REFERENCE

A Project Control Framework for the Libyan Construction Industry

By
Huwaida Abdulmotamad Tahir

A thesis submitted in partial fulfilment of the requirement of Sheffield Hallam University for the degree of Doctor of Philosophy

February 2015

DECLARATION

I declare that the work presented in this thesis is my own work, done to the best of my knowledge and effort except as acknowledged in the text, and the work referred to in this thesis has not been submitted, either in whole or in part, for another degree or qualification.

ACKNOWLEDGEMENT

First and foremost, I give thanks to God for all the care and help that I had throughout the different phases of this research.

Many people, government departments and institutions have been important contributors to this work. It is difficult to name all those who have provided help, support, encouragement, information and advice. The author warmly thanks all those individuals, institutions, firms and many others who have made their documents, notes, time, knowledge and expertise available to me.

I thank my supervisor, Professor Paul Stephenson, for his inspirational guidance, encouragement, valuable comments and constructive criticism during the years of the research process.

I owe my deepest gratitude to my parents Almotamad and Kawtar who gave me their moral support, and prayed for my success during my studies. I would especially like to thank my husband Mohamed as I would never have been able to do this without him. He has given unconditional love and provided me with power, dreams, courage and the determination to finish this thesis. Also, I thank all my family, Fatmha, Abdulsalam, Kawtar, Almotamed, for giving me their inspiration, patience and tolerance throughout my preoccupation with this work.

I am heartily thankful to my daughter Fatmha, who always found time to listen to my problems during my research and provided valuable help. She gave me a magnificent support and she was always cheering me up when I need her during stay abroad.

I will always remember with special gratitude my colleague Mohammed Alzhubi for his unstinting help, and I am heartily grateful to Anselm Kersten who proofread my work. Finally, I owe a special a debt to my country Libya for financing my study.

ABSTRACT

Time and cost overruns are one of the biggest issues facing the construction industry and affecting delivery in terms of time, cost and quality. Libyan construction projects experience these problems, often to a greater extent than most others. This can be attributed to both unexpected and expected risk factors that are not effectively dealt with. A focus on control is therefore vital in order to improve the performance of construction projects. The chief purpose of this study is to explore and understand the main characteristics of the Libyan construction industry (LCI) and its associated processes and operations, as well as to identify the major obstacles constraining its practices. It will also develop and validate a framework through which to manage risk factors that significantly affect a project's time and cost performance.

The initial proposed framework for the design of project cost and time control is based on previous studies; other practices regarding control are derived from the findings in the literature. The framework was reviewed and refined through iterative processes. Semi-structured interviews with professionals in Libyan organisations were used to investigate how costs and schedules of construction projects are controlled in practice and to discover the reasons and related issues that affect the process of cost and time control in practice. Survey questionnaire I was conducted to identify the major risk factors causing time and cost overruns in Libyan projects. The framework for minimising cost and time overruns was subsequently validated by the perception of the professionals (contractors, consultants and owners) involved in the LCI who participated in questionnaires II and III.

Both, theory and practice have been linked through the literature review and the involvement of practitioners to develop a framework by which cost and time overruns in Libyan construction projects can be minimised. It is envisaged that the developed framework will lead to changes in LCI projects, since practitioners can be more systematic in dealing with the factors leading to cost and time overruns. This will further provide improved current practices in delivering better quality construction projects that satisfy clients' requirements and in which cost and time overruns are minimised.

TABLE OF CONTENTS

Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ALE	Association of Libyan Engineers
BTC	Bromilow's Time Cost
CPM	Critical Path Method
CBS	Construction and Building Sector
CCD	Contractor Caused Delays
CIRIA	Construction Industry Research and Information Association
ESRC	Economics and Social Research Council
GCP	General Council for Planning
GDP	Gross Domestic Product
GERT	Graphical Evaluation and Review Technique
GFA	Gross Floor Area
GNP	Gross National Product
GPC	General People's Committee
IMF	International Monetary Fund
LCI	Libyan Construction Industry
LOB	Line Of Balance
LR	Literature Review
MP	Ministry of Planning
NTC	National Transitional Council
OCD	Owner Caused Delays
OPEC	Organization of the Petroleum Exporting Countries
PERT	Programme Evaluation and Review Technique
PMI	Project Management Institute
PMCD	Project-specific Matter Caused Delays
SMEs	Small and Medium Enterprises
SPSS	Statistical Package for the Social Sciences
TPCD	Third Party (natural) Caused Delays
TUMC	Tripoli University Medical Central
UAE	United Arab Emirates
UN	United Nations
UNDHA	United Nations Department of Humanitarian Affairs

1.1 Introduction

This chapter presents an overview of the research study. It provides a background to the study, the statement of the research problems, aim and objectives. The chapter also outlines the research methodology used in actualizing the research and then concludes with giving an overview of the structure of the thesis.

1.2 Background of the Study

The construction industry is one of the most complex and inherently risky businesses and has a very poor reputation for managing risks, with many major projects failing to meet deadlines, cost and quality (Smith et al, 2006). Flanagan & Jewell (2005) note that risk is not handled adequately, resulting in poor performance, increased costs and time delays. Libyan construction projects, in particular, experience these problems and often to a greater extent than most other countries. This can be attributed to both expected and unexpected risk factors, specific to Libya, that are not effectively dealt with at various stages of the construction process. Wells (1986a) states that the lack of an appropriate approach to address these risks has led to lots of undesirable results in project execution, particularly in the Libyan construction industry. According to a report published by the Libyan General People's Committee PGC (2003), 97% of construction projects associated with the public and private sectors between 1991 and 2003 suffered delays and had a high impact on project cost and time. During this period (which was Libya's blockade time) because of the UN sanctions against Libya following the Lockerbie bombing in 1988, the price of construction materials (including steel) was very high and many projects were stopped in anticipation of a return to old price levels, causing direct delays. Contracting parties also created disputes between the contractor and owners, which further increased projects' cost and duration. Another report conducted by the Public Committee of Project Monitoring and Follow-up (2004) in Libya showed that time and cost overruns are a common problem in the Libyan Construction Industry (LCI). Moreover, in early 2011, Libya was mired in political conflict with the widespread popular protest against the Al-Gaddafi government. These dramatic events imply that Libya will be faced with substantial challenges in terms of reconstruction and reorganisation. There is an urgent need to modernize and restructure the country's construction industry.

The chief purpose of this study is to explore and understand the main characteristics of the LCI and its associated processes and operations, as well as to identify the major obstacles constraining its practice and operations. It will also develop and validate a framework through which to manage risk factors that significantly influence projects' time and cost performance.

In order to identify the major risk factors, the author reviewed and examined the causes of cost and time overruns in various countries worldwide; These include Arditi et al (1985) in Turkey, Amer Wahid (1994) in Egypt, Mansfield et al. (1994) in Nigeria, Assaf et al. (1995) in Saudi Arabia, Mezher and Tawil (1998) in Lebanon, Al-Moumani (2000) in Jordan, Ahmed et al. (2003) in the US, Koushki et al. (2005) in Kuwait, Yakubu (2010) in the UK.

Most of these studies have been conducted over 10 years ago. This creates a need for more up to date research and investigation to reflect latest developments. Some of these studies have focused either on cost or time overruns, whereas these two are very much related in the control of projects: the greater the time for completion, the higher the cost, because delays mean more hours worked and more staff, plant, equipment, direct and indirect costs, as well as potential claims between contractor and client and a greater concern with the financing of organisations. Any study devoted to time control should focus equally on cost control, which is the position taken in the present work.

The author has summarised and tabulated the most important causes of delays and cost overruns in different countries by analysing the many previous surveys. The author has collated these studies and investigated the 15 most frequent delay and cost overruns factors in those countries' construction projects. The outcomes are shown in Table 2.4

The quantitative study for this research was carried out through the survey questionnaire I in order to determine the factors influencing time and cost overruns in Libyan construction projects. This stage of the research also identifies the methods used to determine the times and costs of activities involved in construction projects.

Additionally, the study did not stop at the identification of the factors causing cost and time overruns, but continued progress onto finding ways of mitigating measures for the identified risk factors in order to develop a framework for minimising cost and time overruns.

1.3 Statement of the research problems

There is a consensus that the construction industry is subject to more risk and uncertainty than are other industries. The LCI has a poor image in the construction market owing in part to its poor performance over the past few decades. Many Libyan construction projects were, however, found to be completed at a much higher cost over a longer period of time than the original plans allowed for (Libya General People's Committee of facilities and housing, 2006). In 2007, a new boom took place in the LCI. Billions of dollars were offered to rebuild the country and its facilities. For example, in November 2007 the government announced plans to spend more than $123 billion on public works over five years; more than $30 billion were allocated for the infrastructure and housing sectors alone in that year. More than 500,000 housing units were planned for the next ten years (ICS, 2009).

There are wide gaps in knowledge about the LCI in terms of its management and operations and there seems to be a lack of academically based research into the current practice of project management in Libya. However, the available information relevant to the LCI was very limited and characterized by contradiction. Therefore, new regulations and policies are needed. For example, improving construction efficiency by means of timeliness and cost effectiveness would definitely contribute to cost saving for the country as a whole.

In order to improve the processes of the LCI, it is thus necessary to understand the key factors affecting the construction industry and its associated operations: how the industry is organized, how construction activities are conducted and what the major obstacles constraining the industry's operations are. The present work attempts to answer these questions.

Therefore, it was decided to conduct this research to fill gaps in knowledge of the LCI through remedying the unclear understanding of the process of project control in LCI. The main purpose of this research will be to explore and understand the main characteristics of the LCI and its associated processes and operations, as well as to identify the major obstacles constraining its practice and operations. It will also develop and validate a framework through which to manage risk factors that significantly influence projects' time and cost performance.

1.4 Research Aim

The aim of the research is to investigate Libyan project cost and time control process in practice and to develop and validate a framework to proactively minimise time and cost overruns in Libyan construction projects.

1.5 Research Objectives

- To examine the current situation regarding time and cost overruns in Libyan construction projects
- To identify the major risk factors causing time and cost overruns in Libyan projects
- To determine the current procedures of cost and time control tools and techniques adopted by practitioners in the Libyan construction projects
- To explore the perception of professionals (contractors, consultants and owners) involved in the LCI regarding the important processes of cost and time control
- To establish measures that will assist to mitigate the causes of cost and time overruns in Libyan construction projects
- To develop and validate a project cost and time control framework.

1.6 Research Methodology

Because of the wide range of data collection, as well as the nature of the data required to confirm and validate the situation, this study adopted a quantitative approach initially. Nevertheless, qualitative methodology was used to complement that approach because of its advantages – in particular, to develop a framework that will guide the practitioners of Libyan construction projects to the successful adoption of project control. The evaluation process of this study is based on combining qualitative and quantitative methods. The researcher first adopted a quantitative approach using questionnaire II to define participants' responses regarding their perspectives on mitigation measures. Questionnaire III, however, was designed for open-ended questions to reveal qualitative information about the project control framework to use the feedback of participants of questionnaire III to re-validate the developed framework elements. The description of objectives of the study relative to the methods adopted and processes implemented in answering the research questions are shown in Figure (1.1)

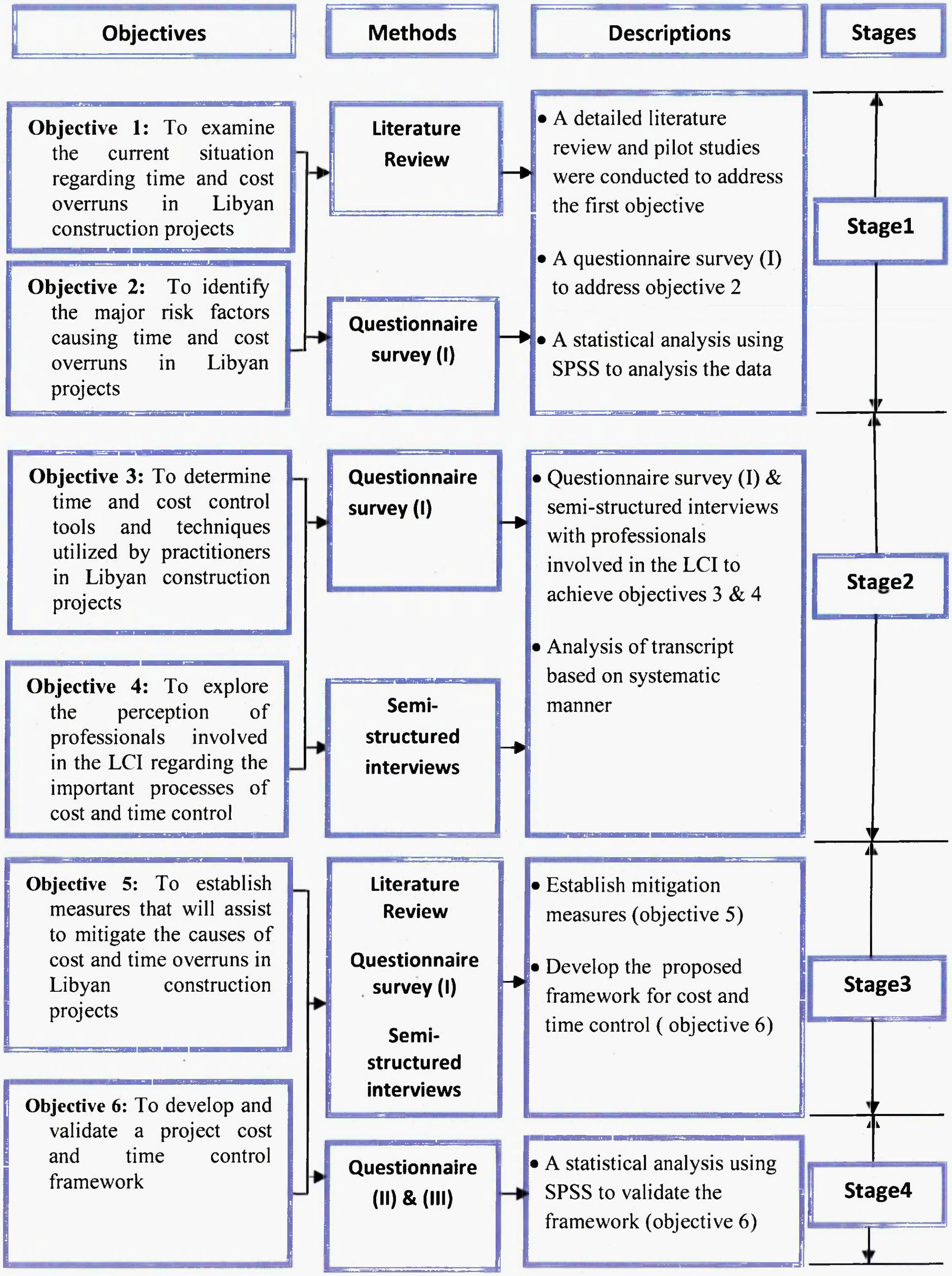


Figure 1-1: Research Objectives Relative to the Methods

1.7 Thesis structure

The thesis comprises four main parts. The first part is focused on exploring and reviewing the delay and cost overrun factors in the construction industry. The second part introduces the research methodology and processes, analyses the methodology for the quantitative and qualitative data, and discusses the study's findings. The third part includes the development of a framework for project cost and time control. Part four includes the evaluation of the developed framework, conclusion and recommendation. Finally, references and appendices are included.

The first chapter of the thesis presents an introduction to the thesis by providing the background to the study and highlighting the statement of the research problem, the research aim and objectives.

