Company management structure demonstrates the contractor and staff roles and responsibilities. It illustrates the contractor’s bureaucratic and decision making procedures. Contractor management structure is an indication of the company’s management system and capability and assists in determining the efficiency of the contractor’s management structure. The expert group agree that it has an impact on project accomplishment time as well as aiding recognition of the company’s strengths and weaknesses from the technical and management capability’s standpoint.

5. Reputation

The reputation of the contractor makes the construction project owner confident about their tender decision. The project owners expressed that a known contractor for them, i.e. one who has completed several projects without a failure, makes them relaxed and confident in their final decision. They expressed the importance and the need to identify the number of past project failures. This provides an indication of the contractors’ reliability in completing the project.

The relationship of the contractors with business stakeholders are important and also needs to be identified and assessed during the contractor pre-selection phase. These relationships include contractor-supplier, contractor-project owner, contractor-client, and contractor-subcontractor. Past interactions can be a predictor of potential good relations in the proposed project. A good relationship helps in completing the project successfully. These criteria can be assessed by reference letters provided by stakeholders in the contractors' previous projects.

Court disputes are one of the main problems in the construction industry which stakeholders need to avoid. From the owner's point of view, a project free of court disputes is a priority in the contractor selection process. The project owner, needs to avoid any court dispute with the contractor, or between contractors and locals, or contractors and owner clients. The project owner also need to avoid any dispute in order to save time, effort, cost, reputation and convenience. Therefore, the framework stresses that contractors should be able to cope with disputes during the project life time and avoid any avoidable delay.

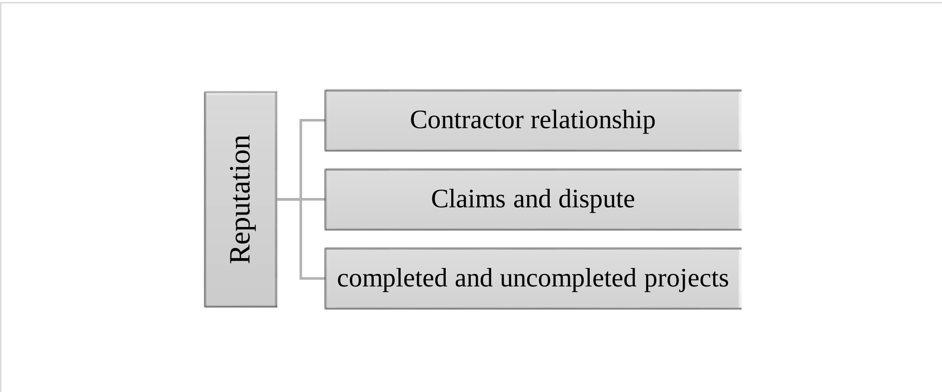

Figure 8-6 Main criteria and its sub-criteria of contractor Reputation

- ***Contractor relationship***

The relationships of the contractor with projects parties are a key factor for contractor success and the literature review considered it essential to be identified and evaluated in the contractor selection procedure. Those relationships include contractor-clients, consultants- contractor-subcontractor and contractor-supplier. These relations could be evaluated by reference letters from stakeholders in the contractor's previous projects. The following briefly shows the main drivers for including contractor relationships.

1. **Contractor- Client relations**

The client's attitude is considered essential for contractor success. Where there is unwillingness to be fully cooperative with the project team especially with regard to a lack of client compromise and a conflicting organisational culture, this usually results in a lack of contractor's faith in their client's capability to efficiently simplify the project team procedure, which eventually induces their lack of commitment. Therefore, the relationship between contractor and clients is very significant and considered as an essential matter for project success. As stated in the literature review, it is the confusion related to duties that creates many disputes between the client and the constructor. This proves that a lot of factors are important from the client's point of view. These criteria may include management skills, financial stability, knowledge of local factors, technical knowhow and also previous experience of the clients in similar projects, clients' understanding of their own needs, and also the ability to adjust to the weather conditions. This will contribute the following benefits:

- Avoidance of misunderstandings between the two parties
- High team spirit of the people working on the project which always leads to a better project outcome
- Increase in mutual respect and understanding
- Better control of the project
- Successful completion of the project enabled by the contractor
- Easily solved problems.
-

2. **Contractor- Consultants relations**

In Libya, an important factor that determines the success of the contactor is the relationship between the consultant and the contractor. Usually, this relationship is built gradually using traditional methods of rapport building such as building up a social relationship along with the professional one. However, things like the consultant's reputation and their experience and expertise, their knowledge of local culture and climate are usually kept in mind at the stage of selection. Therefore, in order to improve the process of selection of the best contractor, this framework recommends some standard and criteria that can be utilised as a guide to determine the relationship between contractor and consultant.

3. Contractor- Sub-contractors relations

Along with the contractor-client relationship, another relationship that one must bear in mind is the contractor-subcontractor relationship. To continue the example of Libya, there have been projects wherein poor co-ordination and relationship between the contractor and the sub-contractor led to the failure of the entire project. A major cause for this failure could be the way in which the sub-contractors are selected. Therefore, choice of adequate sub-contractors is an important step for contractor selection in terms of experience, knowledge and skills. The appointment of subcontractors is simply done through the bureaucratic rules and regulations, without keeping in mind the comfort level between the contractor and subcontractor or considering whether the subcontractor possesses any special expertise in a particular area or not (e.g. resources, knowledge, skills, experience, background, and financial capability). On other occasions, the only criterion that is kept in mind is the lowest tender price. Hence, it is absolutely necessary to considers factors such as the compatibility between the contractor and the sub-contractor, the strengths and weaknesses of the sub-contractor, quality record, technical and managerial competence his health and safety records, how well versed he is with the local culture, language ability, weather conditions, experience and his financial ability. This could result in poor quality of work on the part of the subcontractor. This has had an impact on the success of projects and the development of the construction sector in Libya. Making a sound choice of subcontractor at the commencement of the project can ensure smooth functioning throughout. Therefore, to overcome such problems, the subcontractors' appointment should be undertaken carefully and should be based on the above criteria to safeguard that subcontractors will be suitably selected.

4. Contractor- Supplier relations

The majority of Libyan public projects are large and need a large supplier to support the contractor to project completion. The result stated that there is lack of suppliers in the Libyan construction market and the market has not yet reached standard level especially in supplier concerns. Consequently, contractors have to present their suppliers and the procedures they utilise in dealing with suppliers at the outset of the project.

- ***Claim and disputes***

Claim and disputes are one of the major issues that impact the project accomplishment in the term of time and cost. From the client's opinion, a project free of claim and disputes is an important factor in the contractor selection procedure. The project stockholder seeks to avoid any claim disputes with the contractor and all project parties including locals. This sub-criterion could be judged by asking the contractor to provide reference letters from court to prove his good conduct.

- ***Past completed and uncompleted projects***

The findings from survey data analysis argued and agreed on the significance and necessity to assess the contractor's previous project failure in the contractor's pre-selection performance evaluation as it is one of the most important criteria affecting the reputation of the contractor. It reflects the capability of contractors to carry out the work. Therefore, for projects completed on time, the contractor ought to be evaluated depending on duration of the contract to make sure the project is delivered on time. Past project failure can be measured by classifying the number, type and size of failed projects through investigation of the history of contractor's past project failure record. The results from the collected data stressed the significance of evaluating the contractor's completed and uncompleted projects on time, as it impacts on the reputation of the contractor.

6. Health and Safety Criteria

Contractor health and safety at construction sites in Libya was characterised by the experts as one of the essential factor that are necessary to be included in the construction selection and evaluation process. This is due to the two main factors. The first factor is that the public construction industry has a prerequisite to comply with international health and safety systems. The second reason is to reduce the accident rate by selecting the best contractor who has the best training record and the fewest accidents. This section shows and explores the key health and safety factors for contractor selection procedure. Contractor health and safety factor should to be added to the development framework due to the two main reasons:

- *The absence of legislation and regulations for health and safety:*

The result articulates that there are insufficient health and safety guidelines and rules across the Libyan construction sector. The absence of accountability of contractor in the implementation of health and safety legislation, stresses the necessity of assessing contractor health and safety capability.

- *Lack of understanding of health and safety problems:*

The understanding of fulfilling health and safety regulations is a critical issue in achieving a safe and healthy contractor environment. The main obstacle in this problem is that there is no specific method or procedure that can screen contractor capability and training history with specific regard to health and safety.

- ***Safety record***

Contractor safety record and the reported accidents including injuries or fatality are a critical issue and provide a significant insight into the company's health and safety record at site. The outcome of the questionnaire survey and literature review indicated that safety record is indispensable and must be included in the contractor selection procedure. This sub-criterion can be measured and evaluated by the number of accidents recorded per project and the company's health and safety record. A high rate of the accidents certainly impacts on the reputation, project life cycle and project delay, which generally leads to disputes between the clients, the contractor and the other parties such as victim's family. This sub-criterion can usually be evaluated by inspection of the contractor's accident log book. Therefore, this framework insisted that any candidate contractor has to provide the safety record and number of the accidents in the last five years before starting the projects.

- ***Health and Safety Policy***

In the literature, the health and safety policy was identified as an important factor that needed to be evaluated in the contractor selection procedure to enhance the labourers' knowledge, awareness, and understanding of site health and safety legislation, and of rules at the work, which support in increasing the responsiveness and awareness of workers health and safety. This can be evaluated by assessing the H&S policy documentation provided by the company and investigating the employees training, induction plan record.

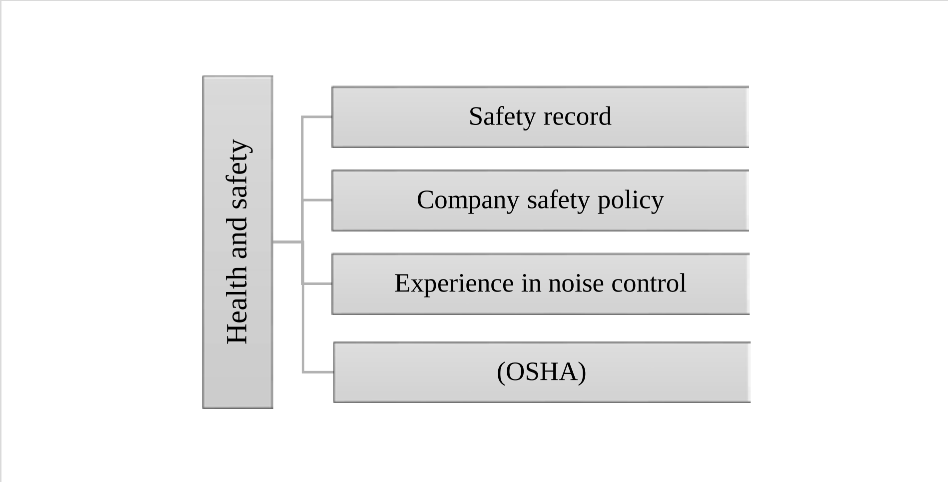

Figure 8-7 Main criteria and its sub-criteria of Health and safety

- ***Experience in noise control***

The analysis of the literature review and questionnaire survey has shown the significance of adding the contractor experience in noise control in the group of the health and safety criteria. The result stressed the significance of having new environmental equipment on the construction site. They also suggested the significance of the health and safety material and instrumentation that will be illustrated on the project to reduce any health and accident risk, such as to maintain air pollution. They stressed that the quality of environmental equipment usually reflects on the nature of the site activity. They suggested providing instrumentation for measuring the level of noise in order to confirm the safety of the employees and others.

- ***Occupational Safety and Health Administration (OSHA)***

A contractor's Occupational Safety and Health Administration (OSHA) incidence rate was considered an important factor in the literature review and the expert group. The expert group presented that the previous accident rate is a significant factor in evaluating contractor competency to provide a safe workplace. The number of accidents reflects the ability of the contractor to finish the work safely. This factor could be measured by inspection the company's accident log book rate.

7. **Culture and weather consideration**

The literature review and data analysis of the study mentioned that the current shape of the LCI has been affected by many factors such as geographical, social, historical, economic, political, factors. The operation of CSP is administrated under a complex social, economic, and geographical environment. Additionally, it is influenced by nepotism and social tribalism. As a third world country, the operation has also been affected by political involvement which played an important role in identifying the current shape of the CSP, by imposing restrictions on foreigners contractors. However, as Libya is located in North Africa, central to the Mediterranean Sea, it is known that the weather is very hot during the summer and this usually causes major delays in accomplishing projects. This is usually a negative reflection of the efficiency and productivity of the labour force. Therefore, the framework stressed that the candidate contractor has to provide proof of familiarity with culture and have a positive experience of working in a variety of weather conditions, especially when it comes to working in hot countries. These sub-criteria can be evaluated by classifying the number, size type and the location of competed projects. Figure 8.8 presents the cultural and weather consideration criteria and its sub-criteria.