The author believes that the tasks needed to achieve the objectives must be split into component parts and programmed within a reasonable time-scale. The literature review process began by investigating project cost and time control processes in order to gain insight into the structures and theories associated with risk in construction projects. These theories and project control modelling approaches were thoroughly reviewed and compared. The literature review's broad scope was important in increasing the researcher's knowledge of the research topic as well as in delineating the research problem.

The general purpose of the literature review is to gain an understanding of the current state of knowledge regarding the research topic. The present research examines what other authors have written about project control, in order to develop a theoretical framework for successful adoption and implementation of time and cost control in the construction industry. The author has found that the literature is a fruitful source of concepts, theories and evidence about construction project cost and time overruns. Monographs provided a good introduction to an overview of the issues of importance in project control. As well as online sources, most relevant information is to be found in journal articles and international conference papers.

The second chapter provides a review of previous studies in this area, deals with the problems associated with project cost and time, and then classifies the causes and factors contributing to overruns in order to determine the most important of these causes in various building projects in countries worldwide. Chapter three takes Libya's demography and its economy as well as just its construction industry into account in order to explore the main characteristics of the LCI and its associated processes and operations, and to identify the major constraints on those operations.

The fourth chapter of the thesis provides justification for the primary research methodology chosen for this project as seen in the chapter. It discusses several methodologies, including the methods of data collection. The research methods considered in this study are literature research, questionnaires and semi-structured interviews to develop a framework to minimise cost and time overruns in Libyan construction projects. Data analysis is carried out using Statistical Package for the Social Sciences (SPSS) for quantitative data and manually based on a systematic process for qualitative data in chapters six and seven.

Theory and practice have been linked through the literature review and the involvement of practitioners in an attempt to develop a framework for minimising cost and time overruns in the Libyan construction projects in the third part of the thesis. The developed framework was refined and evaluated and the proposed mitigation measures were validated. This was achieved using the perceptions of experts in the Libyan construction projects in the fourth part of the thesis in chapter eight. The conclusions derived from the research study and recommendations for promoting good practice are presented in last chapter of the thesis.

1.8 Summary

This chapter has presented an introduction to the thesis by providing the background to the study and highlighting the statement of the research problem, the research aim and objectives. This chapter also presented a brief overview of the research methodology and concluded by giving a structure to the thesis.

Chapter 2 Review of Factors Influencing Time and Cost Overruns in Construction Projects

2.1 Introduction

Modern construction projects do not allow risks and uncertainties to be dealt with at the whim of project owners' and contractors' experience and intuition. Risk management is therefore increasingly a prerequisite in the industry. All organisations face a huge variety of risks including physical risks to property or people, failure of service delivery, financial loss, information management and damage to the organisation's reputation. The importance of risk management to the industry is expressed in pragmatic construction project management methods to identify and remove risk factors before dangerous situations are created. Risk management is not about predicting the future. It is about understanding a project and making better decisions regarding the management of that project in the immediate future.

Construction delays and cost overruns are the biggest issues facing construction projects and affecting delivery in terms of time, budget and required quality. The characteristics of delay factors and their level of impact vary from project to project, ranging from a few days to years. They have significant financial, environmental and social impacts in construction projects; therefore, it is vital to investigate the causes of delays and cost overruns and analyse their impact. Although many studies have examined the causes affecting delays and cost overruns in construction projects, they have rarely discussed the common causes of such delays or cost increases.

Because of one of this study's objectives is to identify the critical factors affecting time and cost within the construction industry, this chapter starts by outlining the concepts involved in risk and uncertainty. It then reviews previous studies in the area of time and cost overrun of construction projects, presents the problems associated with project costs and timings, and classifies the causes and factors contributing to overruns so as to determine the most important causes of delays within building projects in different countries.

2.2 Different Definitions and Perspectives on Risk

The word "risk" originated from the French word "risqué", and began to appear in England, in its anglicised form, around 1830, when it was used in insurance transactions

(Smith, 1999). Risk is a multi-faceted concept that differs according to viewpoint, experience and attitude, which is why it has several meanings and definitions. Contractors, engineers and designers conceptualize risk from the technological perspective, developers and lenders see it financially and economically, and chemical engineers, health professionals and environmentalists view it through the lens of environment and safety. Any concept of risk can thus be uncertain or variable.

The majority of English dictionaries define "risk" as the hazard or danger of something that may have unlikely outcome, or as the probability of an inconvenient incident depending on the circumstances. The Oxford English Dictionary defines risk as danger, hazard, exposure to peril or mischance, and also as the hazard of commercial loss. The Oxford Advanced Learner's Dictionary (1995) describes risk as the "chance of failure; the possibility of meeting danger or of suffering harm or loss". (Hornby, 1995)

Many researchers have attempted to define risk. Among them are the following:

- "The probability of occurrence of some uncertain, unpredictable and even undesirable events that would change the prospects for the profitability on a given investment" (Kartam, & Kartam, 2001)
- The "exposure to loss/gain or the probability of occurrence of loss/gain multiplied by its respective magnitude" (Jaafari, 2001)
- The "possibility that events, their resulting impact and dynamic interactions may turn out differently than anticipated" (Miller and Lessard, 2001)
- "A situation where the future outcome is not known with certainty, but where the various possible outcomes can be predicted from knowledge of past or existing events" (Ejinimma, 2004)
- "The chance of an unfortunate event times the cost if such an event occurred" (Hubbard, 2009)
- "The threat or possibility that an action or event will adversely or beneficially affect an organisation's ability to achieve its objectives" (Burtonshow-Gunn, 2009)
- "A combination of the uncertainty of occurrence of a possible outcome from an initial event and associated positive or negative payoff of the outcome on our intelligent agent with respect to achieving its goal(s)" (Yaxin & Williams, 2010)

- The possibility of loss or injury (Rounds & Segner, 2011)

Construction involves working with dangerous materials, tools and equipment, which makes it risky and depends to a great extent on workers, which entails a great deal of variability that results in an entire class of performance risk. Cretu et al. (2011) conclude that risk represents an uncertain outcome.

Many organisations have also attempted to identify the meaning of risk

- The UN's approach is distinctly techno centric: "expected losses of (persons injured, lives, economic activity disrupted and property damaged) by reason of a severe hazard for a given region and reference period" (UNDHA, 1992).
- "A combination or frequency of occurrence of a defined threat or opportunity and the magnitude of that occurrence" (The Association for Project Management, 2002).
- "A significant uncertain occurrence... defined by the combination of the probability of an event occurring and its consequences on objectives...the term "risk" is generally used to embrace the possibility of both negative and/or positive consequences" (the UK's MoD Risk Management Guidance, 2002).
- "Risk is the possibility for realisation of unwanted, health, property, adverse consequences to human life, or the environment; estimation of risk is usually based on the expected value of the conditional probability of the event occurring times the consequence of the event given that it has occurred" (Society of Risk Analysis, 2003).
- That recognition of both positive and negative impacts resulting from risks is echoed by the Project Management Institute: "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives" (PMI 2004).

Furthermore, the parties involved in a construction project all view risk from their own perspectives. Clients or financiers are concerned in a broad way with how possible changes in estimated costs, benefits and timing will affect their rate of return. Contractors have similar concerns, but might see risks as relating to maintaining short-term cash flows and maximizing long-term profitability. Professional consultants view project risks from the point of accurate fee estimates, good management, prompt and full payment of fees, costs of uninsured risks and the future costs of insurance premiums. In the construction industry, great risks can lead to catastrophe as time and cost overruns turn profitable projects into loss-making ventures.

Risk, seen as chance, can sometimes be viewed as advantageous, as long as it is allowed for (Mills, 2001). Generally, it appears that there are two options by which risk is determined:

- Risk is an umbrella expression with two dimensions:
  - Opportunity, i.e. risks with positive outcomes
  - Threat, i.e. risks with negative outcome
- Uncertainty is the "overarching" term with two formations:
  - Risk, i.e. uncertainty with negative outcomes
  - Opportunity, i.e. uncertainty with positive outcome. (Hillson, 2002)

Aven & Renn (2010) state that definitions of risk have the following properties:

- They accommodate both undesirable and desirable outcomes
- They address uncertainties instead of probabilities and expected values
- They are not restricted to specific consequences and quantities

Basically, construction risks can result in:

- Failure to keep within budget
- Failure to keep within time schedules
- Failure to meet the required quality

2.3 The Distinction between Risk and Uncertainty

Construction practically never operates under conditions of certainty. Chapman and Ward (2002) define uncertainty as "a lack of certainty; involving variability and ambiguity". Winch (2010) state that "it is the absence of information required for the decision that needs to be taken at a point in time". Aven & Renn (2010) see it as the difficulty of predicting the occurrence of events and/or their consequences based on incomplete or invalid databases, possible changes of the causal chains and their context conditions, extrapolation methods when making inferences from experimental results, modelling inaccuracies or variations in expert judgments. According to Cretu et al. (2011), uncertainty poses project management a particular set of problems, as it can potentially affect outcomes for ill as well as for good.

The expressions "risk" and "uncertainty" can be applied in different ways, and it would be useful at this stage to clarify the difference between them. From the above definitions of risk and uncertainty, it can be seen that there is a difference between the two. Risk and uncertainty are distinguished by Merrett and Sykes (1973) as follows: "uncertainty exists when there is more than one possible outcome to a course of action but the probability of each outcome is not known". Uncertain events are random events which defy prediction. Risk events can be managed; uncertain events cannot. It should therefore be a fundamental rule of risk management to reduce uncertainties to a minimum. Although in a practical situation, the distinction between risk and uncertainty is not critical, the concepts of risk must strictly reflect the realities of a decision situation. For example, the change of a government's policies may not be a risk to a Western construction firm, but it is an uncertainty.

2.4 Construction Risk

Flanagan & Jewell (2005) have suggested that, in relation to cost and time, the construction industry is, perhaps more than most, at particular risk. They note that this risk is not dealt with sufficiently, resulting in poor performance with increased costs and time delays. Indeed, many construction projects are faced by scheduling problems, causing them to overrun their predetermined due date and cost, because delays mean more hours worked and more staff, plant, equipment, direct and indirect costs, as well as potential claims between contractor and client and a greater concern with the financing of organisations.

2.5 Concept of Time and Cost in Construction Projects

The purpose of time and cost calculations in the construction industry is to ensure that projects deliver on time and within budget. Construction professionals around the world pay attention to time and cost overruns in projects; their likely query is: "has the project been finished and delivered on time, within budget and to the specified quality?"

The construction industry has a generally poor reputation in terms of delivering projects to cost and on time. Kartam & Koushki (2004) find that most construction projects experience cost overruns and time delays during the construction stage. According to Murray and Langford (2003), the factors leading to failure in construction projects are budget (cost) overruns, lack of value for money, failure to finish on time and poor quality of work. Turner (2006) suggests that time and cost control are inherent elements of project management.

Because the ways that processes, timings and costs of construction projects are controlled differ from one organisation to another, many researchers state that time and cost objectives in any construction project involves dealing with specific problems and risks.

2.5.1 Project Cost Considerations

Project cost is defined in various ways. For Kwakye (1997), the total project cost is the client's total expenditure on the project, which is the sum total of factors such as land and construction costs, interest charges and fees. Hendrikson and Au (2000) maintain that "the capital cost for a construction project includes the expenses related to the initial establishment of the facility: planning and feasibility studies, land acquisition, architectural and engineering design, equipment and labour, construction (including materials), and equipment and furnishings not included in construction". According to Lock (2007), every project should be controlled against detailed cost budgets so as to ensure that the expenditure authorised in its contract or charter is not exceeded. Zwikael & Smyrk, (2011) define a project's cost as the outlays required to purchase resources for the project. Generally, a project's cost depends on its size, type, form, location, complexity, level of specification, tendering climate, predicted inflation, risks and procurement method. It can be concluded that project cost is the amount of money that is required to complete all project activities. It concluded that the cost of the project is influenced by:

- specifications of the end products such as levels of performance, quality, and reliability
- compliance with governmental, institutional, or internal standards
- technical requirements such as the need to upgrade computer hardware, and administrative needs including a company's financial policies

❖ The Project Cost Estimate

For a detailed project, a budget or cost plan and cost estimate are usually prepared as soon as the design has been finalized. The aim of a cost estimate is to give an indication of the possible cost of the project. Cost estimates fall into two groups:

- Unit methods of cost estimate

These unit costs are extrapolated forward in time to reflect current market conditions, the project's location and the particular character of the job being considered.

- Element cost per square metre - GFA method

In this method the element cost is divided by the gross floor area (GFA). This gives the cost per square metre of GFA.

❖ Project Cost Overrun

Cost can be used as an indicator for project control performance. But cost estimates in a project are revised at various stages to improve their accuracy; after every such revision, they invariably increase. According to Choudhury (1988), "Cost overrun, the expression which is used to represent the variance between the original sanctioned cost and the final cost incurred, would then provide no indication of managerial performance". Jackson (1999) defines cost overruns as the difference between the final contract amount and the original contract amount divided by the original contract award amount.

$$\text{Cost overrun} = \frac{\text{Final Contract Amount} - \text{Original Contract Amount}}{\text{Original Contract Amount}}$$

For Choudhry and Phatak (2004), cost overruns are the difference between the original cost estimate and actual construction cost on completion of commercial sector construction projects. Cretu et al. (2011) defines cost overruns as the difference between the low bid and the actual incurred cost at the time of construction completion.

2.5.2 Project Time Considerations

Various definitions of project time have been given. According to Clough et al. (2000), project time is the completion of the project on the interim completion dates required for phases of the work, or the date stated in the contract. Sunny and Kim Baker (2000) define project time as the period needed to finish the work starting from location until completion, while for Kerzner (2009) it is the period from the beginning until the end of the work. Estimating the time of tasks is of great importance. Unfortunately, this is like trying to predict the future. It is only a guess, but there are better ways to guess than others. It should be obvious that the actual project time has to match or improve upon planned progress. All significant stages of the project must take place no later than their specified dates so completion occurs on or before the planned finish date.

❖ **The Project Time Estimate**

There are several methods that can apply to make guesses or estimates of the project time as accurate as possible. They are as following:

- Depending on records of preceding project paperwork or files.
- Trying to find similar project that has been completed.
- Seeking expert opinion, this should be used whenever possible.

- **Project Time Overrun**

The meaning of completion may also differ from project to project. How much time a project eventually takes and who has contributed to overruns are questions that no one can answer without undertaking research. According to Trigunarsyah (2004), time overrun is the extension of time beyond the time estimated as stipulated in the approval contract or planned completion dates traceable to the contractors. Badiru (2009) suggested that time slips away too easily and is irrecoverable. If time is not managed effectively, a project that has a fixed term for completion cannot succeed. Managing time implies eliminating inessential activities from the project's schedule. In summary, time overruns are the extra time taken to finish the project over and above the time schedule; these overruns are caused by both external and internal factors.

2.6 The Time-Cost Relationship

The relationship between cost and time has been explored by many studies over a long period of time. Since the late 1960s many researchers have explored the apparent relationship between the duration of a building project and its price.

Recently, many researchers have turned their attention to long-term trends in the relationship between time and value, developing models that allow the rapid forecast of project duration using only the budgeted cost and current cost indices.

Bromilow (1969) identifies the relationship between project cost and time as

$$T = KC^B$$

Where

T is the actual construction time in working days
C is the cost of building in millions of dollars
K is a constant-characteristic of building time performance in Australia, and
B is a constant-indicative of the sensitivity of time performance to cost level.

Extensive use has been made of Bromilow's time-cost model (the BTC model) in estimating project duration. The model indicates that a construction project's duration is basically a function of its total cost. It provides a basis on which all parties concerned with the construction process can establish a fairly accurate probable duration of a project measured in days, given the estimated cost of the project.