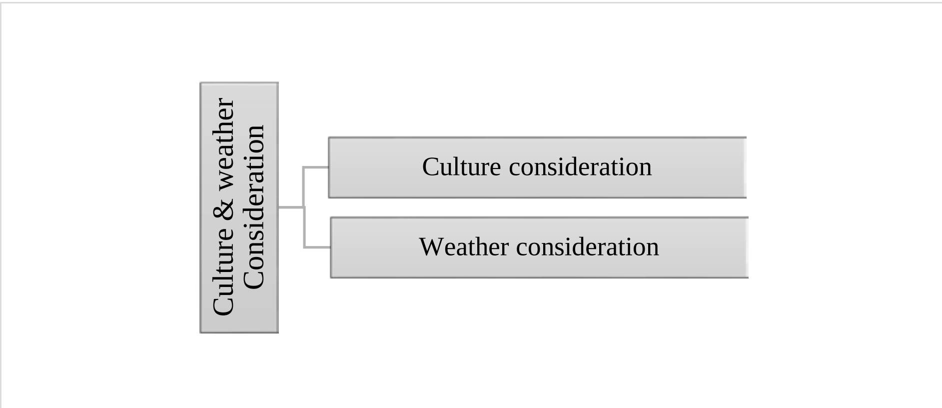

Figure 8-8 Main criteria and its sub-criteria of Culture & weather considerations

- ***Weather consideration***

The working environment in the project site of the employee and labour force in the Libya environment are generally defined by high temperature. It is essential to take the environment and weather circumstance of Libya construction work into the contractors and client's accounts. That is because of the difficulty of the geographical terrain, whereby up to 90 % of Libya's total area is classified a desert and semi-desert, with a hot dry climate especially in the southern of the country where temperatures reach 45°C in the summer. The literature survey and the data collected stressed the significance of evaluating the contractor's work considerations by classifying the number of projects completed in hot countries.

- ***Culture considerations***

The vast majority of Libyan public projects, especially the big projects such as the Great Manmade River are operated by international contractors. The literature indicates that it is essential to take into the account that the majority of contractors' labour force and employees are non-Libyan due to a shortage of sources, skills and experience among of manpower in the LCI sector. Also, this criterion is significant in communication and understanding between locals and contactor. Consequently, it is necessary to consider culture criteria for assessing contractor selection process. In this study the cultural criteria was considered for some important reasons:

- It can be said culture is a significant criteria, where the communication and understanding of the local culture have an influence on international contractor performance.
- Libyan society and associations is a conservative society and has its own private culture.
- Communication between the Libyans and non-Libyans has several advantages which can be gained for example, experience, knowledge, language.

8.13 Road map

The results of the first and the second round of the Delphi indicated that more than seventy percent of the participants were in agreement about the framework and advised that the framework should not be applied at one time period. That is because of many factors such as lack of experience and training program as well as a lack of accountability of the decision-makers. Further, the large size and difficult terrain of the country makes it difficult to monitor and collect information about contractor. Moreover, corruption, bribery and nepotism are a concern. Finally, the government should improve and develop a payment system and help to implement the procurement system. All those factors make the Libyan construction markets not fully prepared for such a high standard of framework. Therefore, the framework highly recommended that application should not occur during one time period and needs at least between eight to ten years of working to implement it fully.

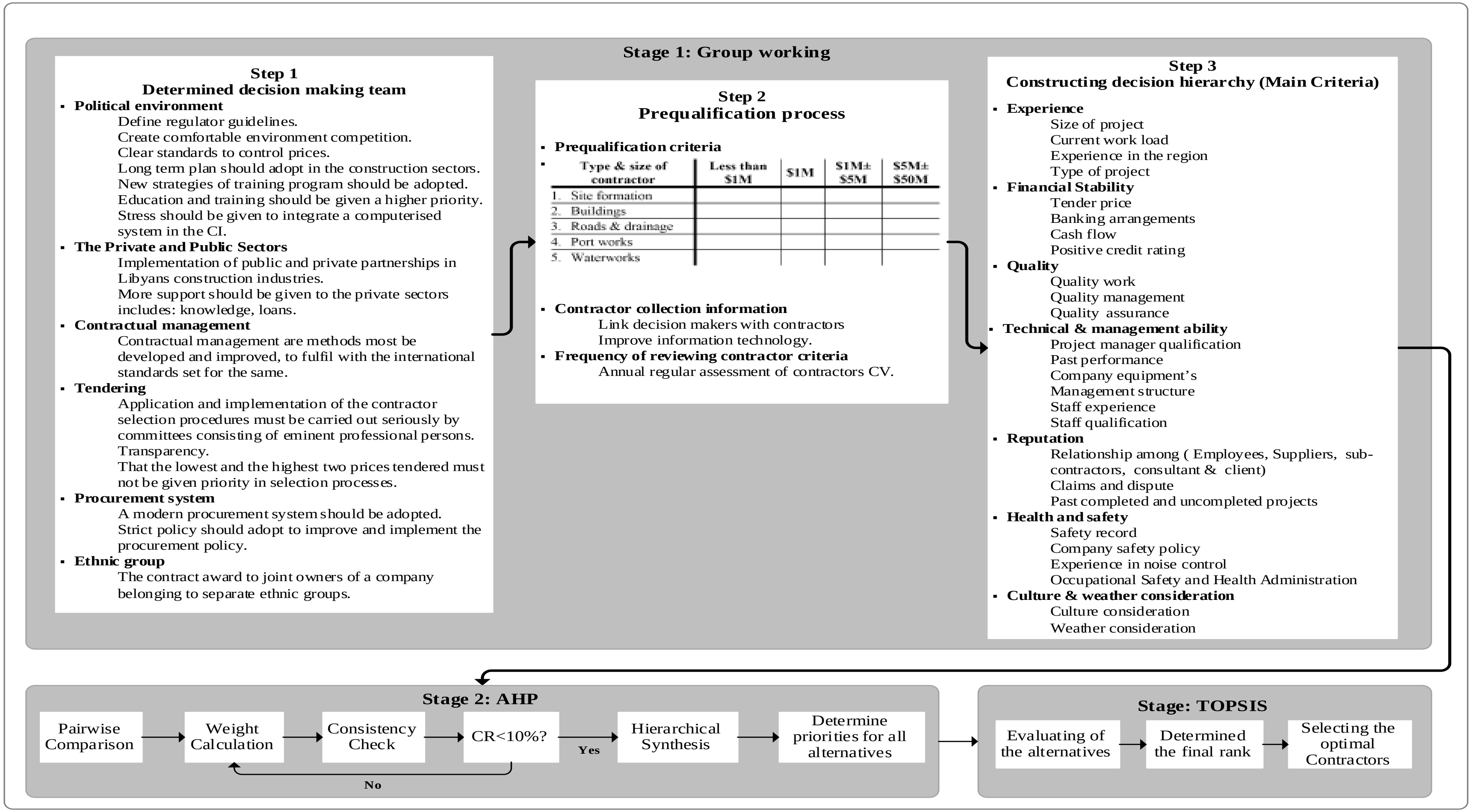

Figure 8-9 shows the Contractor Selection Criteria Framework

8.14 Summary

Chapter eight represents data collected through primary (questionnaire survey and Delphi survey) and secondary (extensive literature review) methods to find out about the factors that play a role in the selection of contractors in the present day LCI. The points that are noted here with respect to the selection of contractors could be used as guidelines to make sure that success rate of the contractor selection process increases significantly. A set of criteria has been recognised for the choice of proper contractors to be utilised as a guide in their selection that will considerably progress the likelihood that the contractor selection will be success. The chapter presents a framework for contractor selection procedure and the sources for this framework. The chapter also highlights the main areas while selecting a contractor. In the next chapter, we will see how experts have validated and approved this framework.

CHAPTER NINE: VALIDATION OF THE FRAMEWORK

9.1 Introduction

This chapter demonstrates the validation of the framework from the findings of the literature review and analysis of the data collected from the questionnaire survey, which was conducted by a group of experts from the Libyan construction industries, in order to test its reliability and utility in the contractor selection procedure. The chapter discusses and argues the validation procedure agreed. The chapter starts by briefly explaining the general outline information about the questionnaire, which usually comprises of a participation rate, the nature of differences of the experts and the business title of the participants. However, it also describes an overview of tests that are used during the analysis, such as Cronbach's Alpha test which was employed to determine consensus and increase the reliability of the experts. Feedback is followed by an analysis of the comments/suggestions made by the research participants. The framework to be validated was dependent on the data sources from the LCI. It was established as a guideline for the decision makers to make certain of greater success in contractor selection process. The section concludes with a section summary.

9.2 Aims of the chapter

The main purpose of this chapter is to test the validity of the developed frameworks practicality, usefulness, clarity and suitability to the LCI. The main aims which are validated are:

- To achieve expert validation and to improve and enhance to the effectiveness of the framework
- To evaluate the applicability of the framework
- To confirm whether the framework requires any amendments to develop refinement
- To evaluate the probable advantage of the framework to improve the contractor selection procedure in the Libyan construction industries

9.3 The response rate

Ghashat, (2012) cited from Thangaratinam & Redman, (2005) argued that the measurement of the Delphi should be based on the quality of the respondents rather than their numbers. However, on the other hand, Hsu & Sandford, (2007) stated that the validity of Delphi technique can be impacted by reducing the response rate. Therefore, high quality and high respondent rate are both factors which should be taken into the consideration in the Delphi rounds. To get a high quality and high respondent rate, different techniques were used to those of a classical survey; for example, letter by email, telephone contact and friendship. Table 9:1 shows the response rates for the first and second round of the Delphi survey.

Table 9-1 The response rate for the Delphi iterations

Iterations	Panellists	Response Rate	
		Number	%
First round	12	12	100 %
Second round	12	11	91.67%

Consequently, twelve participants were involved into this study. For the first round of the survey, the respondent rate was very high at 100%, while the response rate for the second round was 91.67%, despite a reminder procedure. As a result, the response rate for this study was high and the absence of one respondent in the second round of the survey does not influence the outcomes because they were indistinguishable from the rest of the participants. Therefore, the rate and quality of the panel were not affected in this research.

9.4 Responses in the first round

9.4.1 First round consensus

The concept of homogeneity was determined as a condition of consensus within the judgment of the panellists. For this research and to determine whether consensus has been reached or not, Cronbach’s Alpha value of 0.7 was suggested. Therefore, when the required value for Cronbach’s Alpha is obtained and the consensus is achieved, the writing of the analysis of the results will take place.

Table 9-2 Reliability Statistics

Cronbach's Alpha	N of Items
0.710	12

Table 9-2 shows the result of the Cronbach's Alpha for the first round 0.710 for the twelve items tested. This indicated that the level of Alpha value is acceptable and there is consensus and homogeneity between the participants' judgments pertaining to the questions of the questionnaire.

Regardless of the attainment of a satisfactory value for Cronbach's Alpha in the first round of the questionnaire, this result is deemed sufficient for this research as Kuo & Yu, (1999) and many others have applied the Delphi survey in one round. On the other hand, foremost characteristics of this method are iteration, discussion of the feedback and point views. This will make the answers more accurate and reliable as it allows the experts the opportunity to re-evaluate and re-estimate their answers in light of the answers of the other participants. Thus, the second round of the Delphi technique was adopted.

Table 9-3 Descriptive Statistics

Category	Items	Mean	Std. Deviation
Select and rank the main important Criteria	Financial stability	3.25	0.965
	Technical & Management Ability	2.67	1.497
	Experience	3.42	0.793
	Health and safety	2.08	1.621
	Quality	2.75	1.545
	Reputation	2.58	1.165
	Culture and Weather Consideration	0.67	1.231

As can be seen in Table 9-3, the mean value of the experts for the framework is demonstrated to be 3.42 and the standard deviation is relatively low 0.67, indicating that there was no considerable variation in participation answers with respect to the framework. The result demonstrated the expert's opinions of ranking the main criteria for contractor selection. The seven most essential criteria in the contractor selection were gradually ranked as *Experience, Financial Stability, Reputations, Technical and Management Ability, Quality and Culture and Weather Consideration* in Construction Projects. The results show that the respondents were nearly in agreement regarding to their answers.

To relate the mean values back to the scale, 0 to 0.49 = Not important at all, 0.50 to 1.49 = Low important, 1.50 to 2.49 = somewhat important, 2.50 to 3.49 = Important and 3.50 to 4 very important. As a result, as can be seen from table 4, Experience factor with value of 3.42 is considered the most important criteria among the criterions, and Cultural and Weather consideration is deemed to be of the lowest importance.

In order to recognize the acceptation degree of the framework, experts were asked about their opinion and overview about the framework. Figure 9-1 presents that, among the 12 experts, none of the participants considered that the framework is unacceptable. However, 1 (8%) of the experts that participated in the survey accepted the framework, 2 (17%) of the participants confirmed that the framework is good, and about the majority of the experts were in agreement that the framework is very good, with a total of 9 (75%). This indicates that there is a high agreement among the participants about the framework.