Since Bromilow (1969) first presented the relationship between a construction project's cost and time, numerous studies have been carried out for civil engineering and building projects around the world. Bromilow & Henderson (1977), Bromilow et al. (1980, 1988), Walker (1995) and Love et al. (2005) calibrated the BTC model in Australia. Kaka and Price (1991) studied the model in the UK, Chan and Kumaraswamy (1995) and Chan (1999) did the same for Hong Kong, Chen and Huang (2006) for Taiwan, Chan (2001) and Endut et al. (2006) for Malaysia, Ogunsemi and Jagboro (2006) for Nigeria and Hoffman et al. (2007) for the US. Le-Hoai et al. (2009) attempted to fit experiential building project data for the BTC model in Vietnamese construction projects.

Bromilow (1969) and Walker (1995) find cost to be a key determinant of time performance in Australia. Ng et al. (2001), after refitting and testing the BTC model with a new set of data, compare the findings with previous Australian studies and found that the length of unit construction time changed over time. They conclude that there was an improvement in construction speed over the three decades from Bromilow's 1969 study. Love et al. (2005) perform an analysis with a data pool of 161 building projects between procurement method, project type and project duration, and suggest that cost is a poor predictor of time performance.

Kaka and Price (1991) apply the cost-time relationship to civil and building projects, concluding that the BTC relationship remains the same but the constant of the equation changes with the type of project. Kumaraswamy and Chan's (1995) conclusion from their survey of housing, building and civil engineering projects in Hong Kong construction projects is that both types of project can apply Bromilow's model. A study in Hong Kong by Chan (1999) showed that the relationship between cost and time is a suitable tool for construction practitioners in both private and public projects. Between the late 1980s and the early 1990s, Chan's (2001) similar investigation of public sector projects in Malaysia presents an applicable BTC model. Endut et al. (2006) finds that there is no evidence by which to recommend that all project parameters follow the BTC model.

However, Ogunsemi and Jagboro (2006) suggest that Bromilow's model is not suitable for Nigerian construction projects; they therefore seek better predictive abilities by developing an improved piecewise model. Chen and Huang (2006) confirm that only private projects follow the Bromilow model.

2.7 Review of the Causes of Time and Cost Overruns in Construction Projects

Delays and cost overruns in construction projects are a common problem in the construction industry. The extent of these problems differs significantly from project to project, but they are especially severe in developing countries. None of the systems and tools that have been developed to permit successful project delivery and none of the attempts that have been made at improving construction development, have prevented many construction projects from accruing a shameful history of project cost and delivery.

Arditi et al. (1985) carried out a questionnaire survey of contractors, investors and public agencies that undertook public projects in Turkey during the period 1970 to 1980. The most important variables causing time and cost overruns they identified included increased wages, material prices, intermittent inflation, problems obtaining construction materials at their official unit prices, delays in public construction such as inflationary environments, inaccurate cost estimates prepared by public sector quantity surveyors, security problems at work, workers' health problems, difficulties obtaining construction materials, delayed monthly payments by public agencies, contractors' financial difficulties, shortages of construction training, contractors taking on additional jobs, and shortages of skilled workers.

Amer Wahid (1994) posted a survey of the factors involved in time and cost overruns in Egyptian construction projects to consultants, owners and contractors in construction projects, finding that the common causes were design modification during construction, lack of finance and payment for completed work, poor contract management, shortages of certain materials and sub-contractors and material supplier problems.

Mansfield et al. (1994) identified 16 main factors causing cost overruns in Nigeria, including poor contract management, delayed payment and financing of finished projects, deficiency of construction materials, imported plant items and resources, nominated contractors, subcontractors and design changes. The main variables affecting time overruns included price fluctuations, incorrect price estimates, work delays and extra work.

Assaf et al. (1995) outlined 56 common causes of delay in large building construction projects and their relative importance in Saudi Arabia, finding the most important factors to include preparation and approval of drawings, delays in contractor payment by design changes and owners, cash problems during construction, the relationship between the contractors, slow decision-making processes, labour shortages, design errors and inadequate work skills.

Mezher and Tawil (1998) conducted local interviews with Lebanese owners, contractors and architectural and engineering firms, identifying the main causes of delay as materials, equipment, financing, manpower, changes, project management, government relations, site conditions, environment and contractual relationships.

A more extensive study conducted by Kumaraswamy and Chan (1998) identified the factors concerned in construction cost and time overruns in Hong Kong from the contractors' point of view to be lack of design details or delay in their provision, waiting for approvals of drawings, discrepancies or mistakes in design documents, unexpected obstacles on the ground, poor supervision and management in the site, slow decision-making on the part of project teams and professionals, client-initiated variations, essential variation of works and poor contractor experience. The study suggests that identifying the major factors involved in time and cost overruns will enhance a project's performance. The accepted parameters are client satisfaction, completion to time and within budget, compliance with established quality standards and completion without accidents.

Al-Moumani (2000) carried out a quantitative analysis of construction delays by examining their causes in 130 public projects in Jordan from 1990 to 1997. The study presented regression models of the relationship between actual and planned project durations for different types of construction facilities. He found that the actual costs exceeded the original contract price by 30 per cent, with the common causes of delay in construction projects being poor site conditions, user changes, economic conditions, weather, late deliveries and increase in quantities. The study recommended that special awareness of these factors will help industry consultants minimise contract disputes. Time overruns are closely related to ineffective contractor performance, and indeed to contractor failure.

Koushki et al. (2005) personally interviewed 450 randomly selected private residential project owners and developers in selected Kuwaiti regions, and arranged the main causes of delays he found in order of importance: changes in orders, owners' financial constraints, owners' lack of experience in construction, weather, labour and contractor-related problems and material-related problems. The main causes of cost overruns in construction projects were (again in order of importance) contractor-related problems, material-related problems, financial constraints, changed orders, weather and labour constraints.

Assaf and Al-Hejji's (2006) survey of time performance in Saudi construction projects found that only 30 per cent of building projects were finished on time, and that the time overrun was between 10 and 30 per cent. The study listed 73 causes of such overruns, considering the importance of different causes from the viewpoints of owners, consultants and contractors. The main cause of time overruns recognized by all parties was "changing orders".

Sambasivam and Soon (2007) identified the main factors leading to delays on Malaysian construction projects: the contractor's inadequate planning, lack of experience, and poor site management, problems with sub-contractors, inadequate client finance and delayed payments for completed works, materials shortages, labour supply problems, lack of and failures in equipment, lack of communication between the parties and mistakes during the construction stage. The study concluded that time overruns in construction projects were a main problem in Malaysia, and recommended that strategies to deal with the delay be urgently developed.

Kaliba et al's (2009) study of Zambian road construction projects identified scope changes, bad or inclement weather due to floods and heavy rains, strikes, technical challenges, schedule delays, environmental protection and mitigation costs, inflation and local government pressures as the main causes of cost overruns, while time overruns were caused by contract modification, delayed payments, material procurements, financial processes and difficulties on the part of contractors and clients, poor conditions on site, economic problems, changes in drawings, unavailability of equipment, poor supervision, staffing problems, construction mistakes, changes in specifications, and labour strikes and disputes.

It is obvious that most of the existing studies about risk factors concentrated on developing countries. However, very few studies existed that focused on developed countries like the UK. More recently, Yakubu (2010) conducted both a quantitative analysis of a questionnaire survey and a qualitative analysis of interviews in order to investigate project time and cost controls in the UK, showing the main causes of project cost and time overruns to be risks and uncertainties, design changes, complexity of works, inaccurate evaluation of project times and durations, and inadequate performance of subcontractors.

All these studies have added significantly to the body of information regarding the causes of delays and cost overruns in building projects. The major causes of cost and time overruns identified by researchers over a period of more than two decades are illustrated in the following sections.

2.8 Classification of the Factors Causing Cost and Time Overruns

The identification of factors affecting planned, stipulated and achieved construction times and costs of construction projects were found to differ from study to study; no single reliable model of the factors affecting project time and cost overruns was authoritatively established by project management or construction institutions. In brief, every project involves a number of activities, any one of which may take more time than expected. This can be due either to extended activity duration or to delays in starting. The reasons for these two factors may be different, and the resulting delays could knock on to succeeding activities, which in turn could delay the project's completion. Various ways have therefore been used to classify the causes of delays and cost overruns in construction projects. Recently, many researchers have relied on the categorisation of causes identified in the existing literature. Kaming et al. (1997) suggests that delays of construction projects can be divided into three categories:

- Those over which neither party to the contract has any control
- Those over which the construction owner (or his/her representative) has control
- Those over which the contractor (or any subcontractor) has control

Assaf et al. (1995) suggests that the perceptions of the three main parties to a project (owners, consultants and contractors) constitute the most important group of delay factors. This group was rated of great importance by contractors and engineering/architecture companies and relatively lowly by manpower, while owners were also ranked as very important by the clients, moderately important by the contractors and not very important by the engineering and architecture companies, while changes were ranked somewhat high by all parties. Equipment was ranked very low by all parties, and scheduling and controlling as moderately important by contractors. A relation with government was also counted as relatively important by both owners and contractors, but not at all by architecture/engineering firms. These firms themselves were not rated at all highly by the owners. All three parties thought that contractual relationships, while none of them had that opinion of environmental factors.

Chan's (1995) examination of the main factors affecting the time taken for completion of construction projects proposes that these factors can be classified into the following four major categories:

- Project scope
- Project complexity
- Project environment
- Management-related attributes

Al-Khalil and Al-Ghafly (1999) use six major categories, with a further subdivision of "contractor performance" into five sub-categories, resulting in the following scheme:

- Contractor performance
  - materials
  - equipment
  - manpower
  - project management
  - project finance
- Owner administration
- Early planning and design
- Government regulation
- Site and environmental conditions
- Site supervision

Chang (2002), on the other hand, uses a three-part categorisation:

- Compensable - mainly within the construction owner's control – i.e. failure to comply with owners' requests
- Non-excusable - mainly within the consultant's control – i.e. mainly consultant failures
- Excusable - beyond either the owner or consultant's control – i.e. the growing needs of the client and stakeholders.

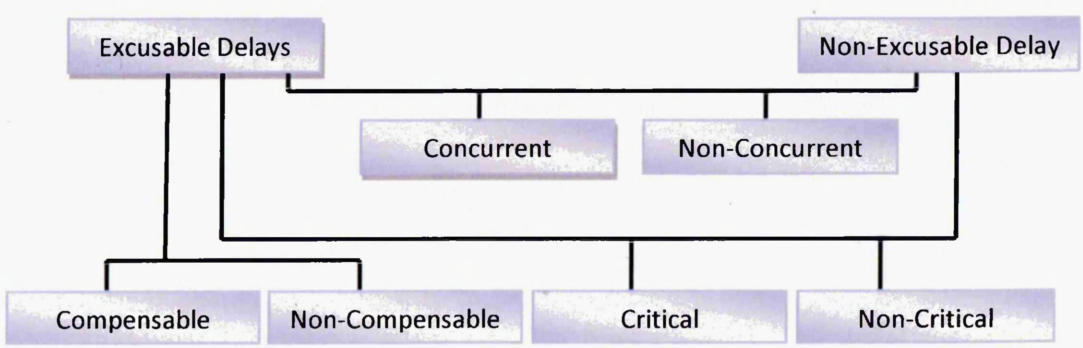


Figure 2-1: Sequential Relationships between Categories of Time Overruns (Vidalis et al., 2002)

According to Chang (2002), his grouping will make it easy to determine where any difficulties within the construction project's life cycle originate.

Chang proposes the following four categories that incorporate all classifications employed by previous studies.

- Owner-caused delays (OCD)
- Contractor-caused delays (CCD)
- Project-specific matter caused delays (PMCD)
- Third party (natural) caused delays (TPCD)

Ahmed et al. (2003) finds that the causes for delays in construction projects fall into the internal and external categories. The former consist of the causes created by the four parties (the contractors, owner, designers and consultants) involved in the project. Other delays for which the four parties are not responsible are external causes such as materials, suppliers, the government or the weather.

Chan et al. (1995), Ogunlana et al. (1996), Kaming et al. (1997), Ahmed et al. (2003), Sambasivan and Soon (2007) and Alghbari et al. (2007) and others suggest the following factors causing construction projects delays and cost overruns. The list is given in the four categories used by several researchers.

- **Contractor-related causes**

The contractor's responsibility is to build the project according to the contract within the specified cost and time constraints, and to the specified standards. Previous studies investigating the responsibilities for project delays have found that, for the most part, that responsibility lies with the contractor. The factors involved can be grouped into the following categories: as shortages of materials on site, delays in delivery of materials to the site, mistakes in construction and defective work, shortages of site labour; poor labour skills and experience, low labour productivity, coordination problems with other parties, financial problems, lack of subcontractor skills, poor site management, lack of site contractor staff and equipment and tool shortages on site.

- **Consultant-related causes**

The consultant's role is to advise the client on the best contract strategy for the project at the conceptual stage. Various factors related to consultants may lead to project delays. These factors fall into the following categories: lack of experience on the part of consultants, absence of consultant site staff, lack of experience on the part of such staff (supervisory and managerial personnel) when present, incomplete documentation, delayed and dilatory decision making and dilatory issuing of instructions.

- **Client-related causes**

Construction industry clients constitute the single most important group on project teams. Since the nature of construction projects requires knowledgeable organisations or people to serve as project managers, the client's responsibility is demanding. Client involvement in construction projects can facilitate the speed at which projects proceed. Clients must be able to take quick decisions on various matters such as approving work, responding to contractors and changing orders. Their involvement in the project must not disrupt the contractor's project plan. Because delays to payments or budgetary shortfalls may result in projects proceeding slowly and therefore in late completions, clients should ensure that adequate funds are available to meet professional service payments and the demands of the schedule.

The factors relating to client responsibility for delays and overruns are procrastination in decision making, contract modifications (replacements and addition of new work to projects and changes in specifications), lack of working knowledge, lack of coordination with contractors, and financial problems (delayed payments, financial difficulties and economic problems).

- **External factors**

External factors are the lack of equipment, tools and materials in the marketplace, poor weather conditions, poor economic conditions (e.g. devalued currencies and inflation rates), poor site conditions (e.g. location and nature of the ground), changes in laws and regulations, transport delays and works on public infrastructure such as roads, utilities and public services.

2.9 Identification of Factors Causing Time and Cost Overruns

Time and cost overruns occur in every construction project and the magnitude of these problems varies considerably from project to project. Therefore, it is essential to identify the factors of delay and cost overrun in order to minimize risk in any construction project. For the purpose of this research, Table 2.1 illustrates factors that influence time and cost overruns in different countries in the world, followed by categorization and tabulation of these factors which collected from literature review into nine groups, followed by identification of 15 most frequent delay and cost overrun factors in construction projects in these countries. See Tables (2.2), (2.3) and (2.4) below

Table 2-1: Previous Studies regarding Causes of Time and Cost Overruns of Construction Project

Research	Project	Causes of delays
Arditi et al (1985)	public agencies in Turkey	Increase wages and the prices of materials, intermittent inflation, problems obtaining construction materials at their officially announced unit prices, delays in public construction such as delays in inflationary environments, inaccurate cost estimates prepared by public sector quantity surveyors, work security problems, workers' health problems, difficulties obtaining construction materials, delays in monthly payments by public agencies, contractors' financial difficulties, shortages of construction training , additional contractor jobs, shortages of skilled workers
Dlakwa and Culpin (1990)	the Nigerian construction industry	Bureaucratic indecision, delays in receiving subventions from government, inadequate funding of projects, poor project design and implementation, lack of coordination between enterprises
Amer Wahid (1994)	construction projects in Egypt	Design modification during construction, lack of finance and payment for completed work, poor contract management, shortages of certain materials, sub-contractor and material supplier problems
Assaf, Al-Khalil and Al-Hazmi (1995),	Saudi Arabia, Large public building projects, Empirical	Material-related delays, equipment delays, preparation and approval of drawings (delays in contractor payment by design changes and owners), cash problems during construction, the relationship between the contractors and a slow decision-making process, labour shortages, design errors and inadequate labour skills Financing, material, contractual relationships, changes and scheduling and controlling constitute the top five causes of delay
Mezher and Tawil (1998)	The construction projects in Lebanon	Materials, equipment, financing, manpower, changes, project management, government relations, site conditions, environment and contractual relationships
Kumaraswamy and Chan (1998)	Hong Kong, buildings and civil engineering projects	Lack of or delays in details of design, time spent waiting for approval of drawings, discrepancies or mistakes in design documentation, unexpected obstacles on the ground, poor supervision and management on site, delays in decision-making by project teams and professionals, client-initiated variations, essential variation of works, poor contractor experience
Al-Momani (2000)	Jordan, Public building projects, empirical	Poor design and negligence of owners, changed orders, weather conditions, site conditions, late delivery, economic conditions, increase in quantities

Table 2-1: Previous Studies regarding Causes of Time and Cost Overruns of Construction Project (cont.)

Koushki, Al-Rashid and Kartam (2005)	Kuwait, private residential projects, empirical	Number of change orders, financial constraints, owner's lack of experience in construction, weather, labour and contractor-related problems, material-related problems, financial constraints, changed orders, weather, and labour constraints
Nirmal, Lee, Kim and Kim(2005)	Nepal, Building projects: Case study	Major delay factors: seasonal unavailability of construction material, work upheavals due to frequent strikes, blockades and riots, lack of use of necessary modern construction equipment, and severe and cold weather
Assef and Al-Hejji (2006)	building construction in Saudi Arabia	Changed orders, ineffective planning and scheduling by contractors, poor site management and supervision, shortages of labour and financing difficulties
Sambasivam and Soon (2007)	Malaysian construction projects	Improper contractor planning, lack of experience, and poor site management, problems with sub-contractors, inadequate client finance and payments for completed works, shortages in materials, interrupted labour supply, unavailability and failure of equipment, lack of communication between the parties and mistakes during the construction stage
Kaliba et al (2009)	Zambia construction projects	Scopes changes, bad or inclement weather due to floods and heavy rains, strikes, technical challenges, schedule delays, environmental protection and mitigation costs, inflation and local government pressures, contract modifications, delayed payments, materials procurement, financial processes and difficulties on the part of contractors and clients, poor site conditions, economic problems, changes in drawings, equipment unavailability, poor supervision, staffing problems, construction mistakes, changes in specification, labour strikes and disputes
Yakubu (2010)	the UK construction projects	Risks and uncertainties, design changes, complexity of works, inaccurate evaluation of project time/duration and non-performance of subcontractors.

Table 2-2: Factors influencing time overruns

Country where survey was conducted	Turkey	Hong-Kong	Thailand	Indonesia	Hong Kong	Jordan	Jordan	Florida (USA)	New Zealand	Thailand	Malaysia	Vietnam	Zambia	UK
Factors causing project delays	Aditi et al 1985	Chan et al 1996	Ogunlan et al 1996	Kaming et al 1997	Kumaras & Chan 1998	Al-Momani 2000	Abdalla et al 2002	Ahmed et al 2003	Ying et al 2005	Shamas & Stephen 2006	Alghbari et al 2007	Long Le-et al 2008	Kaliba et al 2009	Yakubu (2010)
Contractor's responsibilities														
Insufficient number of project team								●						
Time consuming to find sub-contractors who is appropriate for every task								●						
Design changes					●			●						●
Non- performance of subcontractor								●				●		●
Low productivity of workers		●		●		●	●				●			
Poor of subcontractor's skills	●	●			●	●					●	●		
Insufficient number of subcontractor's staff											●			
Poor management and supervision in the site		●			●	●	●				●	●	●	
Shortage of tools and equipment on site			●	●						●	●		●	
Contractor's difficulties in receiving monthly payments from public agencies	●													
Mistakes during construction						●	●		●		●	●	●	
Inadequate contractor experience		●				●	●			●		●		
Deficiencies in coordination between parties-(client, consultant and Contractor)			●					●	●		●			
Uncompromising attitude between project team								●						
Materials management			●											
Contractor's financial difficulties	●		●							●		●	●	

Table 2-2: Factors influencing time overruns (cont.)

Country where survey was conducted	Turkey	Hong-Kong	Thailand	Indonesia	Hong Kong	Jordan	Jordan	Florida (USA)	New Zealand	Thailand	Malaysia	Vietnam	Zambia	UK
Factors causing project delays	**Arditi et al 1985**	**Chan et al 1996**	**Ogunlan et al 1996**	**Kaming et al 1997**	**Kumaras & Chan 1998**	**Al-Momani 2000**	**Abdalla et al 2002**	**Ahmed et al 2003**	**Ying et al 2005**	**Shamas & Stephen 2006**	**Alghbari et al 2007**	**Long Le-et al 2008**	**Kaliba et al 2009**	**Yakubu (2010)**
Consultant's responsibilities														
Management skill of Site Managers		●												
Obsolete or unsuitable construction methods			●							●		●		
Misunderstanding &Poor communications between parties		●			●	●			●					
Absence of consultant's site staff											●			
Deficiency of materials					●						●			
Lack of experience on the part of the consultant's site staff; (supervisory and managerial personnel)					●					●	●			
Slowness in giving instructions											●			
Coordination deficiencies			●											
Poor management of contract by Consultant					●	●	●					●	●	
Preparation and approval of tests and inspections						●		●						
Control/ quality assurance						●	●			●				
Waiting time for approval of tests and inspections			●			●	●				●			
The difficulties of contractors to purchase materials at their officially announced unit prices.	●													
Delays in payment	●												●	●
Lack of timely decisions and corrective actions										●				
Variations (extra job/design changes)		●	●	●	●	●						●		

Table 2-2: Factors influencing time overruns (cont.)

Country where survey was conducted	Turkey	Hong-Kong	Thailand	Indonesia	Hong Kong	Jordan	Jordan	Florida (USA)	New Zealand	Thailand	Malaysia	Vietnam	Zambia	UK
Factors causing project delays	**Arditi et al 1985**	**Chan et al 1996**	**Ogunlan et al 1996**	**Kaming et al 1997**	**Kumaras & Chan 1998**	**Al-Moman i 2000**	**Abdalla et al 2002**	**Ahmed et al 2003**	**Ying et al 2005**	**Shamas & Stephen 2006**	**Alghbari et al 2007**	**Long Le-et al 2008**	**Kaliba et al 2009**	**Yakubu (2010)**
Owner's responsibilities														
Contract modifications (replacement and addition of -new work to the project and change in specifications)											●		●	
Financial problems (delayed payments financial difficulties and economic problems)	●		●			●	●	●		●	●	●	●	
Owner - initiated variation		●												
Unrealistic contract durations imposed by owner		●				●	●							
Owner interference						●	●				●			
Wrong choice of contractor or consultant										●				
Uncompromising attitude between parties					●	●								●
Client's emphasis on quick construction instead of quality													●	
Professional Management														
Lack of detailing of information					●						●			
Poor managerial skills for all parties		●												
Slow decision making		●	●		●	●		●	●		●			
Poor planning		●	●	●		●			●					
Preparation and approval of project drawings					●									
Lack of tracking of programme													●	
Lack of management support & personnel training	●													●
Poor judgment in estimating resources and time													●	
Quality, health and safety program	●		●	●			●							
Collaboration of project participants		●	●	●			●		●		●			

Table 2-2: Factors influencing time overruns (cont.)

Country where survey was conducted	Turke y	Hong-Kong	Thailand	Indonesia	Hong Kong	Jordan	Jordan	Florida (USA)	New Zealand	Thailand	Malaysia	Vietnam	Zambia	UK
Factors causing project delays	**Arditi et al 1985**	**Chan et al 1996**	**Ogunlan et al 1996**	**Kaming et al 1997**	**Kumaras & Chan 1998**	**Al-Moman i 2000**	**Abdalla et al 2002**	**Ahmed et al 2003**	**Ying et al 2005**	**Shamas & Stephen 2006**	**Alghbari et al 2007**	**Long Le-et al 2008**	**Kaliba et al 2009**	**Yakub u (2010)**
Design and Documentation														
Incomplete drawings			●								●		●	
Poor documentation and no detailed written procedures					●						●			
design team experience					●									
Delays in design work / lack of design information	●													
Changes in drawings													●	
Material														
Delay of material delivery to construction site	●		●	●				●			●			
Poor material handling on site			●											
Inappropriate / misuse material			●											
Poor procurement programming of materials		●			●								●	
Shortage of materials in markets	●	●			●		●				●	●		
Shortage of construction materials			●								●			
Low quality of materials			●				●							
Material changes					●									

Table 2-2: Factors influencing time overruns (cont.)

Country where survey was conducted	Turkey	Hong-Kong	Thailand	Indonesia	Hong Kong	Jordan	Jordan	Florida (USA)	New Zealand	Thailand	Malaysia	Vietnam	Zambia	UK
Factors causing project delays	Arditi et al 1985	Chan et al 1996	Ogunlan et al 1996	Kaming et al 1997	Kumaras & Chan 1998	Al-Momani 2000	Abdalla et al 2002	Ahmed et al 2003	Ying et al 2005	Shamas & Stephen 2006	Alghbari et al 2007	Long Le- et al 2008	Kaliba et al 2009	Yakubu (2010)
Material														
Inappropriate construction methods						●	●							
Poor equipment choice/ infective equipment						●								
Highly bureaucratic organisation								●						
Project construction complexity		●												●
Execution														
Price escalation			●											
Lack of a strong organisational culture									●					
Equipment availability and failure			●					●						
Shortage of site workers			●								●			
Inaccurate prediction of equipment production rate			●	●										
Skilled labour shortage		●	●	●							●			●
Lack of equipment											●			

Table 2-2: Factors influencing time overruns (cont.)

Country where survey was conducted	Turkey	Hong-Kong	Thailand	Indonesia	Hong Kong	Jordan	Jordan	Florida (USA)	New Zealand	Thailand	Malaysia	Vietnam	Zambia	UK
Factors causing project delays	Arditi et al 1985	Chan et al 1996	Ogunlan et al 1996	Kaming et al 1997	Kumaras & Chan 1998	Al-Momani 2000	Abdalla et al 2002	Ahmed et al 2003	Ying et al 2005	Shamas & Stephen 2006	Alghbari et al 2007	Long Le-et al 2008	Kaliba et al 2009	Yakubu (2010)
Contractual relationships														
Insufficient overall organisational structure linking all parties to the project						●	●							
Discrepancies and mistakes in contract documents						●								●
Lack of communication between parties							●							
Major negotiation and dispute							●							●
Inadequate type of contract used		●												
External factors														
Poor site conditions (location, ground, etc.)	●	●	●	●		●	●				●			
Poor economic conditions (currency, inflation rate, etc.)						●					●			
Changes in laws and regulations											●			
Transportation delays											●			
External work due to public agencies											●			
Problems with neighbours							●				●			
environmental concerns and restrictions										●				●
Unforeseen site conditions	●			●	●	●	●	●				●	●	
Obstacles from government												●		●

Country where survey was conducted	Turkey	Indonesia	Nigeria	Kuwait	Vietnam	Zambia	UK
Factors causing Project cost overrun	**Arditi et al., 1985**	**Kaming et al 1997**	**Mansfield et 1994**	**Koushki, AlRashid and Kartam 2005**	**Long Le-et al 2008**	**Kaliba et al 2009**	**Yakubu (2010)**
Unrealistic design development periods				●			
Changed engineering conditions from the contract document				●			
Unpredictable weather conditions		●					●
Client-induced additional work beyond the original scope				●			
Rework due to errors/omissions during construction (quantity & quality)				●			
Error in the estimated activity completion time				●			●
Noncompliance with conditions of contract				●			
Delay in contractors payment of completing work				●			
Consultant/engineer-driven frequent changes in design and materials				●			
Lack of co-ordination between design team and contractor				●			
Poor site management and supervision					●		
Poor contract management			●				
Increases in price materials, increase in wages and inflation	●						
Difficulties in obtaining construction materials at official current prices	●						
Bad or inclement weather						●	●
Scopes change						●	
Strikes and technical challenges						●	
Inflation and local government pressure						●	
Schedule delays						●	
Inaccurate estimates leading to delays.			●				
Price fluctuations			●				
Increased cost of materials		●					
Increased cost of labour due to environment restriction		●					
Poor experience of project location		●					
Poor experience of project type		●					
Poor experience of local regulation		●					
Construction delays	●						
Shortages of materials					●		
Inaccurate estimates					●		
Slow payment of completed works					●		●
Design changes					●		●

Table 2-3: Factors Influencing Cost Overruns

From the analyses of many previous surveys investigating, the author has summarised and tabulated the most important causes of delays and cost overruns in different countries. The author has collated these studies and used them to investigate the 15 most frequent delay and cost overrun factors in construction projects in these countries. The outcomes are shown in Table 2.4.

Factors causing project delays and cost increase	**Countries**									
	Turkey	**Nigeria**	**Hong Kong**	**Thailand**	**Indonesia**	**Jordan**	**Malaysia**	**Vietnam**	**Zambia**	**UK**
Inclement weather	●	●	●		●	●		●	●	●
Labour shortage/low labour productivity			●		●	●	●			●
Poor subcontractors' performance/high degree of subcontracting	●		●			●	●	●		●
Variations (design changes/extra work)	●	●	●	●	●	●		●		●
Unforeseen ground conditions	●		●	●		●	●			
Materials shortage/late materials delivery	●	●				●	●	●		
Inadequate construction planning			●	●	●	●	●			
Financial difficulties	●	●	●	●		●	●	●	●	●
Delays in design work/lack of design Information	●	●								
Poor site management		●	●			●	●	●	●	
Mistakes during construction						●	●	●	●	
Poor communication			●			●				
Inappropriate type of contract used			●							
Lack of experience of the consultant's site staff		●	●	●						
Owner interference		●			●		●			

Table 2-4: The Major Factors Causing Time and Cost Overruns in Construction Projects by Country

The major causes of time and cost overruns shown in Table (2.4) reveal that the causes of time and cost overruns are shared by many countries, even though they are in different global regions. Nine out of ten researchers concluded that financial difficulties and delayed payments for completed work are the most frequent major causes of time overruns. The inclement weather and variations (both design changes and extra work) are the second most frequent major cause of time and cost overruns, as found by eight out of ten researchers. Third equal most frequent (six out of ten) major factor are poor site management and poor sub-contractor performance. Fourth equal, at five out of ten researchers, are shortages of construction materials, unforeseen ground conditions, inadequate construction planning, labour shortages and low labour productivity. Mistakes during construction are the fifth most frequent major cause of time and cost overruns. A lack of experience of the consultant's site staff and owner interference are sixth (three researchers), poor communication is seventh (two researchers), and only one researcher found that inappropriate types of contract were the major cause of overruns. Turkey, Nigeria, Hong Kong, Thailand, Indonesia, Jordan, Malaysia, Vietnam, Zambia and the UK share some of these causes, although they are distributed across the globe. The most significant issue faced by these countries is financial difficulties on the part of either contractors or owners. Some of the major causes of time and cost overruns are unique to particular projects or countries.