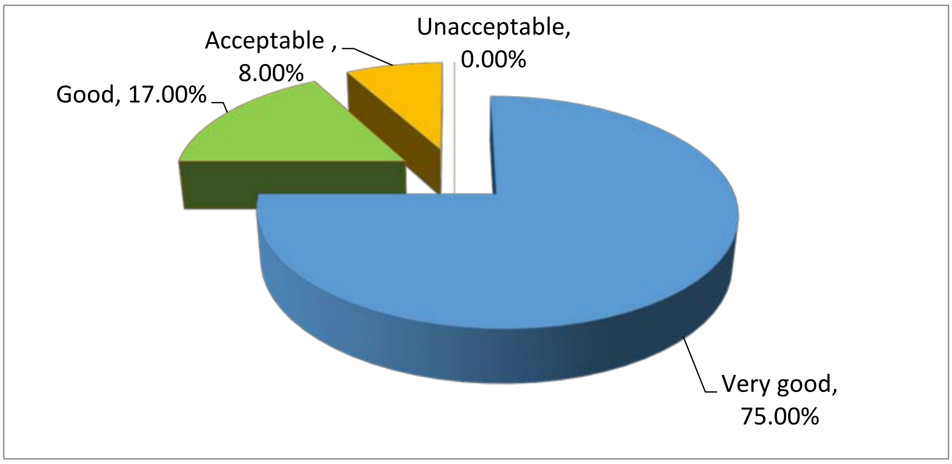

Figure 9-1 showing the percentage of the acceptation framework

As can be seen from figure 9-2 the survey sample was asked about the road map to establish the framework. The results shows that none of the experts mentioned about the road map within two or four years, only 8 per cent (1 respondents) of the sample selected the road map can be done within six years, about only 25 per cent (3 respondents) of the sample selected the road map can be done within eight years, and the rest (67 per cent, 8 respondents) indicated that the road map needed more than eight years. These results indicate that most experts consider the framework needs more than eight years.

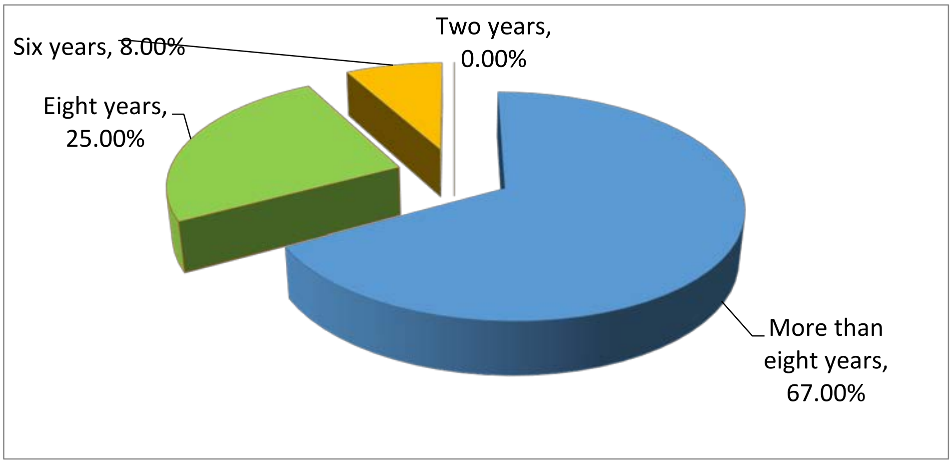

Figure 9-2 showing percentage of the participants acceptation of the framework

9.5 Second round formulation and process

The second round of the survey introduced with the same concept as the first questionnaire, included summaries and notes developed from individual's observations of the 12 participants from the first round. The total respondents of this round are 11 of 12 experts, about 91.67% of the total participants. However, the absence of one none respondent does not affect the results, where the minimum number of respondents in Delphi survey should be at least 7 (Ghashat, 2012). The feedback from each respondent was sent back to the participants to re-estimate and develop their answers. As such, all experts were advised to review and had fully authority to make appropriate modifications.

9.6 Amendments

In the analysis part of the second round of the survey, there was significant harmony among those participating regarding the ranking of the framework. Pertaining to this part, there were no changes to be made.

In addition, in the third part of the survey, in spite of the respondents' majority accord about the acceptation of the framework, more enhancements are needed in the next round to improve the rate of the acceptability.

Finally, the fourth part of the survey, the participants were required to express the degree of harmony about the road map of the framework. Regarding this part, there were some slight changes which have been done in that a timetable for the road map has been added. Furthermore, as suggested by some experts in the first round that the framework will be difficult to implement and apply in one time, the suggestion therefore was to apply the framework in two different stages. In the first four years, a set of criteria will be applied, during which time people will be prepared for the set, including training, courses and enlightenment about the second set of the criteria.

9.7 Consensus elicited in the second round

The same process as in the first round was used to determine consistencies of the respondents' feedback (Cronbach's Alpha). In the first round the alpha value was 0.710. This result indicated that there is a slight increase in the value of the Cronbach's Alpha at the second round of Delphi survey, which is (0.723). According to (Ghashat, 2012), this value is very good. By interpreting the value produced by the scale, as can be seen from table (9-4), the experts' responses were highly homogeneous.

Table 9-4 Reliability Statistics

Cronbach's Alpha	N of Items
0.723	12

In general, the findings in table 9-5 demonstrated that greater harmony among the participants opinions are found, with slight increases in the mean values of the respondents. For example, the mean value of Experience criterion increased from 3.42 in the first round to a value of 3.55 in the second round, and the mean value of Cultural and Weather consideration criterion increased from 0.67 in the first round to a value of 1.09 in the second round.

However, this indicates that there was no considerable variation in participants' answers with respect to the framework. The result confirmed the experts' opinions of ranking the main criteria for contractor selection. The eight most important criteria in the contractor selection were gradually ranked as, *Experience, Financial Stability, Quality, Technical and Management Ability, Reputations, Health and Safety and Culture and Weather Consideration* in construction projects. Additionally, the result shows that the respondents were nearly in agreement regarding their answers.

Table 9-5 Descriptive Statistics

Category	Items	Mean	Std. Deviation
Select and rank the main important Criteria	Financial stability	3.18	0.982
	Technical & Management Ability	2.82	1.250
	Experience	3.55	0.688
	Health and safety	2.36	1.567
	Quality	2.91	1.514
	Reputation	2.55	1.214
	Culture and Weather Consideration	1.09	1.578

In the second round, similarly to the first round, in order to identify the acceptation degree of the framework, participants were asked about their opinion and overview about the framework. Figure 9-3 shows that among the 11 experts, none of the participants pointed out that the framework is unacceptable or acceptable. However, 2 (18%) of the experts agreed that the framework is good, and about 9 (82%) of the respondents (majority) were of the same opinion that the framework is very good. This indicates that there is strong harmony among the respondents about the framework.

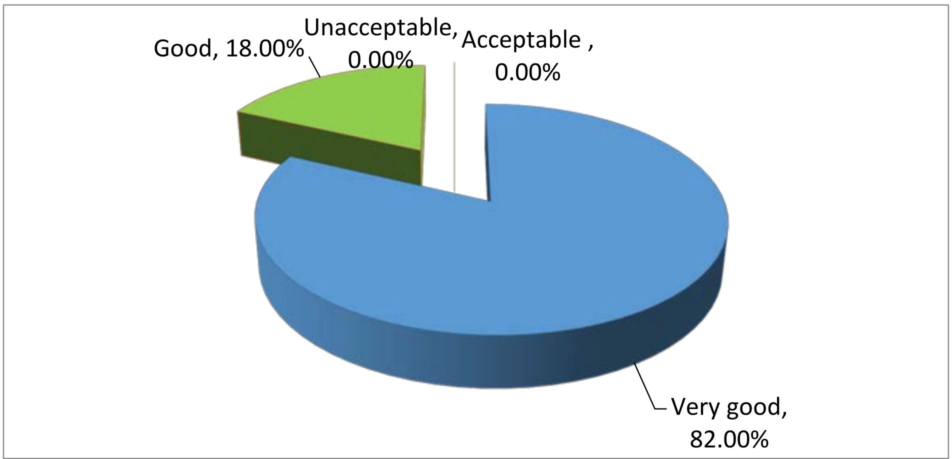

Figure 9-3 showing percentage of the participants acceptation of the framework

However, figure 9-4 shows that none of the experts commented about the road map within two, four and six years, with approximately 27% per cent (3 respondents) of the sample selecting that the road map can be done within eight years, and the rest (73 per cent, 8 respondents) indicating that the road map needed more than eight years. These results indicate that most experts consider the framework requires more than eight years.

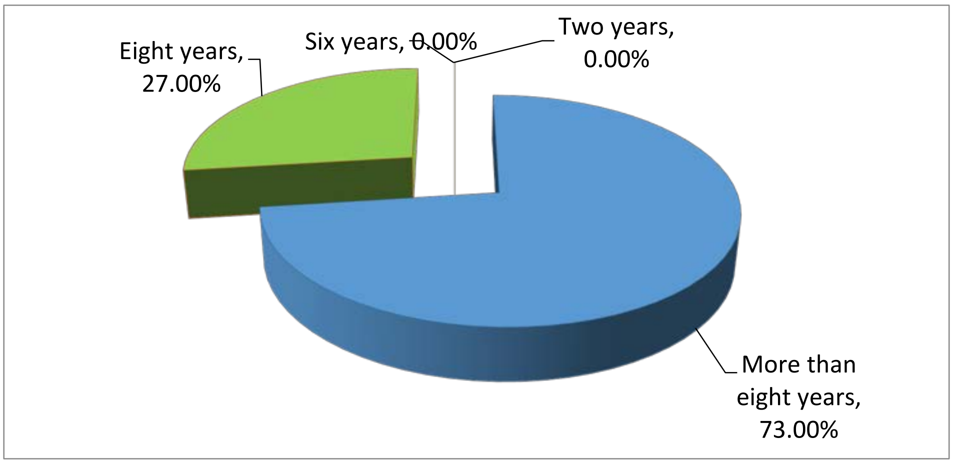

Figure 9-4 showing the participants' views of the framework road map

The results of the first round of the Delphi indicated that more than two thirds of the experts were in agreement about the framework and had the same opinions with regards to the time table. However, some experts argued and advised that the framework should not be applied at one time period because the Libyan construction markets are not fully prepared for such a high standard of framework.

9.8 Validation and discussions of the sub-criteria

The focus group and questionnaire participants were asked to express their views and opinions on the proposed sub-criteria. This section discusses and the main results of the data analysis.

1. Experience

The contractor's experience was explored in the expert group discussions and arose from the questionnaire survey analysis results. The expert groups argued that the experience of the contractor played a serious role towards project success in terms of time, cost and quality of the project which are a further indication of contractor experience in running projects, monitoring and controlling finance and problem solving. Further, they also stressed that the majority of the decisions which cause contractors failures are taken by the contractor experience.

The contractor experience sub-criteria questionnaire responses are shows in Figure 9-5. The focus group discussions emphasised that ***type of the project*** undertaken by contractor assists in identifying the contractor's competence. Further, the expert group also stated that the majority of project delays in the Libya construction sector are related to experience. That is because of the lack of classification and pre-qualification of the contactor in the organisation before commencement of the project. Consequently, the expert group emphasised that a contractor who has been undertaking the same type of project for many years, will have experience that grants him a competitive edge in the market. Also they confirmed that the contractor should employ a high level of qualified staff working in the company. That team needs to have high experience in the same line of project. For the type of the project sub-criteria, none of the experts disagreed with the significance of including contractor experience criteria in the framework all either agreed or strongly agreed with the significance of contractor experience in the contractor selection procedure

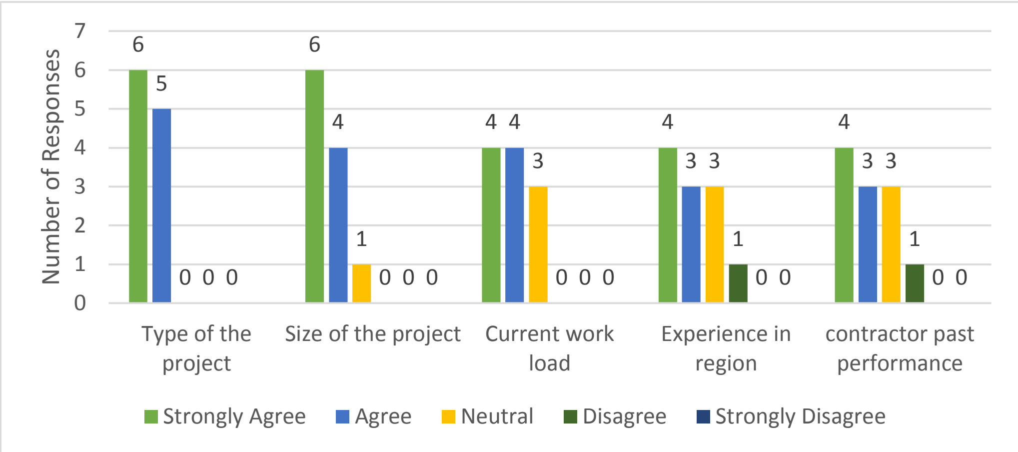

Figure 9-5 validating contractor experience

The respondent groups emphasised the significance of the experience in ***project size***, and stated that the size and number of similar completed projects could be utilised as a measurement of the contractor's capability to take the project. This can be done by investigating the contractor previous and current project size as well as performance history in terms of budget, quality and cost of finished products. 85% of the respondents strongly agreed or agreed that size of similar projects is an essential sub-criterion to be included in the contractor's experience. Only 5% of the total respondents gave a natural response.

Another important sub-criteria needed to be taken into the consideration is the contractor's other project commitments. Consequently, to support contractor experience and capability, ***current workload*** were investigated. The vast majority of the experts (80%) strongly agreed or agreed with only 20% of the expert's neutral with regards to this sub-criterion. The focus groups strongly agreed that the, capability of the contactor could be assessed on the basis of available current workload. They stated that running concurrent projects has a detrimental impact on project finishing time and on outcomes of the project.