2.10 Summary

This chapter has presented the literature on the concept of risk, and the distinction between risk and uncertainty. Prominent features of risk were presented, and the work introduced construction risk (cost and time) overruns. The most common factors influencing time and cost overruns as found in various studies were found to include problems relating to materials, inadequate planning, poor contract management, construction delays, inadequate planning, problems related to finance, and poor contract management. The chapter has shown the causes of time and cost overruns, especially in developing countries' construction projects, as revealed by various studies. The factors causing time and cost overruns were also classified. The chapter concludes by identifying the most frequent delay and cost overruns factors of construction project in different countries. A deeper look at a number of these factors revealed that they lead to cost and time overruns and poor project performance because of their inhibiting effect on effective control. The top six factors inhibiting time and cost control in construction practice were revealed as financial difficulties, inclement weather, variations (design changes or extra work), poor site management, unforeseen ground conditions and labour shortages or low labour productivity.

Having successfully reviewed and examined the causes of cost and time overruns in various countries worldwide, the next stage seeks to present the environment and development of Libya's construction industry as a first step to study of the process of construction project control in the country.

Chapter 3 The Environment of Libyan Construction Industry

3.1 Introduction

This chapter reviews the environment and development of Libya's construction industry. The main purpose of this chapter is to explore and understand the main characteristics of the LCI and its processes and operations, as well as to identify the major obstacles constraining those operations. The chapter focuses on the interaction between the geographical and economic circumstances of Libya on the one hand and historical developments in the construction industry and its current status on the other.

This chapter is organized into seven main sections. The first section briefly outlines the chapter's contents. The second provides general information about Libya's geography, economy and culture. The third provides information about the country's construction industry and its associated processes, the fourth charts the development of the contemporary LCI, the fifth presents the management system of projects in Libya, the sixth identifies risks specific to Libyan projects and the last section provides a summary for the chapter.

3.2 General Information about Libya

The study of cost and time control process implementation in the LCI cannot be properly carried out without understanding that industry's environment and its impact on the implementation of project control.

3.2.1 Libya's Geography

Libya is located in the centre of the northern coast of the African continent. It has a 459 km border with Tunisia and a 982 km one with Algeria to the west, a 1,055 km one with Chad and a 354 km one with Niger in the south, and a 383 km one with Sudan and a 1,115 km one with Egypt to the east. Libya's total area is 679,362 square miles (1,759,547 square kilometres), which makes it the fourth largest country in Africa and 17th largest in the world by size. Its coastline of 1,100 miles (1,770 km) is the Mediterranean's longest, see Fig. 3.1. Over two-thirds of Libyans live on two narrow coastal strips near the Mediterranean Sea. Yet over 90 percent of it is desert, with rain falling only once every two or three years.

Libya has three main regions: Tripolitania, Cyrenaica, and Fezzan. Until 1963, these regional names were the official names of provinces, but now they just indicate general geographic areas. Tripolitania is Greek for “land of three cities” in reference to Sabrata, Leptis Magna and Oea (Tripoli). Its size is 110,000 square miles (284,900 square km), and it has a low, sandy coast occasionally fringed by lagoons. The city of Tripoli has been the capital of Libya since its independence in 1951. It is also the country’s main port and houses a third of Libya’s total population. It is fast-growing city, with new high-rise apartment buildings steadily taking the place of single-floor dwelling and improvised shanties.

The Sahara Desert and the Mediterranean Sea are the dominant climatic influences in Libya. The climate is characterised by a mild and short rainy winter and warm summer in the northern region, whereas the interior desert and the southern region are influenced by the Sahara's climate which is characterised by a dry winter with warm days and very cold nights and a hot, dry and long summer with very extreme temperatures. It can be said that Libya is characterized by the general characteristics of extreme temperature, hot dry lands, low and variable rainfall, scarcity of water, drought and desertification. Consequently, the country has very limited land in terms of being suitable for life and development.

Figure 3-1: Boundaries and Major Roads of Libya (Nicolas, 2011).

Available at: http://www.nybooks.com/articles/archives/2011/apr/07/battle-libya/

3.2.2 The Libyan Economy

Development and economic growth have remained an area of concern for Libya since the end of the Second World War. This section gives a brief historical account of the Libyan economy:

- **Petroleum Industry**

Since the early 1960s, the petroleum industry has increasingly dominated the whole economy; it provided direct employment for nearly 10000 Libyans in 1984. The development of the oil industry was remarkable, in terms of both its rapidity and its proliferation.

By 1977, Libya was classified by various regional and international organisations as one of the world's oil-producing countries. However, Libya's position declined somewhat in the early 1980s as OPEC production quotas were cut. By 1986, Libya was only the 15th largest producer of crude oil (Wallace & Wilkinson, 2004). In 2009 The World Bank defines Libya as an 'Upper Middle Income Economy', along with only seven other African countries. According to Obeida (2007), oil is still the main source of foreign currency, as oil revenues constitute 95.0 per cent of the country's hard currency. Moreover the oil sector contributed 52.5 per cent of (GNP) in 2008 (The Central Bank of Libya, 2009).

When oil prices dipped in the early 80s, Libya's GDP growth slowed to 2.6 percent. In 2001, high oil prices boosted GDP growth to 4.6 percent in 2004 and to 10.6 percent in 2010 (Zuliani, 2011). A small population and high oil revenues have allowed the state to provide an extensive level of social security, particularly in education and housing.

- **Gas Industry**

Production of natural gas in Libya received a major boost in 1971 when a law was passed requiring oil companies to store and liquefies the natural gas condensate from their wells, rather than burning it off as many had previously done. However, natural gas production has lagged far behind oil because the high costs of transport and liquefaction have made it a less attractive alternative (Wallace & Wilkinson, 2004). Although engineers estimate that Libya only has enough oil in existing known deposits to last until about 2070, the country has huge natural gas reserves that could last for several more centuries (Di Piazza, 2005). Zuliani (2011) states that while Libya has the ninth largest oil reserves, it has the world's 23rd largest proven gas reserves, at 1.539 trillion cubic metres (2010 estimate).

❖ Mineral Resources

Libya's commercially usable mineral resources – apart from its hydrocarbons – were limited to a large iron ore deposit in the Wadi Shati in the south of the country and scattered deposits of cement rock, limestone, gypsum, salt and building stone in Fezzan and northwest Tripoli.

Except for wood, natural resources and the raw materials needed for construction projects – gravel, stone clay, gypsum, limestone and cheap fuel – are found in abundant quantities and suitable commercial qualities adjacent to production and major population centres in both Cyrenaica and northern Tripolitania. The thickness of these deposits is up to 350 metres in the western areas (Oxford Business Group, 2008).

❖ Agriculture

In the period prior to the influx of oil revenues in Libya, agriculture accounted over 26 per cent of the GDP and the country was self-sufficient in food production. The Great Man Made River was created in the 1980s to bring water from underground aquifers in the Sahara to dry tracts near the coast for general use and irrigation and to meet the country's food needs. Today, despite the dominance of the oil industry, agriculture contributes nine per cent of Libya's GDP and its workers make up 17 percent of the workforce (Di Piazza, 2005).

❖ Libya's Tourism

Libya has more than 1,700 km of virgin beaches and the finest and best-preserved cities of the ancient world in the entire region. The desert embraces oases of breathtaking beauty, galleries of prehistoric rock art and medieval towns still thriving. The five UNESCO World Heritage sites in Libya are Leptis Magna, Sabratha, Cyrene, Ghadames, and the prehistoric rock art sites at Tadrart Acacus.

When the UN suspended some of its sanctions in 1999, the number of visitors to the country increased and tourism has raised the sector's contribution to the economy. Libya's Minister of Tourism declared that "tourism will soon contribute at least five per cent of the country's GDP. This may seem a small figure but for a country like Libya it will be an enormous achievement" (Venditti, 2005). In 2009 capital investment in travel and tourism was estimated to comprise over 26 per cent of the country's annual investment in infrastructure (World Travel and Tourism Council, 2009).

❖ Libya's Industry

Libya has successful built up an industrial sector, but these businesses are still dependent on and closely tied to the oil industry. For example, construction serves the needs of the oil industry by building roads, buildings, refineries and other relevant structures. Other industry includes steel, iron, petrochemical and aluminium production. Factories also make steel pipes, drums and other equipment for oil drilling.

In addition, the country has expanded its production of food products such as beverages, dates, olive oil and citrus fruit. The greatest numbers of food processing plants were built during the 1970s, but this continues to remain a high priority. Handicrafts also employ carpet weavers, metal smiths and leather workers, while the textile industry makes clothing, leather goods and shoes.

The LCI is known as the "Construction and Building Sector" (CBS). It can be defined as the economic sector involved in planning, construction production, design and maintenance, repair, operations, alteration, demolition and other improvements of civil infrastructure works and buildings. Libya's CBS comprises two important sub-sectors: construction sectors and consulting.

The construction industry has played a prominent role in socio-economic development since the early 1970s. As a result, the country has experienced a great increase in the volume and scale of construction activities. In 2004, the industry contributed 5.2 percent of the country's GDP, and it employs around 3.2 percent of the total workforce (General Council for Planning (GCP), 2004). In 2009 the growth was reported at nine per cent year-on-year (y-o-y), this real growth making Libya one of the best performing countries globally, despite difficult conditions in terms of risk aversion and reduced oil revenues (Libya Infrastructure Report, 2011).

In fact, Libya's economy is experiencing an extremely sharp contraction in economic activity since 2011, as political revolution and war disrupted all forms of business activity. According to the African Economic Outlook (2011), the construction industry accounted for 8.7 per cent of the country's GDP. However, in spite of the massive investments in construction activities over the past four decades, the LCI has been underdeveloped. Libyan construction companies mainly prefer foreign workers to native ones because the latter by and large lack special training, making them unable to meet the needs of the new labour market, and also because well-educated Libyans are rejecting jobs in construction or metalwork (Bansal, 2010)

3.2.3 Libyan Culture

The concept of culture has been variously defined. Each definition places emphasis on different aspects of the environment which affect and give rise to individual and group behaviour. Factors such as language, religion, education, politics, economics, law and technology are sometimes cited, while others take culture to refer to the way of life of a given society as a whole.

Many authors have discussed the effect of culture on project management as a discipline of organising, planning, and monitoring a project from inception to completion. These authors observe that cultural elements affect project management procedures and processes, stating that they directly impact on success; as such, they demand careful consideration. Vanasse (1985) sees the relationship between culture and project management in these terms: "the cultural concepts could profitably be applied to project management. As in organisation, although culture in project management is quite different from organisational culture, working groups on a project need to have shared perceptions, values and beliefs concerning the project and their responsibilities in regard of the project".

Cusworth and Franks (1999) describe the effect of culture on project managers in developing countries: "Project managers in developing countries work in different contexts and face a different set of problems from those in industrialised countries. This has led many observers to question the applicability to developing countries of the whole range of management concepts developed in the industrialised world, and even their general usefulness in their own context."

Culture in Libya is closely linked to religion, as it relates to all aspects of life among Muslims. The vast majority of Libyans are Sunni Muslim. The influence of religion on most aspects of Libyan's life is obvious, as they practice their faith through their daily actions. "No nation can achieve greatness unless it believes in something; and unless that something has the moral dimensions to sustain a great civilization. The release of human potential, the enhancement of individual dignity, the liberation of the human spirit". (Gardner, 1961).

Islam is a religion that directs worship as well as providing a social and economic system for Muslim to live by. Unfortunately many Muslims only adhere to the religious aspects of the religion as heritage and tradition, ignoring the social system that can help them solve their problems and offer a good example to others in their day-to-day activities. Islam believes that most social and economic problems emanate from a focus on individual desires and whims and a disregard for the rights of others. Islam warns against the disruptive power of those whims and believes in managing them before they get out of hand and interfere with individual life and ultimately with society at large.

❖ Leadership in Libyan Culture

In Islamic culture, the leader is completely responsible for the welfare of his group before God. He should treat his employees with respect and kindness, and his followers should obey his orders. The Quran states, "O ye who believe! Obey Allah, and obey the Messenger, and those charged with authority among you (The Qur'an, 5: 59). The leader should also be trustworthy and strong. The Qur'an says, "The best recruit is the one who is strong and trustworthy" (their strength could, however, be in faith and knowledge) (Qur'an 26: 26).

Abdul-Khaliq *et.al* (1982) stated that Arab managers often concentrate on seniority rather than merit in most of their decisions affecting employee relations. Individual family, kinship or tribal background strongly influences Libyan organisations' selection of decision makers and managers, which leads to the wrong people being appointed to the wrong positions, and to the promotion of unqualified and inexperienced managers and directors.

❖ Commitment to Work

Islam recommends that its believers be committed to their work. The prophet Mohammed said in his Hadith "Allah likes that when a man does a certain task he does it perfectly." This Hadith is identical to the sentiment "do it right, first time, every time". In fact, commitment and lack of interest are the biggest challenges face the libyan companies and that might result in a divergence between boards and department heads. Grifa (2006) stated that despite the strong commitment of the Libyan state to regulate the construction projects with formal construction standards, informality is one of the key features of its operations. This is due to the significance of social and tribal context in Libya. Nevertheless, tribalism and its associated attitudes should be utilized to improve the operation of the industry.

❖ Responsibility

The prophet Mohammed said in his Hadith "Each one of you is a Guardian and responsible for those of whom he is in charge". The Ruler is a Guardian and thus responsible for his subjects. A man is the Guardian of his family and is responsible for those under his care. In like manner, each one of you is a guardian and is responsible for what he is entrusted with".

Grifa (2006) argue that the weaknesses of LCI are, in part, responsible for the current operations and performance in terms of low capacity and capability, delays to projects, high cost overruns and poor image and reputation of the industry. Therefore, more responsibility should be given to local authorities. However, this shift should be associated with the training of local decision makers, staff and operations of the LCI.

- **Teamwork**

Islam states that partnership, consultation, joint planning and teamwork are to be the rule. Believers are instructed to cooperate and work as part of the team. Islamic teachings urge believers to act and work in unity and avoid disunity and discordance.

"Shoura" is another important component of leadership in the Islamic tradition. In order to establish the common good, consultation or "shoura" means that every community member participates in the dialogue. Many verses in the Quran advise the believer to work together and in harmony while keeping in mind their individual responsibilities, with due consideration given to accountability as well. Under individual responsibility falls the expression of "itqan" which translates as "high perfection or quality". Islamic culture exhorts that "itqan" is to be desired in every action taken, without exception, but as mentioned previously, many Muslims only adhere to the religious aspects of the religion as heritage and tradition, ignoring the social system that can help them solve their problems.

Twati and Gammack (2004) consider organisational culture in Libya as strong, a feature that resists organisational change in many ways, including the adoption of information communication technology, decision making processes, communication, employment and professionalism.

❖ **Management of Knowledge**

A Muslim should always strive to excel in his or her understanding and should seek knowledge continuously. As the Qur'an says:"Allah will exalt in degree those of you who believe and those who have been granted knowledge" (The Qur'an: 58: 111)

Islam has placed thinking and knowledge as a condition for action, which ensures that the actions undertaken are morally correct, that they accord with Islamic precepts, and that they are the appropriate ones for the intended aim. As the Qur'an says: "Do not be quick to recite the Quran before its revelation has been accomplished, but rather say: 'Lord, increase my knowledge'". (The Qur'an, 20: 114)

It is fairly clear that in Libyan project management processes suffer from the lack any in-house expertise and need systematically intensive training systems to produce a generation of skilled people for this position. Therefore, the education plan in the country is considered as the source of trained manpower required to achieve the objectives of development. The education plan comprises the following:

- In order to graduate, sufficient numbers are needed to fill the technical manpower gaps. The country is therefore seeking to increase the number of students attending universities and vocational institutions.
- Provide adequate educational facilities which help in raising the standard of education.