The other sub-criterion where the outcome of the expert were harmonic with questionnaire responses is that related to contractors ***experience in the region***. The experts also identified this as an important sub-criterion for contractor selection. The vast majority of the experts, 70%, strongly agreed or agreed compared with only 20% who neutral and only 10% disagreed.

The expert group discussions focused on contractor ***past performance*** dependent on number of completed projects, previous similar projects and previous projects delayed. They stressed that this is a reliable source for assessing contractor past performance. About 65% of the total respondents strongly agreed or agreed contractor performance is an essential factor in the selection procedure and should be included as new sub-criteria to the contractor experience, while 25% were neutral and only 10% disagreed. The focus groups indicated project delay is common in Libya's construction industry, and results in heavy costs for that industry. They argued that it was time to minimise the number of projects delayed, due to the associated costs, and inconvenience. The respondents point out that failure to take into account the contractor's past performance resulted in delay and heavy costs for the LCI industry.

2. **Financial stability**

The contractor financial stability sub-criteria questionnaire responses are shows in Figure 9-6. The participation confirmed that contractor financial stability is a critical factor in the contractor selection process. None of the experts responded with disagreement with the significance of including the financial stability factor in the framework, as it was ranked the second important criteria after the contractor experience in contractor selection. The literature review and questionnaire indicated that contractor financial stability assists in identifying the contractor's capability to react to fluctuations in the market, such as increases in material and labour costs. Further, it can be said that the majority of disputes in the LCI sector are associated with financial disputes. Moreover, due to its sensitivity to the market, the evaluation of financial capability requires an accurate assessment in the selection procedure. That is because prices material and labour can change rapidly, which sometimes results in serious problems for contractors and clients. Consequently, to avoid any delay and disputes with the project clients, it is very important that the contractor ought to be able to deal with these financial changes during the project life time as it is known that the Libyan construction markets is sensitive and unstable in prices.

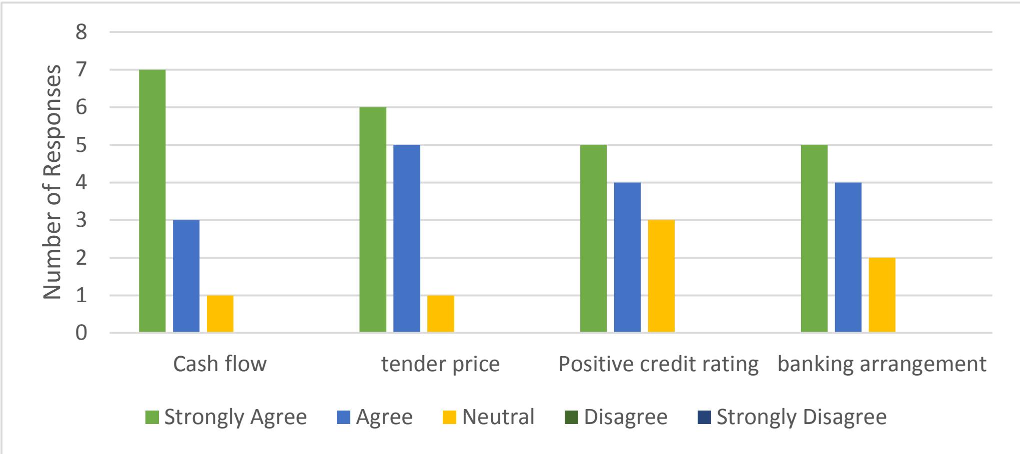

Figure 9-6 Validating contractors' financial Stability

Most of the contractor's expenses have to be paid in cash. Accordingly, availability of cash flow is a critical factor for a contractor to run the project. Contractor payment plan and cash flow should be well planned controlled to ensure business will run smoothly. Consequently, the cash flow will be a high priority for the decision makers. Therefore, it is not surprising that the contractor's ***cash flow*** was selected as the most important sub-criteria for financial stability as the tender price in many case will determine whether a contractor win the project or not. Determining the ***tender price*** including, labour cost, construction equipment, material, subcontracts, taxes overhead is not easy task for contractor. Therefore, the expert group also agreed with the results found, as the tender price is considered the second and most significant sub-factor in the financial stability.

The third most important sub-factors were the ***Positive credit rating*** of contractor's. This is a very important criterion for measuring the financial capability of contractor. Therefore, the expert group emphasised the importance of checking the contractor credit rating.

The least important sub-criteria depended on participants opinions were the contractor's ***banking arrangement.*** Bank arrangements are used as a monitoring tool to assess the contractor financial soundness. It also shows whether or not the contractor has sound financial status and would be able to complete the contract.

3. Quality

The expert group discussion emphasised the value of quality and the necessity in the contractor's selection process. The discussions explored several motives for adding quality. One of the most important factors was the necessity to comply with national and international quality legislation and processes. Furthermore, the discussion argued that low cost and speedy construction would not be achieved at the expense of the quality of the project. The group also stated that the implementation of quality legislation management is not only significant during the construction stages, but is significant throughout the project life cycle.

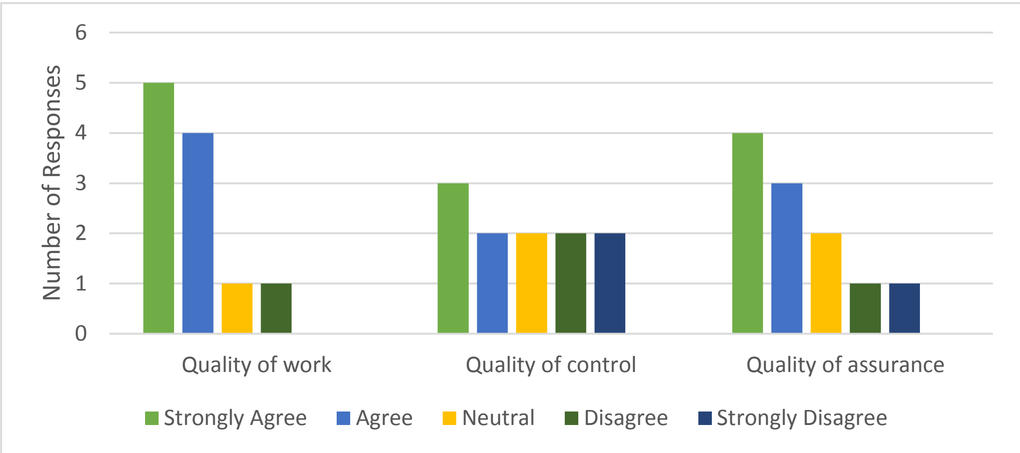

Figure 9-7 Contractor Quality

The quality sub-criteria questionnaire responses are shown in Figure 9.8. The results shows that 9-7 respondents, which is about 90% of the participants, strongly agreed or agreed with the significance of the inclusion of ***quality of work*** as sub-criteria to the quality list, while only 10% to fifteen present were neutral or disagreed. The discussion explored how dealing with the contractor dependent on the lowest price and experience largely resulted in low level of quality of work. This indicated inadequate financial standing of a selected contractor and could lead to late completion and unsatisfactory quality of work.

The expert groups discussed and explained in detail the significance of such sub-criteria. They argued that the understanding and implementation of the legislation of contractor ***quality assurance*** systems is critical in the project success. The result shows that 7 respondents, which represented about 75% of the participants, strongly agreed or agreed with the significance of the inclusion of quality assurance as sub-criteria to the quality list, while only 15% were neutral and 15% disagrees or strongly disagreed. As quality assurance is a system covering the essential activities of training, procedures, and standards of the projects, the experts stressed that constructors are accountable for improving a suitable program for each project.

The last sub-criterion of quality group is ***quality control.*** Although a main principle of quality control is to reduce the opportunity of omissions and mistakes, there was no clear agreement on this sub-criterion, where only 40% strongly agreed or agreed on the significance of the quality control, while 30% were neutral, and 30% strongly agreed or agreed.

4. **Technical & management ability**

The expert groups explored the contractor's technical and management capability with regard to two main issues. The first issue is the contractor's technical & management competences. The expert group discussion stressed the significant of management structure and the necessity to add it as new sub-criterion into the contractor selection procedures list. The experts considered that management structure was indispensable and therefore needed to be added to the contractors technical and management ability. The company management structure demonstrated the roles and responsibilities of each member of staff including contractor in the organisation. The lack of determined authority and responsibility for each member of the company causes delays in the project because of the contradiction between project parties. Thus, if the contractor is systematic, the project can be accomplished without obstacles with a reduction in the probabilities of failure.

Further, it illustrates the decision making procedure and the flow of information. It is also provides an indication of the efficiency and capability of the project management team. Therefore, it was highly recommended by the expert group expert to add this sub-criterion to support the management contractor capability. The Technical & management ability sub-criteria discussion and validation are shown in Figure 9-8.

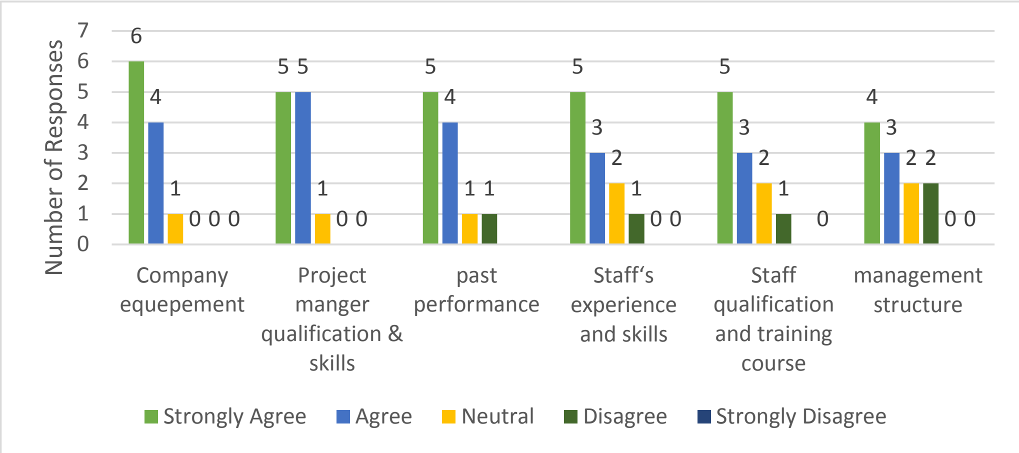

Figure 9-8 Validating Technical & management ability

None of the experts responded with disagreement to the significance of including contractor technical & management ability; almost 90% of experts strongly agreed and agreed with the significance of contractor technical & management ability. The experts' discussion emphasised the role and power of the ***project manager*** and their impact on the project life. They argued that the manager should build good leadership with the project team. Further, the project manager needed to be able to cope with the project workload, motivate employees and manage problem solving. The expert groups emphasised that certain technical capabilities were a necessity in the project senior manager and key personal, such as academic certificates, training courses, experience and technical knowledge. They confirmed that these skills assisted in communication with the project parties, helping in problem solving procedures and in understanding project needs. There was strong agreement of the focus group participants with the questionnaire responses. About 90% of the expert respondents strongly agreed or agreed with the qualification skills and experience of project manager, while about 10% were neutral.

The other significant sub-criteria explored is ***company equipment***. About 65% strongly agreed or agreed, while 35% were neutral. Heavy construction equipment plays a significant role in project success. In nature, the Libyan public projects are large and heavy construction equipment is needed to complete such projects. The experts argued that many contractors in the construction sector must replace or maintain their machines and equipment due to old age and poor condition. The respondents stressed that the contractor has to provide evidence of the equipment that will be utilised in the project and this will indicate whether the contractor is capable to cope with the work. As contractors consider their equipment as company assets in their proposed tender, the respondents stated that there is a necessity for an approach to evaluate the condition of contractor equipment expected to be utilised in the project. Therefore, the experts argued that the condition of the equipment is an important factor and it could make huge impact on the project quality and time completion.

None of the expert disagreed with the significance of including contractor ***Past performance***, in the framework; 100% of experts were agreed or strongly agreed with the significance of contractor experience in the contractor selection procedure. The expert argued that 10 years' experience in the LCI construction market was suggested as minimum experience to be assured in awarding a work to a contractor.

The second issue in the discussion was the contractor's human resources, considering the staff and contractor training courses, skills, education level in the projects teams. Therefore, the contractor needs to provide full details of the current and future human resource plan including staff experience, skills, training courses that will be utilised in the project.

The expert group agreed and strongly agreed that the ***contractor and staff's experience and skills*** is essential factor in the contractor selection procedure. They emphasised the significance of identifying basic skills and personnel ability. They also, stressed that this ought to be done by screening their CVs, with attention emphasised on the practical areas associated with the required project. They also confirmed that skills of contractor and his staff assist in analysing problems and facilitating problem solving procedures. The results of the experts were in agreement with the findings from literature review and questionnaire survey. Figure 9.10 illustrates that about 70%, strongly agreed or agreed with the significance of the contractor and staff experience and skills, as contractor's sub-criterion, while only 20% were neutral and 10% disagreed.

The other essential sub-criterion explored was ***the contractor and staff qualification and training course*** of the contractor and staff. The focus groups discussed the practical competences necessary to be presented and up to date in the contractor and his staff, including training, academic and technical knowledge. The results of the experts revealed agreement on the importance of the contractor and staff qualification and training course. Figure 9.10 shows that about 70 %, of the total respondents agreed and strongly agreed, while 20% were neutral and 10% strongly disagreed or disagreed.

5. Reputation

The experts' group discussion emphasised, the significance of contractor ***past completed and uncompleted projects on the time*** and the necessity to add it as new sub-criteria into the contractor's reputation list. The participants stressed that past completed and uncompleted projects are an extremely important factor in contractor selection. They argued that clients cannot take a risk on a contractor with previous uncompleted projects due from moral to financial problems. They stressed that in the selection procedure, contractors must provide CVs for his company including their completed and uncompleted projects, with justification if there is any delay or failure in projects in order to evaluate their capability. Therefore, it was strongly recommended by the group of experts to add this sub-criterion to support the contractor reputation criteria.

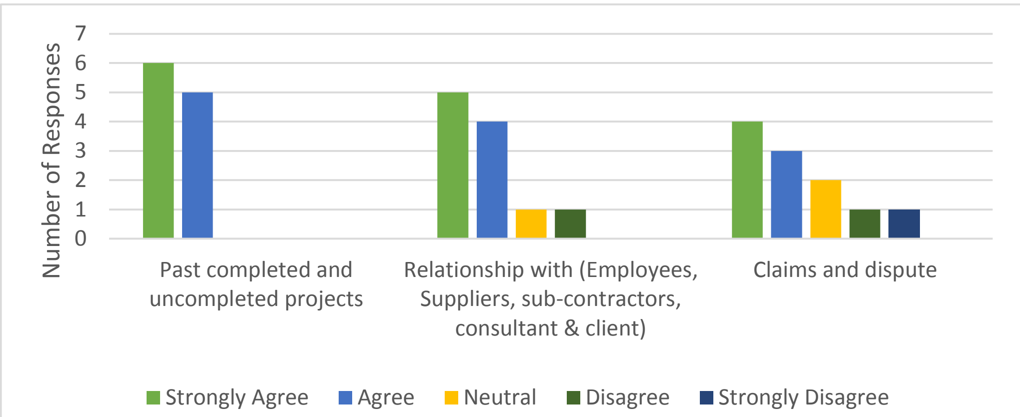

Figure 9-9 Validating of Contractor Reputation

The reputation sub-criteria questionnaire responses are shown in Figure 9.10. The results show that none the experts disagreed with the significance of including financial stability factor in the framework. All of experts were agreed and strongly agreed with the need for past completed and uncompleted projects. Figure 9.11

presents that in terms of the ***contractor employees, suppliers, clients and consultants contractor relationships sub-criterion relationships***, the majority, 80% of questionnaire respondents, strongly agreed or agreed with this item, while 20% strongly disagreed or disagreed. The experts argued that a good relationship between contractor and stakeholders assists in finishing the project effectively. However, such factors may be evaluated by reference letters from clients in the contractor's previous works.

The last sub-criterion of the reputation criteria is ***claims or disputes***. The expert group stressed the significance of avoiding any claims or disputes, arguing that contractor court disputes past record is utilised as a sign of the contractor's relations and a way of solving problems during and after completing the work. That record can indicate their tendency towards litigation. They also confirmed that disputes between parties will lead to increased problems and delays and as a result, increase cost and time of the project. 65% of the expert strongly agreed or agreed, while only 15% remained neutral and 20% strongly disagreed or disagreed.

6. **Health and Safety**

The validator group discussion emphasised the importance of health and safety and the necessity to add it to the contractor's selection process list. They argued that the employees should not begin working without a health and safety training program. In Libya, both the Ministry of Health and the Ministry of Labour are clear in implementing the rules of health and safety to ensure healthy and safe workplaces and employees. The expert's explored that indispensable nature of Occupational Safety and Health Administration ***(OSHA) incidence rate (points)*** and the necessity to supplement it to the contractor's Health and Safety group. This sub-criterion was statistically dropped out of the group of health and safety, because of law correlation (section 7-4). The expert discussion encouraged the significance of OSHA and the need to add it to the health and safety group. A contractor is accountable for providing a safe and healthy workplace for his staff and employees. The main principle of OSHA is to ensure the safety and health of workers by providing training, establishing partnerships, outreach and education and encouraging continual development in workplace safety and health and to fulfil international legislation and systems.

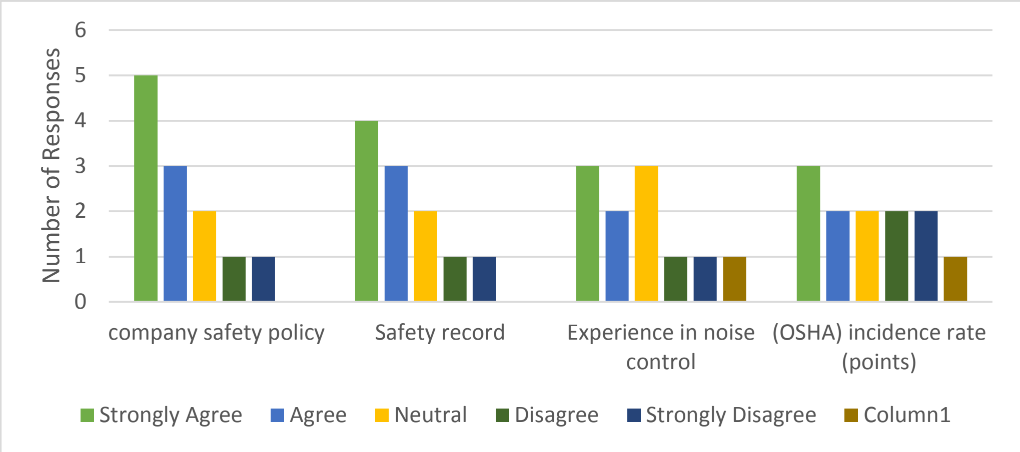

Figure 9-10 Validating contractors' H&S

The results of the health and safety sub-criterion responses are shown in Figure 9.10 and show that 8 respondents, which is about 75% of the total participants strongly agreed or agreed to classify the ***company safety policy***, as the most importance sub-criteria in the contractor health and safety, with only 2 respondents (15%) strongly disagreeing or disagreeing. They stated that the awareness and understanding of contractor's safety policy and plan is a serious issue in the construction industry. They also confirmed that implementation of the health and safety policy and plan helps to a productive working environment and productive individuals.

The participations discussed the issue of the contractor ***safety record*** which includes the number of fatalities and reported accidents and their impact on the project's life, company and on the work environment and therefore on the time scheduling. Almost 75% of respondents (7) experts agreed or agreed the significance of including the safety record, fatalities and reported accidents in the selection procedure, whereas about 15% of the experts (2) strongly disagreed or disagreed. Further, they also agreed with the result which classified contractor's safety record as the second most significant health and safety sub-criterion that should be taken into consideration in the contractor selection. The final sub-criteria discussed regarding the health and safety is ***experience in noise control***. The experts stated that noise health effects are due to elevated sound levels. Further, elevated workplace, vehicles or other noise can create stress, hearing impairment, hypertension, annoyance, sleep disturbance and increase workplace accident rates.

7. Contractor culture and weather consideration

Contractor culture and weather consideration has become one of the most essential factors for improving the quality level of selection procedures. It was discussed in the focus groups to recognise its significance and validity in the contractor selection process. The expert group emphasised that it is essential to take ***contractor culture consideration*** into the decision maker's consideration. They also opined that there were many multinational employees are working with Libyan contractors. They also emphasised that the different cultures of the employees causes communication problems and impacts on the productivity of the employees. Recently, and after the cancellation of the international sanctions imposed on Libya, many multinational companies have signed construction contracts in Libya and come from different cultural backgrounds. It was stated that language plays a significant part in employee communications and impacts on knowledge sharing among employees, as well as quality and productivity of the contractors in the line of work. The other important culture-related discussion is Libyan tribes, as the basic units of Libyan society are the family, the clan, the tribe. The experts emphasised that tribes are an important social unit in the Libyan society, and consequently, selection process is likely to be impacted by tribal pressures. Therefore, the contractor's language, working culture, knowledge sharing culture and cultural background needs to be taken carefully into account when dealing with the CI and its connected activities in Libya.

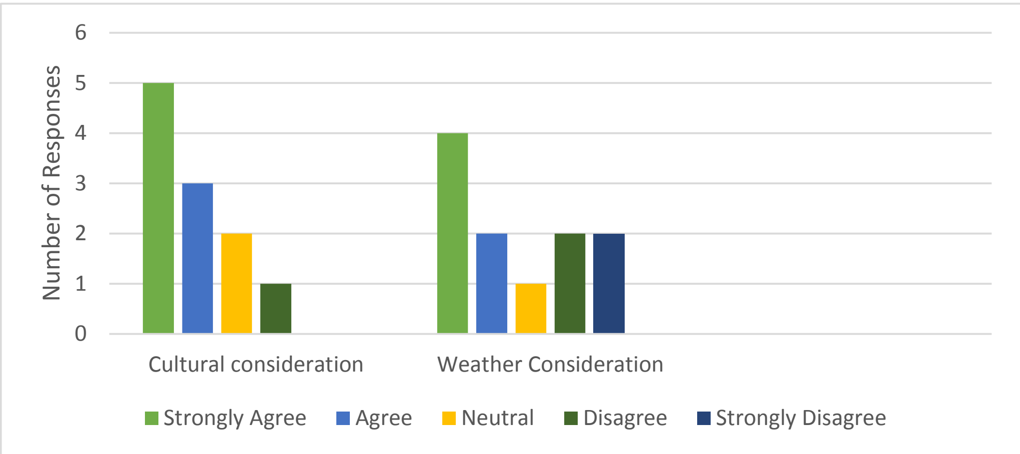

Figure 9-11 Contractor culture and weather consideration

As it is known that in Libya the weather is very hot during the summer and this causes major delays to the development of a project, particularly in significant activities such as concreting. Hence, the expert group argued and stressed that the candidate contractor has to be familiar with and have a positive experience working in a variety of weather conditions.

The questionnaire responses toward the contractor culture and weather consideration sub-criteria are shows in Figure 9.11 with about 75%, of the experts strongly agreeing or agreeing, while about 15% are neutral and only 10% strongly disagreed or disagreed that the cultural consideration is important in the selection process. Finally, ***weather consideration*** was also identified as significant for contractor selection: 60% strongly agreed or agreed, while 10% remained neutral and 20% strongly disagreed or disagreed.

9.9 Summary of findings from the validation process

Very optimistic and cheering feedback has been received from skilled professionals in the construction industry in Libya. The feedback has assured that the suggested framework covers all the areas of the contractor selection procedure, and if appropriately utilised, might not only bring about an extraordinary development and enhancement in the selection procedure, but could also improve success in construction projects. These are shown by the following views:

"I am quite confident about the success of this framework as it covers the main areas of anxiety in contractor selection process. This stride will very much demonstrate to be valuable for all Libyan construction industry ".

(Validator 1)

"The illustration of the framework is unblemished and collaborative, and the snags for which explanations are proposed are well regarded. “

(Validator 2)

"The suggested framework elevated all the most vital points to make the contractor selection process in Libya successful".

(Validator 3)

"The recommended framework is quite thorough and covers a wide range of issues that hamper the contractor selection process in Libya. The framework is perfect and ... will be an important enhancement on the implementation of construction schemes in Libya".

(Validator 4)

"The framework looks complete and well detailed; it appears to discourse the numerous issues that can regulate the achievement of the servicer selection process in Libya as well as in other countries. If one keeps in mind all the recommendations mentioned in this framework while selecting a contractor, a number of problems will be overcome in the Libyan construction sector".

(Validator 5)

"*The aims for developing the framework have been stated clearly. In instantaneous the aim for the growth of the framework is well expressed and the text is fathomable. Also, the diagrams are byzantine and defined. This document will undoubtedly be an important guide in the implementation of contractor selection procedure in Libya".*

(Validator6)

9.10 Impacts of validation on the framework

The feedback recognised by validation has importantly focussed the concluding draft of the framework; this was attained through using the considered remarks offered by the verifiers as to the framework. However, most of the feedback proposed by experts was not reflected in the final shape of the framework, because the framework covered most comments that were suggested by the validators. The validation outcomes proposed some modifications to the framework, mostly in adding some new sub-criteria to the main criteria. For example, *company management structure* was suggested by experts group to be added as a new sub-criterion to the technical and management ability. That is because it provides an indication of the success of the contractor project management staff team. Also it shows decision making procedure and responsibilities of the staff team. Another sub-criterion proposed by the decision makers is *Occupational Safety and Health Administration (OSHA)* to be added to the Health and Safety group. Moreover, some feedback was not considered in the report in order to avoid irrelevant material and also, in some cases, repetition, as the author has already thrown light on those areas.