3.3 Characteristics of the Construction Industry in Libya

3.3.1 Traditional Resources for Construction in Libya

The vernacular or traditional buildings in Libya have been described as architecture without an architect (Rudofsky, 1964). Most of the country's construction has been shaped by the dictates of geography and climate. The ancient Berbers used the natural fortifications of the mountains they inhabited, whereas the desert peoples used some of building materials that protected them from the harsh Saharan climate. The country also inherited a rich collection of architectural gems left by the invading armies who occupied Libya (Ham, 2007). Each region in Libya has its own type of building tradition. These can be categorized as follows:

- **Construction of Dwellings in the Mountain Regions**

Stunning representations of indigenous Libyan construction are the Berber qasrs of the Jebel Nafusa, Qasr al-Haj, Kabaw and Nalut, dating back as far as the 12th century. The other highlights of Berber construction are the underground houses in Gharyan, Yefren, Zintan and elsewhere. Built to protect against cold winters, fierce summers and invading armies, a circular pit was dug in the earth. The rooms were cut into the base of the walls around the sunken courtyard and they were reached via a tunnel that ran from the upper level down through the earth to the base of the pit. The astonishingly spacious living quarters included a kitchen, storage areas, bedrooms and living rooms.

In the northern mountainous regions, people used local construction materials such as earth, wool, stone, palm, gypsum, animal skins, reeds and olive stems and olive wood to construct their traditional shelters and settlements (Shaiboub, 1979).

- **Construction of Dwellings in the Desert Regions**

The desert region is mostly flat, dry and rocky, and is covered with sand with a few scattered oases such as Ghadames, Ghat, Murzuk, Sebha, and Kufrah. The mud-brick houses of the Fezzan region in the southwest are well suited to the harsh demands of Saharan life. During summer season, the ancient buildings in Ghadames are well enough preserved for some of the population to move from their new air-conditioned dwellings into the old city. Most of the medinas of the desert region, on the other hand, have been abandoned for modern accommodation and are quickly deteriorating.

In desert regions, builders used simple construction methods and locally available materials in all settlements such as stone, mud and palm reeds, leaves and stems in order to construct their huts, thatches and shelters (Awotona, 1990). Limestone and dried brick or mud was used in the construction of all desert settlements. The materials were made of a mixture of straw, water and clay soil formed into a rectangular wooden form. These bricks were used for the construction of arches and walls after being dried in the sun, and palm trunks were the usual means of reinforcement. Palm trees provided joists and beams, which were covered with a matting of straw and leaves.

The relocation of the residents of small settlements has led to many traditional flat-roofed Fezzani houses being neglected to the point of dereliction. Part of the problem is that the absence of regular maintenance of roofs with fronds and palm beams means that they are likely to collapse on the rare occasions when it rains.

- **Construction of Dwellings in the Coastal Regions**

The Mediterranean coastal region in Libya is located on the country's northern border, extending from Tunisia in the west to Egypt in the east. The land is mainly flat. The commercial centres on the coastal strip such as Tripoli, Khoms, Benghazi, Alzawia, and Misurata. Old Tripoli is one of the important traditional cities in this region. According to Azzuz (2000), the consideration of customs, climate and traditions were major factors in shaping that city.

Dwellings in the coastal regions were built using different materials to those presently utilised. Construction materials such as mud brick, sandstone and limestone were locally available, and usually roofs were flat, generally made of clay straw or fine compacted earth, and were laid on a timber structure made of timber boards.

3.4 Development of the Contemporary Construction Industry in Libya

This section discusses the history of the contemporary construction industry in Libya. For the aims of this discussion, the processes of the LCI's development are divided into historical periods.

3.4.1 The Construction Industry during the Italian, British and French Occupation Period (1911-1952)

The appearance of the modern LCI was based on the principles of the Italian, French and British construction industries. Shawesh (2000) says that the Italian construction industry can be viewed in three phases. The first phase was from 1911 to 1913, a period almost entirely military in character, including administrative offices and camps. The second phase from 1913 to 1929 saw the government of Italy start to expand a new Tripoli that was separate from the old city. The strategy adopted by the Italian government was not to destroy the existing architecture and the traditional cities, but to produce new structural designs. The third phase, from 1929 to 1943, was based on Fascist concepts and ideology, which reflected the policies and attitudes of Italians in many structures such as churches, banks, houses and office buildings. To increase the height of buildings and the size of spaces, the Italian government used materials and modern construction methods such as reinforced concrete in floors and framed structural forms.

The French governments from 1943 to 1951 had a great impact on the development of construction, introducing new construction materials, standards, regulations, specifications and codes as well as new construction systems and technology.

The British strategy in Libya was based on a "care and maintenance" basis. The only attempt made by the British government to develop the country was the establishment of bus lines inside Tripoli and the rebuilding of the city's port, which was destroyed during the war.

Daza (1982) states that "the Italians, like the French and British, were trying to spread, through architecture, a perception of themselves as paternal, caring and not rejecting of tradition." Hakim (1986) describes developments in construction operations and methods during the French occupation in Arabic countries: "The construction of buildings by the French using modern materials and technologies also impressed the Arab population. The buildings were higher, seemed to be better constructed, and the use of modern materials such as a glass on windows and store frontages had their share of creating a shift in the mind-set of the Arab population towards their traditional built environment".

3.4.2 Development of the Construction Industry (1952-1969)

The most important economic factor that has influenced the operations and development of the LCI was the discovery of oil in 1950s and its exploitation in 1960s. The development of the oil industry was remarkable, in terms of investment in the country's construction industry. According to the Libyan government (1966), the LCI shares in the economy as a whole, and has in fact realised a remarkable expansion in terms of the sizes, types and amounts of construction in the period between 1964 and 1966. In the period before independence, construction in Libya relied on plans prepared in 1918, but the period after independence witnessed the effective implementation of a global and general strategy, prepared from 1966 until 1968. Modern materials such as wood in windows, aluminium, reinforced concrete in columns and ceilings and paint in various colours on building exteriors characterised the beginning of the independence period. In 1958, the production of cement was 60,000 tons; only two per cent of the cement produced was used for construction in Libya in 1964.

In the 1960s the LCI suffered from limited human resources, as many Libyans proved unwilling to work in construction, metalwork or carpentry. The country also suffered from a lack of administrative and financial capacity because of limited budgets and resources (The Ministry of Housing, 1968).

According to Grifa (2006), in 1956 the Libyan Construction Board was established to organise the various government departments and ministries concerned with building construction, and to manage construction activities. In order to overcome shortages in the local construction industry and in labour, and the incapacity of local contractors, the construction market in Libya was opened to foreign construction organisations and workers and companies

3.4.3 Development of the Construction Industry (1970-2000)

The phase that followed the revolution of 1969 introduced new political, social and economic factors. To meet the urgent need of the Libyan people for schools, roads, houses, and infrastructure there was high spending in all sectors including the construction industry and a series of changes and reforms in construction operations and processes.

The General People's Committee (2002a) indicated that over the past three decades the LCI operated according to different political, economic and social strategies. The General People's Committee report stated that these strategies were grouped into three main chronological stages, from 1970 to 1978, 1979 to 1985 and from then until the report's date.

- **The first stage (from 1970 to 1978)**

During this period the country was described as a busy construction site. Ibrahim (1987) indicated that at that time "social and economic projects were built everywhere, and Libya changed into a large construction site."

In the early 1970s the LCI was completely transformed from an indigenous construction practice to a cement-based industry that is currently producing about seven million tonnes of cement annually from nine plants (World Report International, 2004; Hokoma *et al.*, 2007a). The importance of cement in the LCI is paramount; it is widely used in most Libyan construction projects (Hokoma *et al.*, 2006c; Hokoma *et al.*, 2007a).

In the socio-economic development plan during the period 1973-1975, the Libyan government intended to construct the largest possible number of housing units for low-income people in different geographical areas of the country. The government also conducted new strategies to improve the construction industry such as providing building materials, encouraging self-built housing and using new technologies.

By the end of the decade the country had become the world's leading per capita consumer of cement. More than 97 per cent of the LCI used cement-based materials regardless of cost, location or environmental conditions. During this period construction activities changed from indigenous and domestic activities based on formal construction regulations and on dry and local construction materials, to professions and standardised materials. (Ngab, 2007)

- ❖ **The second stage (from 1979 to 1985)**

During the period (from 1979 to 1985) the LCI experienced remarkable changes in its organisation, structure, role and management. Its environment was organised around the public sector. The Libyan government invested more than 10 billion US dollars in infrastructure and housing; this made possible the construction of 277,500 dwelling units by 1985. To achieve these aims, the country drew not only upon Libyan resources but enlisted companies from Spain, West Germany, France, Turkey, India, Italy, South Korea, Cuba and Eastern Europe. (Ngab, 2007)

The General People's Secretariat of Planning (1982), however, found that, in spite of high development budgets during this period compared with the previous one, the housing allocations ratio decreased from 13.2 per cent during the former period to 9.46 per cent by 1988. Grifa (2006) stated that the possibility to run an individual firm in the LCI was restricted in the period between 1978 and 1985 because of the political, social and economic issues of that time relevant to the LCI include the collapse of oil prices, the implementation of socialist laws, and contracting in the construction sector was limited to only public and international companies.

- ❖ **The third stage (from 1985 to 2000)**

The LCI witnessed a recession during the period (from 1985 to 1999). Since 1985 the state decided to move towards restructuring and reorganising the construction industry. Public sector construction was privatised and the private sector was encouraged to contribute to the industry in terms of operations and investment (Libya General Council for Planning 2002a, 2002b, 2002c).

After the UN sanctions against Libya following the Lockerbie bombing in 1988, budget allocations for infrastructure and housing fell in keeping with a general decline in government spending. The public construction sector during the period between the second half of the 1980s and the end of the 1990s failed to meet national construction requirements and expectations. Many housing contracts were cancelled or suspended, numerous new construction projects were not started and large numbers of on-going construction projects were postponed or stopped. Payments to construction firms and consultants were delayed, many organisations and public companies collapsed or were abolished, and hundreds of foreign construction companies and consultants suspended their activities and withdrew from the Libyan construction market.

3.4.4 The Construction Industry (2000-2010)

After the suspension of the UN sanctions in 2001 there was a general expectation that a significant increase in investment would take place in the LCI. The country planned more investment in cement manufacturing and promoted the development of some mineral resources such as gypsum, clay, stone, iron and sodium carbonate (Hokoma *et al.*, 2007a; Hokoma *et al.*, 2008b).

During this period, the plan for the country was to free the economy from state control, motivate the expansion of private enterprise and build up the country's infrastructure. By 2008, 360 state-owned and run companies, ranging from small and medium size firms to major enterprises, were transferred to the private sector in three stages. Billions of dollars were spent on rebuilding the country and its facilities. More than 30 billion dollars were allocated for the housing and infrastructure sectors in 2007 (ICS, 2009).

3.4.5 February 17 2011

2011 was a momentous year for Libya. A 10-month civil war sparked by the Arab Spring in February saw Libyan leader Muammar Gaddafi killed in October. Some cities suffered severe damage as a result of clashes either between Libyans or NATO attacks. The impact of these events on the risk management profession in both the short and long terms seems quite profound. In the short term it would appear that the effects locally and globally within the profession were dramatic. The majority of private companies that do restart operations in Libya are likely to see the benefits of a softer approach, and local contacts as well as partnerships with local firms may well form the backbone of any in-country business plan. The current political uncertainty also means that many companies are seeking the financial benefits of a low profile at present. The events in Libya have had knock-on effects on businesses worldwide. Despite the longer-term nature of reconstruction in Libya, foreign companies have been eager to court the National Transitional Council (NTC) in order to secure new contracts and protect existing projects halted once the civil war erupted. Companies are eager to assess the status of pre-war contracts, with project sites likely to have been looted or damaged.

Mr Warren, a director of research at advisory firm Frontier, says companies with pre-2011 contracts are reluctant to revive them until outstanding payments are made and terms of return clarified. Others are in limbo as their contracts face reviews over corruption concerns. Security advisers say urban centres are relatively safe for workers, but harsh contracts remain the most pressing concern for foreigners operating in the country. However, the Libyan authorities have recently reiterated that existing contracts would be honoured provided that such contracts had been properly entered into (Simeon, 2012).

Over the long term, an overhaul of Libya's infrastructure will be required. It was already in a bad state prior to the civil war, following years of underinvestment and international sanctions. Although work to rehabilitate the existing infrastructure and expand its scope is therefore necessary, the government currently has no structure in place by which to procure projects. Institutions and regulations must therefore be established.

If one views risk management proper as enabling business to be carried out in difficult environments, rather than pertaining to the losses inevitable when operating in hostile conditions, a different perspective on what effective security management means is possible. In fact, many companies lost hundreds of thousands of dollars in damaged and stolen property. Proper risk management is necessary in certain environments, even benign ones, to project an image of security as well as to provide adequate protection against all manner of threats such as insurgents, criminals and business rivals.

There is now a realisation among those companies worst affected by the Libyan crisis that more attention needs to be paid to risk management planning. Local engagement, communicating and maintaining good local relationships, using local fixers/employees, understanding and a prior knowledge of local culture and languages (often necessary to defuse situations quickly) are all imperative. In addition, training staff to raise awareness of risk-crisis planning at the beginning of the process can save both dollars and potentially lives in the long run.

Context analysis is also a key consideration, as it is easier to mitigate risks when they are properly understood. If a company has considered all contingencies as best as it can ahead of time, then dealing with them as they occur is easier and can be modeled and prepared for. A change of perspective from "it won't happen to me" to "what if?" reaps benefits. Other methods of offsetting financial risk include insurance policies to cover in-country staff and particularly contracted personnel.

3.4.6 The Future of the LCI

In early 2011, Libya was mired in political conflict. Matters changed with the widespread popular protest against the Qadhafi government. There is an urgent need to modernise and restructure the country's construction industry. In order to avoid the problematic circumstances of the last few decades and meet current and future needs and challenges, local private construction companies must play the leading role; changes, new policies and restructuring of the construction industry are required. New homes, railways, ports, airports and roads need to be upgraded and built. Offices, hotels and resorts are required to meet the needs of an expanding tourism industry.

Grifa (2006) states that the future of the LCI and its capability to cope with challenges, changes and threats will be determined by certain planning processes, including the application of new tools and techniques in the construction industry and in project management, the improvement of design and contractual documents, the application of more flexible procurement systems, the development of better and more modern systems of information, communication and review, an increase in management capability and a revision of laws and regulations that restrict the application of modern project management programmes and techniques. Given that the poor management of construction projects is an industry weakness, it is necessary to commit strongly to education and training in construction and project management.

3.5 Management System of Projects in Libya

To improve the processes of the Libyan construction industry, it is required to understand the management system of construction projects in the country. In fact, in the LCI many companies have managed their projects according to the same processes that produced the previous Libyan government. The processes of Project Management in Libya presents in Figure (3.2).