9.11 Summary

The outcomes of this chapter illustrated the validation of the suggested framework for contractor selection procedure. The objective of the validation was to utilize the results of the validation to improve and develop the framework, as well as to get closer to the reality of the CI requirements. The procedure of validation was done with the support of Libyan public and private construction industry. The validation was done through Delphi survey and consistency was reached after two. Twelve experts participated and were respondents in the first round, including 3 (25%) Contractors, 3 (25%) Consultants, 3 (25%) clients and 3 (25%) Project Managers. The overall response rate of the Delphi questionnaire of the first round was 100%. In the second round eleven of twelve responded and those included 2 (18.18%) Contractors, 3 (27.27%) Consultants, 3 (27.27%) Clients and 3 (27.27%) Project Managers. The overall response rate of the Delphi questionnaire of the second round was about 91.67%. Therefore, the data analysis of round two is based on the 11 who responded and effectively participated in the round. The expert group selected involved key staff members from both public and private sectors, with consideration that the vast majority of participants (75%) are accountable to the public sector and the rest of the participants come from private sectors.

The experience range of the participants selected was between 10 to 20 years of experience. As it was the first framework for contractor selection in the LCI, the main result of the validation is that the framework was explored to be workable, virtual and suitable to reach to the requirements of the LCI market. The experts also stated that the overall framework were clear and easy to apply for the decision makers. The validation procedure focused on the express opinion of the experts and their acceptation degree of the framework, also to build a roadmap for the framework and finally to rank the main criteria and their sub-criteria.

However, in contrast, the outcomes of this research found that financial stability is not the best factor for selecting the best contractor and that the contractor experience has been selected as the most significant factor. The results demonstrated that the highest ranked criteria are experience, financial stability, quality, technical and management capability, reputation, health and safety, human resource and cultural and weather consideration. Conducting the Alpha Cronbach's test for the main criteria of the suggested model indicated that there is a good relationship among the criteria used. The criteria ranking could vary with respect to the significance of the criteria as they are affected by many factors. For example, it can be affected by number of criteria selected. Ranking can also be affected by the number of participants. In addition, it could be affected by marketing needs, cultural consideration and economic strength. Finally, factors may be affected by type of the project.

The outcome of a Delphi survey will help to evaluate and build a framework for contractor selection in LCI. The method was utilized for important reasons such as, as a validation, road map, and to argue and discuss the previous technique and systems as well as to identify the degree of consensus among the decision makers; the contractor, clients, consultants and project managers in the LCI.

CHAPTER TEN: SUMMARY AND CONCLUSION

10.1 Aims of the chapter

This chapter reveals the conclusion of the research done in terms of identifying the original contribution towards the work done on the research objectives stated in the study. This theory describes a summary stating the conclusion and research findings for all the eight chapters. The research also highlights the achievements as results of the preliminary results and the outcome from the study which demonstrates the achievement of the research aims and objectives. The originality of the research outcomes and its contribution, along with the limitations of the research work, are explained. The further strategy which needs to be taken for future research is also recommended. Finally, the chapter concludes with a chapter summary.

10.2 Introduction

For the determination of lucidity, the conclusions and recommendations of this research are accessible in three foremost sections: policies, recommendations and conclusions are summarised in the first section. The practical implications are then further highlighted in section two whilst section three highlights areas of further research.

The study was done on the basis of the research objectives stated which have been listed in this chapter. The findings of the study have been listed and the aspects in which it helps have been stated. Assessment of the research work done and to the extent to which it can prove useful has also been done. The research also highlights some practical applications for the public sector and also presents suggestions for future research.

The research in improving contractor selection during the last two decades has shown a significant concern in introducing improved methodologies. Although such efforts are praiseworthy, there is still a need to present new methods to overcome the difficulty of contractor selection. One significant matter in choosing the contractor is whether the designated contractor can attain the client's needs. The main client's needs that are measured in the research are to complete the project within the planned time, within the assigned budget and with adequate level of excellence.

The main purpose of this study was to design a framework and to provide practical techniques for selecting the most capable contractor who can reach the client's objectives while rejecting those who are liable to be unable to do so to improve the contractor selection procedures in major construction projects in Libya.

To address the needs of the contractor selection in Libya, the planned project will aim to develop an assessment framework for contractor selection process in the LCI. The framework will allow the evaluation of the utility of the current contractor selection practices in Libya, together with the provision of a 'good practice' toolkit for future construction projects. In order to realise this, the following objectives are anticipated: To attain the aim of the study, the following objectives were drawn:

10.3 The objectives of the research

In order to achieve the research aim, the following objectives were set: -

- *Identify the problem areas associated with contractor selection in Libya*
- *Investigate the existing CSP from developed and developing countries and identify the attributes that can be used to evaluate contractors*
- *Investigate the existing models and tools from developed and developing countries and identify the attributes that can be used to select contractors in LCI.*
- *Develop an evaluation framework for contractor selection in construction projects in Libya*
- *Validate the framework and devise a roadmap for its implementation by consulting practitioners from the LCI*
- *Establish a comprehensive system for helping contractor selection in construction projects in Libya.*

10.4 Summary of the Research Process

Libyan construction projects experience many difficulties, one of which considered by researchers is the process of contractor selection. Selection process has been a major weakness commonly found within Libyan construction projects. Thus, there is serious need for improvement in contractor selection procedure that can clearly contribute to learning and developing the LCI. Although, background literature in contractor selection procedure demonstrates many evaluation methods that are employed in construction projects in developing countries, the Libyan construction sector is suffering from the absence of a framework for contractor selection process of projects in both the public and private sector. This results in delays, cost overruns and in some case failures during and after project implementation, as well as the dissatisfaction of stakeholders regarding project products due to these failures. This research gap necessitates conducting an in-depth study of the process of the contractor selection procedure in the LCI and the development of a measurement framework for this sector of the industry. This research is based on the lack of pre-qualification for contractor in the pre-selection stage, moreover, the failure of selection during the operation stages. It is also based on finding a lack of mechanisms and approaches for selection process which is a common problem in third world countries such as Libya. Therefore, this research is aimed at developing a framework for contractor selection procedure in major construction process in Libya. To achieve this aim and to fulfil the research gap, the research was implemented in five stages: the literature review, pilot study, data collection, data analysis, and the framework and framework validation phase. The attainment of the research objectives assisted in achieving the research aim. The outcome of the tasks that were undertaken to attain the research objectives are as follows:

10.4.1 Literature Review Findings

Objective One: *Investigate the existing (CSP) from developed and developing countries, and identify the attributes that can be used to evaluate contractors;*

The task under this objective was to review the way LCI operates and how it is used in Libya. Further, the construction industry and the key issues that are directly associated with the contractor were also investigated. Initially, this entailed investigating the geographical, social, historical relationships between factors and the operations of the CI. Moreover economic issues regarding the CI which include privatisation, employment and unemployment, and the hiring of foreign workers, all of which have a direct impact on the CI, has been explained in previous sections. Also discussed were the structure of the tender process including the invitation to tender, tender form, identifying the most important type tender, open (competition) tendering, closed (competition) tendering, and negotiation tendering as well as construction procurement systems and their associated types. Furthermore, contracts and contracts types were also discussed.

The purpose of this objective was also to present an in-depth review of the existing contractor selection frameworks that are being applied in the different construction industries in developed countries, including strengths, weaknesses and strategies of the contractor selection process. Also, factors affecting the principles on which the contractor selection process is based were discussed. Further, pre-qualification and some contractor selection systems in less developed and well-developed countries were collated. In addition, the most important criteria for contractor selection and its sub-criteria were considered. In addition, it is proposed to identify the relationship between contractor and the project team. To summarise, one can conclude that a number of factors like political, social, and economic plans along with various other authorities have played a vital role in the CI in Libya. Most of contractor selection frameworks considered the most important factor for contractor is tender prices regardless of capability and experience of the contractor and it depends on the decision maker's team.

10.4.2 Preliminary Data (Case Study)

***Objective Two**: Identify the problem areas associated with contractor selection in Libya;*

Two real case studies were used in this study. The case studies were used to give more indication about the current situation of the LCI. The purpose of this objective was to identify the contractor selection procedures of construction projects in. Also, it helps identify key research questions that can later be used in a questionnaire survey. To diagnose what the problems or issues in the contractor selection are, and why they have occurred to justify what you believe to be the best solution. The interviewer in this field showed that CSP in Libya based mainly on traditional construction system. Tendering is by open competition method and the lowest bidder wins the contract regardless of experience, expertise and capability to implement the project to successful completion.

10.4.3 Main Survey Data (Questionnaire)

Objective Three*: Develop evaluation framework for contractor selection of construction projects in Libya;*

This is the main essential objective in the study aiming to explore the procedure that should be conducted to select the contractor, also to investigate the current practises used for contractor selection process for the LCI. To achieve this objective, the required data were collected by distributing 400 questionnaires survey to clients, consultant, project managers and others who have an experience for contractor selection.

Objective Four*: Validate the framework and devise a roadmap for its implementation, by consulting practitioners from Libyan construction industry;*

The purpose of these objectives was to develop a practical framework for enhancing and improving contractor selection procedure in Libya. It began with clarifying the details and procedure utilised to validate the framework. The developed and validated framework for this study has been demonstrated in chapter eight and nine. Two rounds of Delphi survey were used to validate the framework. The framework identifies the most important criteria that can be used for CSP. This framework aims to help the decision makers to select the best contractor.

Objective Five*: Establish a comprehensive system for helping contractor selection of construction projects in Libya.*

The purpose of these objectives was to develop a practical framework for enhancing and improving contractor selection procedure in Libya. It began with clarifying the details and procedure utilised to validate the framework. The developed and validated framework for this study has been demonstrated in chapter eight.

10.5 The Key Conclusions and Recommendations

Grounded in the results of the literature review, questionnaire survey and Delphi literature and case studies innovative knowledge has been provided with a thorough view of the methods of contractor selection criteria. The result of such investigation presented the development of an integration method based on two methodologies, first is AHP which is used to give weight to the contractor selection criteria, and second is TOPSIS model which is used to select the most suitable contractor (details given in chapter 6). Further, a framework for contractor selection procedure was developed (details given in chapter 8). By using the skills of the experienced professionals and experts of the Libyan construction sector, a good framework can be developed and validated. As there are no former key studies of the CSP in Libya, numerous issues, questions, findings, deliberations and inference emerged over the diverse stages of this study. These give signs of the overall advantages and disadvantages of the CSP. For the persistence of appraising and illuminating the related conclusions within a framework relevant to the research questions and objectives, and to address the key issues of the suggested model of the contractor selection procedure (see chapter 8), the conclusions and recommendations are illustrated under the following main headings:

10.5.1 Geographical factor

The contractor selection in Libya operates in extreme temperatures and social circumstances (see chapter two). Hence, it is argued that the present construction method and operational procedures of the contractor selection procedure have not developed as a consequence of a full understanding of Libya's geography, society, and climate. In addition, no recorded attempts have been made to adapt and improve contractor selection procedure and operations to suit Libya's fragile geographical environment. That is because Libya lacks the technological ability for this. Consequently, it appears that there are overall weaknesses in the relations between the construction technology and operations of the contractor selection procedure and its geographical context.

Therefore, it is argued that there are chances to achieve and decrease the impact of these factors on the contractor selection operations. Therefore, two important factors should be taken into the consideration by the design makers when selecting the contractor:

1. When formulating construction projects, the decision makers should take into consideration the geographical and other climatic features of arid lands for construction projects.
2. An information technology (IT) and wireless communications procedure should be developed and improved for use in the selection process. This would likely offer a valuable economic solution to the issues of geographical

dispersal. However, this issue needs further technical, social and economic, environmental assessment.

10.5.2 Social factor

The present and future operations of the contractor selection process are and would be limited by many factors. One of the most important factors which should be considered by clients, decision makers and operators is the Libyan tribal composition of the social environment. Furthermore, the influence of tribalism and associated cultural patterns affect the contractor selection operations by many factors such as favouritism and nepotism which have a long history and deep roots in Libyan society. Many construction companies are founded on the basis of social and tribal roots which helps unqualified contractors to access the construction sector. This usually causes a lack of credibility, corruption and increasing levels of risk in the contractor selection operating environment. Furthermore, the contractor selection operations should be planned in terms of regulations and operations to eliminate the influence of these threats on future operations.

Therefore, social and tribal relationships partially affect the processes of the contractor selection process. This research has reached the conclusion that the family and tribe are important social and economic units in Libyan society which cannot be ignored in terms of organisation and the operations of the contractor selection procedure. In economic terms, business in construction cannot be remote from social and tribal relationships in Libya. Thus, some important points are recommended:

1. When choosing the contractors, the tribal system should be taken into consideration.
2. The negative influence of tribalism needs to be eliminated and to do these special steps needs to be taken.
3. Taking advantage of tribal and family relationships so as to exploit it as channels of communication and sources of information about contractor.

10.5.3 Developing the Management Capability of the decision makers

There are been different factors which have affected the selection procedure. The considerations of different factors include economic and political environments, management methodologies, and the contractual system that are in current use. The contractor selection procedure needs to be improved for the selection of the contractor and much focus has to be given for the management capability of the contractor. The main focus should be to stabilise the industry's operating environment and to readjust and develop management systems in Libyan administration. Several proposals have been made in this aspect:

1. Much attention needs to be given towards education focusing on the construction industry. This includes setting up educational programmes focusing more towards the construction industry on the decision maker teams.
2. More focus should be given towards the application of information technology in the CI by the management.
3. The attitudes of the staff should be in line with the operation of the system and the necessary reforms and procedures to do so should be implemented as stated earlier.
4. By taking appropriate steps, the current gaps in the field can be overcome and it can even clear the understanding of the selection procedure and the acute shortages of highly educated expert workers in the CI which will help to develop the management capability of the decision makers.