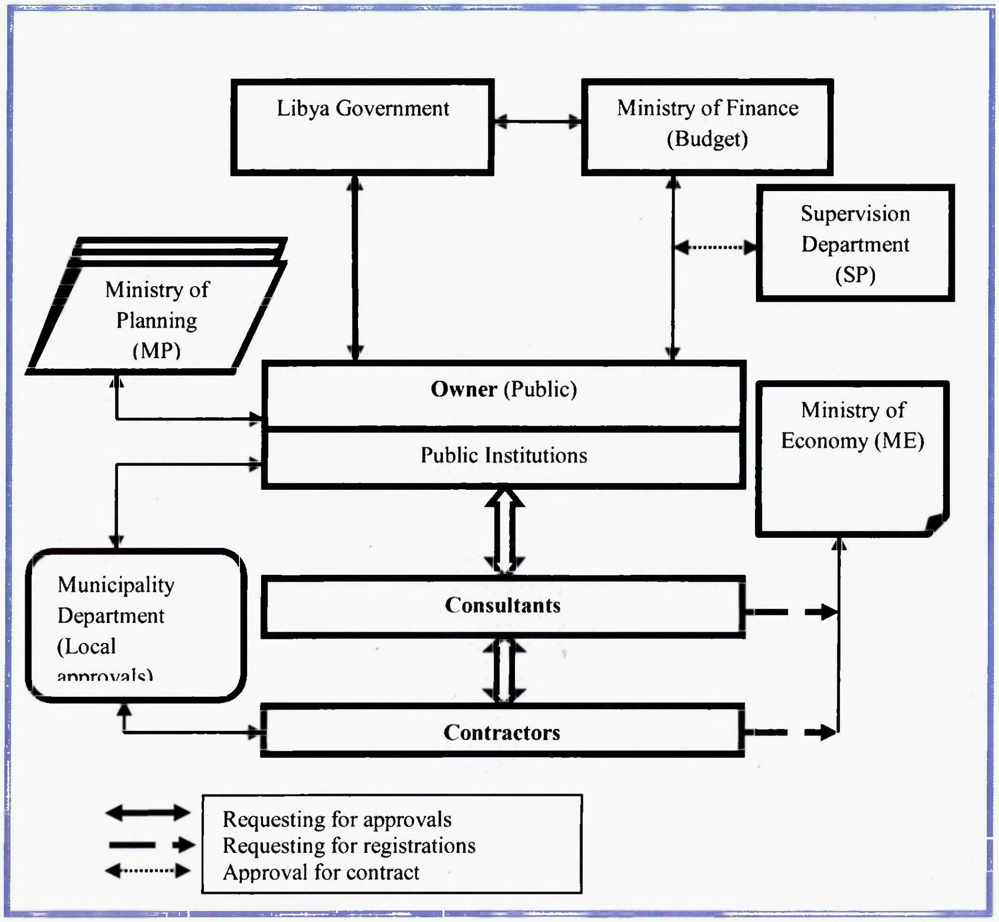


Figure 3-2: Project Management System in Libya, Source: Al-Gathafi (2005)

3.6 Specific Risks of Libyan Projects

There are unavoidable risks in any phase of a construction project. According to Grifa (2006), the unplanned move towards the enabling strategy in Libya caused many bottlenecks and serious challenges to the country's construction industry. To avoid these difficulties, it is necessary to understand what the key factors affecting the construction industry, and what the major obstacles constraining the industry's operations, are.

As a result of these bottlenecks and serious challenges, two of the biggest difficulties facing Libyan construction projects are time and cost overruns. Many public projects of the last three decades have not been finished in time and to cost, some of them taking so long to build that they have become worn out during the construction phase, so that many parts have had to be rebuilt. In addition, the activities comprising construction projects have often totally stopped, and the public has consequently lost hope of some of them ever being completed.

According to the Ministry of Planning (MP, 2005), although the ratio of the total cost of national development projects planned to the total cost of projects completed on schedule in Libya was about 15 per cent in the last decade of the 1990's, the ratio has gradually fallen to 8-10 per cent since the year 2000. For example, only 20 per cent of public projects were completed on schedule in the 1990's, whereas the completion of 15 per cent suffered delays of up to four years. Investigation of the transport and health sectors indicates that in the 1980s and 1990s the construction of motorways and hospitals was delayed on average by 45 per cent. The many extreme examples of delay include the construction of Tripoli University Medical Central (TUMC), which was expected to be finished in 1982-86, but was only completed in 1993. According to a report published by the General People's Committee PGC (2003), 97% of construction projects associated with the public and private sectors between 1991 and 2003 suffered delays and had a high impact on project cost and time. It is therefore obvious that one of the foremost problems related to the LCI during the last three decades is time overruns.

The many detrimental effects of such overruns include increased costs, loss of revenue and productivity, lawsuits between contractors and clients and contract termination. Many studies have investigated the causes of time and cost overruns, but they seldom identify causes that are common to a wide range of construction projects around the globe. A comprehensive study of those factors leading to a risk of time and cost overruns is therefore important. The central focuses of this study are to explore and understand the main characteristics of the LCI and its associated processes and operations, to identify those major obstacles constraining its practice and operations, and to explore how the strategy of application of project control affects project target times and costing.

Examining these difficulties in the construction industry and recognising how and why construction policies have failed are the objectives of the present study, which seeks to identify the important problem of risk management, in particular those risk factors affecting cost and time performance, and to investigate the tools or techniques used by construction project practitioners for controlling time and cost in Libyan construction projects and to develop a framework to manage risk factors that significantly influence projects' time and cost performances.

3.7 Summary

The chapter has presented some general information about Libya, demonstrating the strong interaction between the country's geographical and economic circumstances on the one hand and the historical development of the construction industry on the other. The chapter gives the main characteristics of the construction industry in the country.

In addition, the chapter has outlined the development of the contemporary LCI. The development strategies of the industry are grouped into three main stages. These stages, together with the future of the LCI, were discussed. The major difficulties and serious challenges encountered during construction projects were identified and the processes of project management in Libya were presented in order to understand the management system of construction projects in the country

4.1 Introduction

The purpose of this chapter is to present the processes and methods with which this study attempts to achieve its aim and objectives. The chapter provides a broad overview of the research questions, paradigms approach and style, the methods of data collection used and research design evaluation criteria.

To achieve the research objectives, the chapter describes different methodologies. The objective of selecting the most appropriate research methods within the context of the LCI is to obtain an appropriate set of data that will allow the study to examine hypotheses and meet the objectives, and to address the research questions as rigorously as possible. The methods to be considered in this research are the extensive literature review, the questionnaires (I) & (II) and (III) and semi- structured interviews with Libyan construction professionals. In considering the requirement for data analysis, the chapter discusses the procedures that will be used for data analysis.

4.2 Research Questions

Research questions are central, whether they are pre-specified or whether they unfold during the project. They do four main things:

- They organise the project and give it direction and coherence
- They delimit the project, outlining its boundaries
- They keep the researcher focused during the project.
- They describe the data that will be needed. (Punch, 2005)

Defining the research questions for this particular study is the most important step that has been taken. It can be summarised as:

"How can professionals improve the performance of construction project control processes in Libya?"

Essentially the study is about investigating how cost and time of construction projects are controlled in practice to disclose reasons and related issues which affect the process of cost and time control in practice. Consequently the inclusion of these results combined with participants' perspective to control cost and time in practice to develop the proposed framework. The framework would help determine the appropriate actions to minimise the overruns in practice in Libyan construction projects. To do this, the following questions should be considered:

1- What is the current situation regarding time and cost overruns in the LCI?

2- What are the critical factors affecting time and cost control in practice in the LCI?

3- What are the tools and techniques that are currently being used by Libyan projects to control the cost and time?

4- How do professionals in the Libyan construction industry perceive and discuss the important processes of time and cost control in construction projects?

5- Are there any barriers during the process of construction projects that affect the attainability of cost and time control in Libyan construction projects in practice?

6- How can the time and cost of construction projects be better and more effectively controlled in the LCI?

4.3 The Research Paradigm

Research paradigms and methods are the "set of activities a research community considers appropriate to the production of understanding (knowledge)" (Esteves, 2004). According to Smyth & Morris (2007), paradigms shape the way professionals and practitioners perceive the discipline, and directly shape many of its aspects such as services, techniques and tools. It is therefore important that a researcher should think about the elements that form a valid study, and decide which methods are suitable for achieving the research's aims and objectives. Research paradigms will direct how researchers evaluate their data and carry out their study, and to think how they can integrate the various elements of their research.

Guba and Linccoln (2005), Blaster (2008), Daymon & Holloway (2010) and Chilisa (2011) identify four basic belief systems. These can be characterised by the following questions that help define a paradigm:

- The axiological question asks, " what is the nature of ethics?"
- The ontological question asks, " what is the nature of reality?"
- The epistemological question asks, " what is the nature of knowledge and the relationship between knower and that which would be known?"
- The methodological question asks, " how can the knower go about obtaining the desired knowledge and understanding?"

They state that a research paradigm can be identified by its axiological, ontological, epistemological and methodological stances and by the relations between them. The following subsections represent the four core elements of a research paradigm.

4.3.1 Axiology

Axiology refers to the role of values and ethics in research. In the postpositivist view, ethics is intertwined with methodology in that the researcher has an ethical obligation to conduct "good" research. Good research in this paradigm means, " intellectual honesty, the suppression of personal bias, careful collection and accurate reporting of data, and candid admission of the limits of the scientific reliability of empirical studies – these were essentially the only questions that could arise" (Christians, 2005)

4.3.2 Ontology

Ontology can be taken to refer broadly to conceptions of reality. The fundamental questions in the field of ontology are "what is the nature of social reality? How does a researcher view reality – subjectively or objectively? Does reality have a single or multiple meaning depending on the researcher, the individuals being investigated and the audience interpreting the study?" (Daymon & Holloway, 2010)

4.3.3 Epistemology

Epistemology addresses the paradigmatic question, "what is knowledge, and how is it acquired?" or, put another way, "How do I know the world?" It also asks, "What is the relationship between the enquirer and the known?" Epistemology is the branch of philosophy that deals with the origin, nature and limits of human knowledge and that focuses on the relationship between the knower and known. Epistemology also deals with ways of knowing and the researcher's belief system about the nature of knowledge, such as beliefs about the certainty, structure, complexity and source of knowledge.

Tzortzopoulos (2004) states that positivism and interpretivism are the two main approaches to thought that can shape epistemological philosophy. Smith (1998) describes positivism as "Approaches to the social sciences [that] claim the label scientific, for they assume things can be studied as hard facts and the relationship between these facts established as scientific laws".

Thompson, (2000) defines positivism as a term used to describe a particular approach to science, whether natural or social. He shows that positivism has been a major influence in the philosophy of science for some time. Although less dominant now than in the past, positivism remains a pervasive influence at both an explicit and implicit level. Positivism accepts that we cannot observe the world of which we are part as totally objective and disinterested outsiders, and acknowledges that the natural sciences do not provide the model for all social research. However, they do believe in the possibility of an objective reality (Muijs, 2004).

Positivists believe that reality is separate from the individual who observes it. It assumes that reality is objective and can be described by measurable properties that are independent of the researcher. They also believe that knowledge is based on observation or experience of the real world, as in a scientific theory whose predictions can be falsified if they are not supported by empirical testing. The training needed to conduct research using this paradigm is necessarily highly quantitative and technical in character (Lincoln and Guba, 2005).

In contrast to positivist paradigms, interpretive ones assume that people create and attach their own meanings to the world around them and to the behaviour they manifest in that world (Lee, 1991). Lee points out that this paradigm emerges from the inadequacy of the methods used in the natural sciences when applied to the social ones.

Generally, the interpretive researcher collects data from members and social groups in their real life situations that describe a phenomenon's possible meanings and interpretations. It sets out to subjectively understand the human constructs concerned, often through active involvement and observation, making understanding rather than prediction the main role of interpretation. Unlike the positivists, the interpretivists believe that reality and the individual who observes it cannot be separated (Weber, 2004). The lack of a reality independent of the observer means that interpretive research must follow a procedure whose aim is to understand situations and give reasonable and acceptable accounts of them (Stahl, 2005).

In short, epistemology is intimately related to both ontology and methodology; ontology involves the philosophy of reality, epistemology concerns how we come to know that reality, and methodology identifies the particular practices used to attain knowledge of it. Thus, ontological assumptions are translated into specific methodological strategies.

From the point of view of the present research it can be concluded that interpretivism is seen as integral to the research project and that this can be very useful in the field of project management research because of the fact that the research is based on constructing and (over time) constantly re-constructing meanings from different individual experiences. In addition, the research questions that the researcher seeks to provide answers to cannot all be answered only from the positivist viewpoint of the world being deterministic. Walsham (1993) asserts that the purpose of the interpretive approach in information science is to produce an understanding of the context and the process whereby information science influences and is influenced by the context. Understanding and interpretation of the subject come from researcher's own frame of reference. This philosophical stance led to the utilization of the multiple methods (quantitative and qualitative research methodology) in providing answers to the research questions that this study seeks to provide insight on.

Carr and Kemmis (1986) argue that in the interpretive approach the researcher does not stand above or outside, but is a participant observer who engages in the activities and discerns the meanings of actions as they are expressed within specific social contexts. The present researcher is part of what is observed and cannot be isolated from the phenomenon investigated; the researcher focuses on meanings and the constant process of interpretation and reinterpretation of the intentional, meaningful behaviour of 'experts' – including researchers regarding the process of project cost and time control. The researcher tries to understand the process of project control from their point of view, look at the totality of each phase of construction project, and develops a framework through the utilisation of both inductive and abductive reasoning from data in order to answer the research questions. Moreover, this study adopts the Interpretivists paradigm as suitable for the further development and testing of the research model.

4.3.4 Methodology

Research methodology is a way to systematically solve research problems. Methodology addresses the question "how should the researcher study the subject of the research?" Methodological debates address the issues of types of sampling, data, design, analysis and the consequences that result from methodological choices. Methodology reflects beliefs about knowledge and values inherent in the paradigm within which the study is conducted, and implies a concern with and commitment to construct a particular type of knowledge. Research methodology has many dimensions. Research methods constitute a part of research methodology. According to Klenke (2008) researchers should classify selection inquiry concepts according to their stance as depicted in Fig 4.1

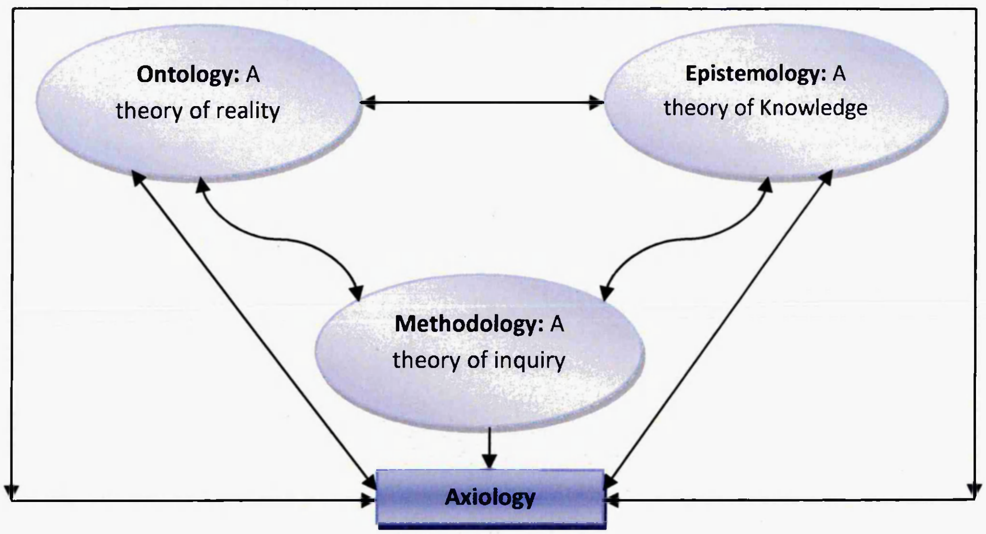


Figure 4-1 The Research Triangle (Klenke, 2008)

4.4 Research approaches

The methodological details adopted by the present researcher are a function of the research problem which has been set; different problems must be undertaken in different ways. Traditionally, nevertheless, the most common approaches to problem-solving are classified into three categories: inductive, deductive or abductive. The qualities of every common methodology interact with the problem, and consequently the deductive, the inductive and the abductive approaches are preferable depending on the situation.