10.5.4 Construction Processes Procurement methods

The research also found that the most common procurement method that used in the LCI is the traditional method followed by B&D method. Also, the result revealed that the Libyan political and economic circumstances directly affect procurement systems.

Therefore, it can be said that, there are considerable weaknesses in the procurement methods in the LCI. Procedures and operations of the LCI have been arranged around traditional procurement methods. To progress the effectiveness of construction procedures, more integration between construction and design procedures is recommended. Moreover, in order to enable project parties to adopt proper procurement systems contractual regulations of the procurement system should be improved and revised to limit some of the weaknesses associated procurement systems, and as such, some future advice should be recommended as follows:

- Simplifying construction codes and regulations
- Contract documents should be rational
- Staff training, computer-aided programs and information technology should be utilised in design procedures and construction management

- Concentrating on training programme in construction and project management
- More encouragement and efforts should be made to enhance partnering among local consultancy and international consultancy firms
- New alternative procurement systems dependent on improving educational and training programmes should be recommended focusing on, such as, D&B

Therefore, it can be concluded that, in the long term, to meet the clients' needs and to preserve the rights of the contractor, the training program and educational system of staff and design makers should be carefully revised and developed.

10.5.5 Contractor relationship

In the construction industry, it looks very simple when we talk about contractor relationships albeit that simplicity hides invisible intricate concepts of the nature of the relationship. Good communication usually assists project teams in relating more efficiently with each other. Further, sharing information in an open, honest, accurate, and timely manner along with a helpful, open attitude with respect and trust in others will be the key to good communication.

Lack of experience is one of the main failure factors of any project in the construction industry. Not only does the contractor have to have the relevant experience, but the project manager, consultant and sub-contractor should also aim to employ a highly qualified team in the company. The working team must also have good experience in the same line of work, which will make it possible for management to maximise the usage of the company's resources. Not only does the working team have experience, but the client also should have experience in the line of work. For example, if the client does not have experience, he may not appreciate any improvement or any fresh ideas, which could bring good income in the future. Most of the decisions which cause contractor failures are taken by the management. The most important thing for the contractor about the client are the client experience, client past performance, financial stability, the reputation of the client and the capability of the client representative. A lack of intimacy in relationship between the contractor, client, project manager, consultant and sub-contractor could also have a negative influence on the effectiveness of contractor selection. However, the result shows that there are no such guidelines for the association between project managers, contactors, consultants and subcontractors. Thus dissimilar approaches, traditional methods and low price are being followed for the selection procedure without taking into account the selection criteria e.g. experience, knowledge and capabilities.

10.5.6 Pre-qualification

The result demonstrates that contractor pre-qualification procedures are rarely re-evaluated more frequently than annually in the LCI and clients would not scan a contractor further before giving a contract. Additionally, the range size of the Libyan companies are small and medium, therefore, the contractors should be grouped and classified into at least four or five groups and based on their experience and financial capacity. Each group should be classified into five categories (site formation, buildings, roads and drainage, port works, and waterworks) according to their relevant expertise and managed by the relevant Works Departments. The information and services of the pre-qualification team members are still struggling as to how to achieve the classification of contractors. Lack of experience and control from decision making parties obstruct the successful selection of the appropriate contractor. Also, traditional procedures for collecting contractor's information used in the Libyan construction sectors reflect the progress of the contractor selection, as they still manage registration using old management methodologies.

10.5.7 Main Criteria

The results of the literature review and statistical analysis (questionnaire survey and Delphi survey) of the local practice (Private and public sectors) in the (LCI) conducted in this study support conclusions from previous studies that profit is not the most important factor for decision makers (Darvish, et al., 2009) (Wang & Yuan, 2010).

The study further revealed contractor financial stability as the second important factor for contractor selection. The reduced interest in the contractor financial stability could be traced to the LCI client's belief of not having accurate financial data from the contractor. Quality identity also has a high importance along with technical & management ability, reputation, health and safety as a moderate importance. Finally, culture and weather considerations have low importance in the contractor selection procedure decision.

The current considerations of health and safety, culture and weather are regarded as sixth and seventh. Limited awareness and absence of health and safety, culture and weather consideration rules and regulation within the LCI may be sufficient reason for this result.

In order to see whether there was a difference in the views between the public and private sector an independent sample t–test was conducted. The result indicates that there is no statistically significant difference between the groups' responses which means that there is no bias. The finding of reliability test and factor analysis, Cronbach's Alpha, of each criteria revised structure for the main criteria and sub-criteria of contractor selection list.

The factor loading for all the criteria were found significant (above 0.5). The development of a new structure arranged the highest correlated factors under a new group of criteria.

The focus of the collected data was the framework and its components. The questionnaire participants and the focus group participants were asked to express their opinions and views on the proposed framework. This section presents and discusses the main outcomes of the data analysis.

10.5.8 The integrated method between AHP TOPSIS

The literature review provided advanced knowledge and a detailed view of the method of contractor selection criteria. The result of such investigation led to the development of a method that combines the use of AHP and TOPSIS for contractor selection. The model was grounded on a hybrid model composed of two methodologies, the first of which is AHP which is used to present a relative weight to the contractor criteria, and secondly the final ranking was deliberated by using the TOPSIS method. The main benefits of using those methods are:

- It is a dependable and orderly technique as it has the facility to capture an expert's judgment when complex MCDM struggles are deliberated. Therefore, the integration of the AHP and TOPSIS approaches makes the decision-making process more realistic and rational. Because of this capability, decision-makers can use this combined approach in making their strategic decisions.

- It considers the categorised structure, pair-wise comparisons and constancy checks in the valuation process. Thus, this approach can be considered as an excellent tool for calculating quantitative and qualitative criteria.
- The ranking of the alternatives obtained by using the AHP and TOPSIS methodology may change if a new criterion is added.

10.6 Significance of the study and contribution to knowledge

In general, all of the aims and objectives have been achieved in this research study. The major contribution of this research to knowledge is that it highlighted and investigated the client's needs at every stage of a selection procedure, determined mainly from decision makers' teams through the pre-qualification process and selection operation stages. Further, the CSP has now become very comprehensive and a reference for any problem is now available. Additionally, this study will assist decision makers, policymakers, and others involved to be more percipient of and have a better understanding of the selection process in the LCI. This new understanding will assist decision makers to make more efficacious decisions and to adopt good short and long term policies for contractor selection planning which can then be put into procedure.

- As it is deemed the first research that focused on the CSP in the LCI, the outcome of the study can be considered a significant reference and important reference document.
- This work has contributed to and assisted in providing a significant database for other investigators in this area, helping the reader to understand the kind of areas that would impact the selection of contractor in Libyan construction industries.
- Although this research is done bearing in mind the LCI, the results can be generalised to other countries. With slight modifications, this frame work be utilised in other countries that have similar construction industry characteristics.
- Another contribution found is that as this is the first study that investigates and compares the contractor selection procedure in private and public sectors, the research can be considered an important reference and milestone

for any future studies. The result shows that there is no difference between the two sectors in the term of contractor selection process.

- This is a very generic framework. However, it will surely encourage and enhance research in more specific areas that are dealt with in this research. For example, contractor relationships with projects team such as supplier relations.
- This study will help and contribute to opening the horizons of knowledge in this area and hearten Libyan investigators to enter the arena and investigate specific dimensions of the framework more deeply.
- Since social, nepotism and tribal relationships are a very strong aspects of the Libyan society and have been proven to be a strong influence the operations in the construction industry, consequently, the researcher has found that the family and tribe cannot be neglected in the operations of the contractor selection procedure and they have been taken into consideration while designing this research. There is a very evident connection between the Libyan economy and society. This research aims to give adequate importance to tribal society while deciding upon the economic policies as neither society nor economy can work without affecting the other. Also, it seeks to find ways of reducing the effects of nepotism, tribalism and others on the operations of the contractor selection.
- The findings of the research supports previous studies, stating that the decision makers consider the contractor experience factor as more important than contractor profit factor in the term of contractor selection. It mentions that the necessity for experience is the most significant criteria among all other criterion.
- The multi-criteria model created for mark-up decision is based on the analytical hierarchy process. The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) can be easily used by contractors in the construction industry to determine which project will result in higher mark-up.
- The CGI Software can be simply used by the decision creators even if they are not acquainted with the mathematics underlying the Logical Hierarchy Process. In addition, the CGI software approach is confirmed to be an operative method for solving the pair-wise comparison matrices, generated

using the Analytical Hierarchy Process and compared with the outcome from the other the AHP approaches, such as, Criterion Decision Plus Software.

10.7 Limitations of the Study

A number of limitations have affected this study. The suggested framework has number of constrains terms of its conduct and scope as summarized below:

- The fact that there had been no previous theoretical or empirical studies on this subject under discussion in Libya.
- There is a lack of information and data available regarding the LCI in general.
- There were limitations regarding the social/cultural perspective of the study. With regards to the desire to participate in the survey, the responses to the research were also not very encouraging. This could be attributed to social/cultural state of affairs.
- Most foreign companies hurriedly left the country during the onset of the civil war. Therefore, the feedback of the questionnaire survey was based on the local participants.
- The validation of this research was based on Delphi survey. Therefore, the interview was not included because of the sensitivity of the security situation in Libya and difficulty of obtaining data through personal interviews.
- Delphi method is time consuming.
- Selection of right participants could pose challenge.
- It is important that the participants remain committed to complete survey. If they leave earlier, this will skew the results.
- The final limitation was the political unrest and civil war taking place in the country. Due to this instability and conflict within the country, most organisations in both the public sector and private sector were not fully operational.

10.8 Recommendations for further research

As stated in the previous chapters, there are numerous criteria that might affect the operation of contractor selection. The limited scope of the research project cannot completely cover all factors. However, the most important factors influencing success and/or failure of contractor were covered with the LCI. Therefore, for further research the following areas are suggested.

- Focus on the various areas associated to the success and/or failure of contractor selection in Libya is needed, for example, the supply chain management and clients' needs;
- A first class IT-based organisation system for selection contactor application is wanted;
- A case study to learn more issues linking success factors that may affect contractor selection might need to be used in further research.;
- Further investigation may be done as a contrast between two countries for example, one of the developed countries and Libya to compare the contractor selection process;
- Further research in training and educational desires in the LCI: given that the LCI shortage efficient management programme, skilled labour, consultants and other experts, new methods for training and education in the LCI can be considered in future work;
- Further research in the construction procurement system and contract strategies in Libyan public projects is required to establish a line of action in ensuring these policies are carry out correctly and ideal outcomes are achieved to satisfy public requirements.

10.9 Summary

This chapter concludes the thesis. At the beginning, the main conclusions from the research project were presented. It is worth mentioning that the analyses of the literature review, questionnaire survey and interviews provide the research findings in details of each phase, which formed the basis for the framework development. The summary of the conclusion subsequently followed. The findings from the conclusion provided the need for the framework that has been developed. The section summarised with the research findings. It explained the need for this research study, and the achievement of the research aims and objectives. The unique nature of the work, the contribution this research makes to the body of knowledge and its benefits to construction projects and the development and growth of the construction sector are outlined. The limitations of this research and the application of the framework were highlighted. Finally, the areas for further research work were also identified.

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APPENDIX (I)

Interview questions

1. Could you tell me about the criteria for contractor selection in your organisation? If yes, could you please explain the selection process?
2. What are the most important criteria for contractor selection criteria at your organisation?
3. Do you do pre-qualification process before you select contractor? I not why?
4. In your selection system, do you consider another important criteria such as health and softy record, or quality record?
5. Are there any difficulties that you have faced during the selection procedure? Please explain your answer
6. Did the contractor have any problems regarding to the payment, like the delay in payment?
7. Do you consider the project as a successful project or you thing there was a failure in the project?
8. Who is the main responsible for this failure? And why?

APPENDIX (II)

First questionnaire

Dear Respondent,

As part of my PhD thesis at Edinburgh Napier University, I am carrying out a survey which will investigate the contractor selection system in Libya to set up the key evaluation criteria of obtaining the optimal contractor. I will be so thankful if you possibly complete the following questionnaire where your response will give a better insight of the contractor selection criteria system being followed in Libya.

***Part one*: Identified responded profile;**

1. Name …………………..……
2. Organisation business name...........
3. Contact address........................
4. What is your job title…………..…..
5. Fax number…………….........
6. Telephone number...........................

7. Job title?

☐ Contractor
☐ Clients
☐ Project Manager
☐ Consultants
☐ Other

***Part two*: Contractor selection system in Libya**

8. How long have you been working in the construction sector?

☐ 0-5
☐ 6-10
☐ 11-15
☐ 16-20
☐ 21-25
☐ Over25 years
☐ Other

9. In your organisation, do you adopt any measurement system for contractor selection (please select the right answer)

☐ Yes
☐ No
☐ Other

10. In case that contractor selection process are adopted at your organisation, could you possibly advice why does your organisation do so (You can select more than one answers when necessary).

☐ For selection the most appropriate contractor
☐ To comply with the organization roles and regulation 11-15
☐ For the transparency and credibility purpose 21-25

☐ To fulfill the sponsor or other stakeholders requirement
☐ To accomplish clients' interest
☐ For other reasons, please specify

11. In which format do you collect the information that required for your organisation own assessment?

☐ Standard application made by your organization or client
☐ Contractor own choice
☐ Others please specified

12. What sort of information that your organisation is seeking to obtain from the contractors in order to prepare the evaluation list?

☐ Financial stability
☐ Technical & management ability
☐ Experience
☐ Health and safety
☐ Reputation
☐ Culture experience
☐ For other reasons, please specify

13. In case that your organisation using decision criteria, Which methods dose your organisation used to assess decision criteria

☐ Pre-defined model, please specify
☐ Professional judgment
☐ Others please specified

14. At which level the assessment of contractor selection process take place?

☐ Technical department and engineering
☐ financial department
☐ Project management team
☐ High managerial level (director)
☐ Independent consultant
☐ a committee consist of (1, 2, 3, 4)
☐ Other reasons, please specify

15. Does your organisation classify the contractors On the basis of their qualifications? If yes to how many classes the contractors are usually categorised

☐ Three (1st – 2nd – 3rd)
☐ Four (1st – 2nd – 3rd – 4th)
☐ Five (1st -2nd -3rd – 4th- 5th)
☐ Others please specified

16. Does the socio-economic (tribe) have any influence in the contractor selection?

☐ Yes
☐ No

17. Do you prefer to award work to company belonging to separate ethnic groups or to individual owners who belonged to specific ethnic groups?

☐ Yes
☐ No

18. How often contractors re-qualify?

- ☐ Never
- ☐ Annually
- ☐ Less than once per year
- ☐ Others please specified

19. What are the main criteria of selection Sub-contractor process?

- ☐ Low price
- ☐ Experience
- ☐ Reputation
- ☐ Cultural eperiance3
- ☐ Health and safety record
- ☐ Others please specified

20. In which way dose clients and contractor selection project manager and consultant?

- ☐ Traditional method
- ☐ Standard criteria
- ☐ Others please specified

21. Which is the most popular procurement method that using tin the Libyan construction industry?

- ☐ Traditional procurement System
- ☐ D&B Procurement Systems
- ☐ Management Oriented Procurement Systems
- ☐ Others please specified

22. Dose the Libyan government has any influence on the implementation of the procurement method?

- ☐ Yes
- ☐ No

Part three: Select the most important sub-criteria for contractor selection.

(0)Not important (1) Low important (2) Somewhat important (3) Important (4) Very important

Main Criteria	Sub-criteria	Impotence				
		0	1	2	3	4
Financial stability	Positive credit rating					
	Financial status					
	Banking arrangements					
	Tender price					
	Staff experience					
Technical and management ability	Staff qualification					
	Project manager qualification					
	Past performance					
	Company equipment					
Experience	Experience edge					
	Size of project					
	Length of time in business					
	Experience in the region					
	Type of project					
Health and safety	(OSHA) incidence rate (points)					
	Safety record					
	Company safety policy					
	Experience in noise control					
Quality	Quality management					
	Quality work					
	Quality policy					
	Quality assurance					
Cultural experience	Relation with local working culture					
	Relationship with(Suppliers, sub-contractors, consultant and client)					
	Claims and dispute					
	weather consideration					

Please note, that any data information will be provides in this questionnaire will be handled privacy, confidentiality and it will be only involved on the academic aims to complete a PhD. At the end of this questionnaire, thank you very much for your participations. If you have any questions about the
Questionnaire or research, do not be hesitating to contact me on 00447846184141 or email me on elsayah2@yahoo.com.

Notes:

Appendix (III)

Second questionnaire

Dear Colleagues
This is the second questionnaire on the subject of Building a Framework for Contractor Selection Criteria. Your kind contribution in the first survey, which looked into the current practice for contractor selection criteria, has helped to identify the most important criteria for contractor selection. As you know, the main target of clients' objectives is to complete the work within a specified time, a defined budget and a high level of quality. Therefore, you would be asked once again for you contribute for:

1. Rank the main criteria,
2. Validate and express your point of view of the suggested framework
3. Establish the road map for the framework

- **Aim and objectives of the survey**

This research aims to build up a framework for contractor selection criteria in construction industries in Libya.

***Part* 1:**
Identify respondents' profile

Name...
Organisation business name..
Contact address...
Telephone number...
Fax number...

Part 2:
How do you think about the framework?

☐ Unacceptable
☐ Poor
☐ Acceptable
☐ Good
☐ Very good
☐ Other

Part 3 A:

Select and rank the main important criteria

(0) Not important (1) Low important (2) Somewhat important
(3) Important (4) Very important

Main Criteria	The importance of the criteria				
	0	1	2	3	4
Financial Stability					
Human Resource					
Technical & Management Ability					
Experience					
Health and Safety					
Quality					
Reputation					
Local Culture External Culture					
Other					

Part 3 B:

Evaluate and rank the importance of the sub-criteria criteria

Main Criteria	**Sub-criteria**	**Impotence**				
		0	**1**	**2**	**3**	**4**
Experience	Experience edge					
	Size of project					
	Length of time in business					
	Experience in the region					
	Type of project					
	Other					

Main Criteria	**Sub-criteria**	**Impotence**				
		0	**1**	**2**	**3**	**4**
Financial stability	Positive credit rating					
	Cash flow					
	Banking arrangements					
	Type of project					
	Other					

Main Criteria	Sub-criteria	Impotence				
		0	1	2	3	4
Quality	Quality management					
	Quality work					
	Quality policy					
	Quality assurance					
	Other					

Main Criteria	Sub-criteria	Impotence				
		0	1	2	3	4
Technical & management ability	Staff experience					
	Staff qualification					
	Project manager qualification					
	Past performance					
	Company equipment					
	Other					

Main Criteria	Sub-criteria	Impotence				
		0	1	2	3	4
Health and safety	(OSHA) incidence rate points					
	Safety record					
	Company safety policy					
	Experience in noise control					
	Other					

Main Criteria	Sub-criteria	Impotence				
		0	1	2	3	4
Cultural experience	Relation with local working culture					
	Relationship with (Suppliers, sub-contractors, consultant and client)					
	Claims and dispute					
	weather consideration					
	Other					

- ***Part 4:*** Road map to establish the framework

If the framework is acceptable, how many years does it take to apply this framework?

☐ Two year
☐ Four years
☐ Six years
☐ Eight years
☐ Other

Please note, that any data information will be provides in this questionnaire will be handled privacy, confidentiality and it will be only involved on the academic aims to complete a PhD. At the end of this questionnaire, thank you very much for your participations. If you have any questions about the
Questionnaire or research, do not be hesitating to contact me on 00447846184141 or email me on elsayah2@yahoo.com.

Notes:

Appendix (IV)

Sub criteria	Sector	N	Mean	Std. Dev.	Std. Error Mean	P- Value of difference in Means
Positive credit rating	Public Sector	82	2.80	1.094	0.121	0.195
	Private Sector	30	3.10	0.960	0.175	
Financial status	Public Sector	82	3.21	1.097	0.121	0.908
	Private Sector	30	3.23	0.935	0.171	
Banking arrangements	Public Sector	82	2.65	1.082	0.119	0.931
	Private Sector	30	2.67	1.155	0.211	
Tender price	Public Sector	82	3.10	1.038	0.115	0.758
	Private Sector	30	3.17	1.085	0.198	
staff experience	Public Sector	82	2.95	0.993	0.110	0.705
	Private Sector	30	3.03	1.066	0.195	
Staff qualification	Public Sector	82	2.88	1.104	0.122	0.0336
	Private Sector	30	3.10	0.995	0.182	
Project manager qualification	Public Sector	82	3.24	0.897	0.099	0.335
	Private Sector	30	3.43	0.971	0.177	
Past performance	Public Sector	82	3.22	0.831	0.091	0.525
	Private Sector	30	3.10	0.994	0.181	
Company equipment	Public Sector	82	3.34	1.080	0.119	0.383
	Private Sector	30	3.53	0.860	0.157	
Experience edge	Public Sector	82	3.18	0.957	0.106	0.932
	Private Sector	30	3.20	0.887	0.162	
Size of project	Public Sector	82	3.27	0.861	0.095	0.072
	Private Sector	30	2.93	0.868	0.159	
Current work load	Public Sector	82	2.65	1.058	0.117	0.361
	Private Sector	30	2.43	1.165	0.213	
Experience in the region	Public Sector	82	2.62	1.096	0.121	0.363
	Private Sector	30	2.40	1.248	0.228	
Type of project	Public Sector	82	3.27	1.078	0.119	0.284
	Private Sector	30	3.00	1.390	0.254	
(OSHA) incidence rate (points)	Public Sector	82	2.84	1.071	0.118	0.236
	Private Sector	30	2.57	1.104	0.202	
Safety record	Public Sector	82	2.57	1.054	0.116	0.148
	Private Sector	30	2.23	1.194	0.218	
Company safety policy	Public Sector	82	2.51	1.157	0.128	0.201
	Private Sector	30	2.83	1.206	0.220	
Experience in noise control	Public Sector	82	1.96	1.409	0.156	0.591
	Private Sector	30	2.13	1.655	0.302	
Quality management	Public Sector	82	3.24	1.049	0.116	0.554
	Private Sector	30	3.10	1.348	0.246	
Quality work	Public Sector	82	2.82	1.389	0.153	0.863
	Private Sector	30	2.77	1.305	0.238	
Quality policy	Public Sector	82	1.93	1.530	0.169	0.782
	Private Sector	30	1.83	1.704	0.311	
Quality assurance	Public Sector	82	2.06	1.485	0.164	0.851
	Private Sector	30	2.00	1.619	0.296	
Relation with local working culture	Public Sector	82	3.04	1.071	0.118	0.238
	Private Sector	30	3.30	0.952	0.174	
Relationship with (Employees, Suppliers, sub-	Public Sector	82	2.34	1.307	0.144	0.740
	Private Sector	30	2.43	1.251	0.228	

contractors, consultant & client)						
Claims and dispute	Public Sector	82	2.09	1.450	0.160	0.793
	Private Sector	30	2.17	1.440	0.263	
Weather consideration	Public Sector	82	2.28	1.363	0.151	0.468
	Private Sector	30	2.07	1.413	0.258	

CASESTUDIES (V)

- CASE STUDY (A)

Due to the large geographical area covered by the Libyan borders, more than four thousand kilometres of difficult terrain and arid desert, the Libyan government has a very difficult time controlling their borders (see section 2.2.1). This situation contributes to the prevalence of smuggling and illegal immigration, and has resulted in several problems such as the deaths of many people as a result of dehydration and starvation. As a result, the Libyan government, with the support of the European Union, has decided to build number of centres for providing refuge to those people who might otherwise have died in the desert crossing. These centres are spread over several areas adjacent to the Libyan borders, and have been built in order to provide health services. These centres have been designed with high technical specifications including:

- Bedrooms
- Integrated medical clinics
- Rooms for general surgery
- Laboratories with high technical specifications
- Sports centres with football pitches, tennis courts, etc.

However, to build all the above facilities, the Libyan government's Organisation Development of Administration Centre (first part), signed a contract (Contract No 214/2008) with the company Holding Group for Engineering and Construction (second part). The total amount of the contract is, 15 million Libyan dinars, which is equal to about 12 million U.S. dollars. The proposed duration of the project was two years. The refuge centres are distributed in five main places: Sabha, Ubari, Murzuq, Alkufra, and Ghat.

The construction company is based in the capital (Tripoli), which ranges from 1,000 to 2,000 km away from the locations of the centres. Further, the company is not familiar with the geographical area of the Libyan borders. A huge delay in project implementation was recorded by the first part. After that, the company was noticed was twice. Finally, the contract was withdrawal from the company.

- CASE STUDY 2

The project is the establishment of a water supply network in Tripoli. This job was given to five companies. In the beginning, work went well, but after some time, finance was reduced and accordingly the performance of the companies also reduced. Some of the companies lacked the experience to complete the job. Infrastructure work requires underground maps of existing work, but the engineers did not have these maps. The proposed duration of the project was three years, but there were no detailed plan for its implementation and, in addition, import of material was delayed. Moreover, the construction caused problems with telecommunication, traffic and transport in the city. All these problems combined to delay the project, with the contractor blamed for the delay because at that time most of the materials were supplied by the state. It was bad planning and lack of experience by the contractor which caused the delays and failure of the project. Clearly, if the senior project manager who was appointed by the contractors had the necessary experience and authority, and was appointed early enough in the project, then the necessary preparations – obtaining essential plans and maps, liaising with the local transport authorities, etc. – would have been carried out and any unavoidable delays planned for. Also, it is possible that avoiding delays could have helped avoid the reduction in finance, and the delays in deliveries of materials could have been managed in such a way as to have had considerably less impact on the project. From this example, it is clear that one of the major problems in this project was the lack of experiences and authorities of project managers. To eliminate such problems project needs a project manager with same background, experience and ability to complete the project within plan and taken into account to monitor any deviations. A successful project manager should have managerial and technical skills as well as should be responsible to resolve any problems occur in the site.