4.4.1 Deduction: testing theory

In general, deductive research is associated with positivist studies. The approach involves the development of a proposal, or hypothesis, from existing theory which can then be tested in the data collection stage (Gratton & Jones, 2010). According to Russell (2011), deductive research designs begin with theory grounded in common sense, observation or the literature, and hypotheses derived from such theories, and then moves on to observations that either confirm or negate those hypotheses.

Collins (2010) lists five sequential stages through which deductive research progress:

- Writing (a testable proposition, which details the relationship between more concepts or variables)
- Indicating exactly how the concepts or variables can be measured
- Testing this proposition
- Examining the outcome of the study, which will validate the theory or establish how the operational hypothesis needs to be modified
- If necessary, modifying the theory (proposition) and then repeating the process

Some important characteristics of the deductive approach are its searching for explanations of causal relationships between variables, the need for the research to be independent of what is being observed (which in turn requires both researcher and research to remain objective), the importance of generalisation from a sample that must be of sufficient size to ensure that the researcher can make inferences about a more general population from the sample data.

Copi & Burgess-Jackson (1995) argue that phenomena that appear in the field are not subject to deductive logic at all; the field is merely the court in which the a priori hypotheses can be examined. Because of deductive logic does not use the field to validate variables and suppositions stemming from an existing theory, it is the opposite of the logic used for this research study, since it examines the field in order to disclose the elements and the variables that play a role in the project control process.

Therefore, deductive research cannot be used in this research, since it is field-dependent; it is not theory-dependent in the sense that the questions it poses do not arise from a theory, but from the findings, data and phenomena that revealed themselves during the research process.

4.4.2 Induction: building theory

Inductive research is often associated with naturalistic studies. The intent is to collect data and analyse it in order to develop a theory, model or explanation. A research project using the inductive approach is more likely to be concerned with the context in which the events are taking place, and might mean that a small sample is more appropriate than a large one (Gratton, 2010).

Russell (2011) states that inductive research involves looking for patterns in data and then developing explanations or theories for those patterns through a series of hypotheses. The hypotheses are tested against new cases, modified, retested against yet more cases, and so on, until saturation occurs – that is, new cases no longer require testing.

The purpose of the inductive approach is to understand the nature of the problem and then make sense of the data the researcher obtains from, for example, focus groups. The strength of this approach lies in understanding the context within which the research takes place, rather than focusing on a cause and effect relationship.
Deductive research designs begin with theory then move on to gather data, as opposed to inductive designs that begin with data and end by generating a theory, as shown in Fig.4.2

The choice between deduction and induction is important, because it allows researchers to make an informed decision about the research design and helps them think about which choices and research strategies work best. Knowledge of the different research traditions also allows the researcher to cater for potential constraints such as limited access to data, a lack of prior knowledge of the subject, the researcher's inability to formulate a proposition or insufficient understanding of the subject.

According to Saunders et al. (2009), any research should use either the deductive approach to develop a theory and hypotheses and design a research strategy to test the latter, or the inductive approach, in which data is collected and theory developed as a result of the analysis of that data.

Since the process would have to move toward the hypothesis and not from it, inductive logic runs to be a one of the logic of the present study. Induction means to move from incidents to some superior rules or structures through generalisation. It is a method used is to reach a conclusion or a summary of understanding through examples or observation.

The following are some of the purposes underlying the choice of using an inductive approach in this study:

- Allows the condensing of raw textual data into a brief and summary format
- Establishes clear links between the research objectives and the summary findings derived from the raw data
- Is well suited to large data sets
- Allows for categories to emerge from data
- Has a more flexible structure than the deductive approach. (Saunders et al., 2009).

The main steps of the inductive method that have been conducted in the present study were as followings

1. Define the problem area: gather information to identify the most common factors influencing time and cost overruns as found in various studies.
2. Collect Data: Gather information including informal conversations, observation, reading books and articles regarding the factors influencing time and cost control in LCI.
3. Form a Hypothesis: the problem statement has been identified.
4. Develop a research plan: This is the most important step which includes strategies to collect and analyse data.
5. Collect and analyse the data.
6. State Conclusion: This presented the analysis and findings of the survey questionnaire (I).

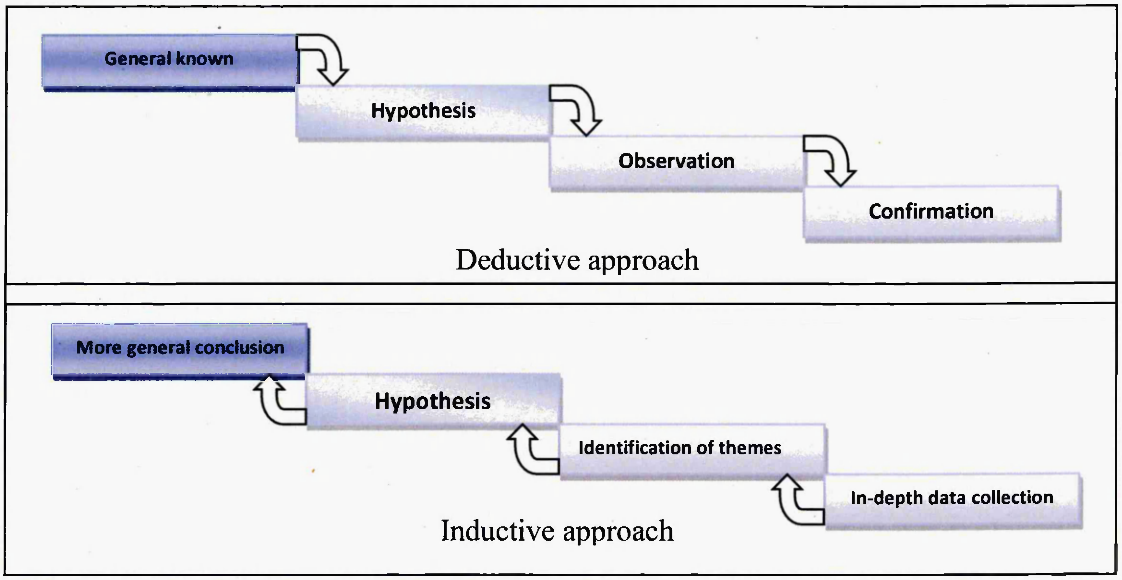


Figure 4-2 Deductive and Inductive Research Approaches (Russell, 2011)

4.4.3 Abduction: explanatory hypothesis

This approach is based on making and testing hypotheses using the best information available. It often entails making an educated guess after observing a phenomenon for which there is no clear explanation. Thagard (2007) argues that this term is much less familiar today than "deduction", which applies to inference from premises to a conclusion that has to be true if the premises are true. And it is much less familiar than "induction", which sometimes refers broadly to any kind of inference that introduces uncertainty, and sometimes refers narrowly to inference from examples to rules, which call "inductive generalization".

In the twentieth century, there is still philosophical scepticism about abduction, but many others contend that abduction, construed as inference to the best explanation, is an essential part of scientific and everyday reasoning.

Despite its inherent riskiness, abductive inference is an essential part of human life. When scientists produce theories that explain their data, they are engaging in abductive inference. Abduction or inference to the best explanation is a form of logical inference that goes from an incomplete set of observation to a hypothesis that accounts for the reliable data (observation) and seeks to best explain relevant evidence. Most philosophers agree that abduction is frequently used by social actors, in some form or other, both in everyday and in scientific reasoning. Richard Fox (1998) defines the use of the process of abduction thus:

Abduction is inference to the best explanation. It is a form of problem solving used in a diverse number of problems, from diagnosis to story understanding, to theory formation and evaluation, to legal reasoning, to, possibly, perception.

The abductive process begins with the initial findings. It is "hypotheses on probation," and a cyclical process of checking and rechecking against our observations takes place, widening and modifying the explanation through this process. Abduction is based on empirical facts just like the inductive approach but it does not reject theoretical ideas and is therefore, closer to the deductive approach. The abductive research approach becomes a combination of both induction and deduction, but it also adds new elements and includes understandings. (Levin-Rozalis, 2000b, 2003)

This research described is field-dependent in the sense that the field being studied dictates the variables, the questions, and the sample of population for the research. It deals not with abstract variables and the generalized, but with immediate and specific facts. And facts need explanations that will organize them into a sensible structure – some kind of theoretical or conceptual framework

Therefore, the researcher stated that the abductive approach is best suited for this research since the researcher will adopt a qualitative strategy where data is collected from semi- structured interviews. The data is based on the participants experience and the aim is to get a closer understanding of the views of the participants. It is worthy of note that the hypotheses of this research do not arise from any theory, but from practical facts from previous studies about cost and time control processes. The design of the abductive research that has been conducted in this research is shown in Fig.4.3

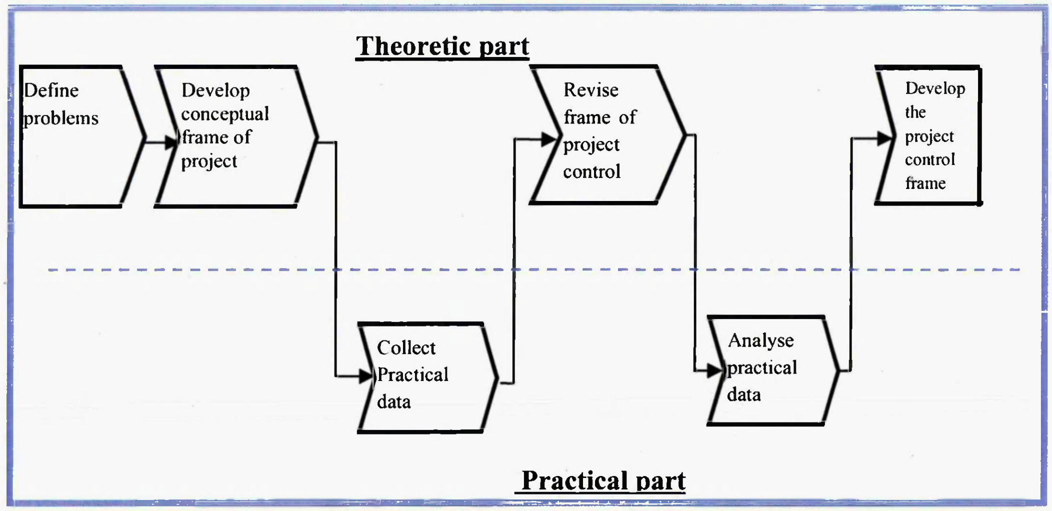


Figure 4-3: Abductive approach adopted in this research

In short, based on the principle that inductive and deductive and abductive approaches can be used effectively and in combination for research, the present researcher uses an inductive-abductive approach throughout. In this study, the researcher first examines the literature to derive a conceptual framework for the adoption and implementation of a project control process from it. To identify the categories that populate the conceptual framework initially induced, the study then uses an abductive approach because it is suitable for investigating the social context – in particular for comparing the way people perceive that context with the body of relevant theory.

4.5 Research Styles

The adoption of the most appropriate research method for data collection and analysis is critical: it has a direct impact on the results, and thence on the conclusions, values and validity of any significant research. The main priority in determining the most appropriate methods to adopt is to ensure that the research maximises the chance of realising its objectives. Consequently, the researcher should consider that the research design must take into account the research questions, decide what data are required and how those data are to be analysed.

Fellows & Liu (2008) consider that there are five basic approaches to, or design for, research in construction management, namely ethnographic, action research, survey, experimental and case study. The ethnographic approach demands that the researcher becomes part of the group being studied and observes such phenomena as subjective behaviour and verbal statements in order to gain insights into what, how and why, those patterns of behaviour occur. Action research is designed to suggest and test solutions for particular problems. Surveys operate on the basis of statistical sampling through questionnaires or interviews. Case studies encourage intensive investigation, while the experimental style of research may be suitable to "bound" problems.

Each of these methods has its advantages and disadvantages, and the final choice in the present study takes careful account of all of them. The choice of research methods depends not only on the limitations of the author's personal conditions, but also reflects her perceptions of the problems involved in the study.

4.5.1 Ethnographic

Ethnographic studies provide interpretative and descriptive analyses of the connotative and symbolic meanings that inform the routine practices of everyday life. Ethnographic research within one's own subculture or culture is not without difficulty, because it requires the researcher to "make the familiar strange", or make visible what are otherwise implicit and assumed aspects of social life. To facilitate the researcher's understanding of the respondents' perspectives, the empirical element of the approach needs an initial period of questioning and discussion between respondent and researcher. (It should be noted that the intensive, and therefore time-consuming, nature of this process is a disadvantage.) Fellow & Anita (2008) state that in order to conduct research, the researcher must become part of the group being studied, and must interact with the participants so as to gain insight into what their patterns of behaviour are and how and why they occur.

This research strategy is not practical when aiming to gain information about a broad range of industries whose participants are geographically disparate and who only have the need for strategic risk management in common. Another potential drawback of this approach is its attention on determining meanings through which the members of the group make the world intelligible to themselves and to others. Based on the prior drawbacks, the present researcher argues that the ethnographic method might prejudice the results gained from a sample group in the present study. This is why the ethnographic research method is not the most suitable vehicle for this research study.

4.5.2 Action research

Action research is a democratic, participatory activity involving the processes of identification, evaluation and solution of a problem under consideration. The method is concerned with developing practical knowledge of the pursuit of worthwhile human activities, grounded in a participatory worldview. Generally, action research – whatever the scenario – involves seven steps:

- Selecting a focus
- Clarifying theories
- Identifying research questions
- Collecting data
- Analysing data
- Reporting results
- Taking informal action (Sagor, 2000)

Coughlan & Coghlan (2002) recommend the use of action research "when the research question relates to describing an unfolding series of action over time in a given group, community or organisation; understanding as a member of a group how and why their action can change or improve the working of some aspects of a system; and understanding the process of change or improvement in order to learn from it" (Smite et. al, 2010)

According to Fellow & Anita (2008), action research is complex: the observer is not only involved but indeed has the crucial role of creating a field for discussion of the process. It is arguable that the need to be involved, and to impact on the sample, is the major disadvantage of this research strategy. This strategy has not been considered to be of primary interest to this research study, as its intensive nature restricts generalisation to the wider field of investigation of the application of project control.

4.5.3 Case Studies

Case studies are investigations that focus on understanding, describing, predicting, and/or controlling particular instances of the research subject (e.g. process, organisation, group, industry). In classic case study research, the case study may be an individual, where that individual is the primary unit of analysis. Case study research may also be carried out on several individuals, or it can be an event or entity that is less well defined than a single individual. Other case study research has examined individual decisions, programs, organisations, implementation processes, organisational changes, national economies, industries and policies (Yin, 2003). This definition is intentionally broader than the one proposed by Scholz and Tietje (2002): A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clearly evident.

Yin (2004) and others have stated that the case study is a way of doing social science research; it is the preferred strategy when "what", "why" and "how" questions are being used and when the investigator focuses on a contemporary phenomenon within some real-life context.

The major advantages of case study research are that it can support the development of historical perspectives, produce an extensive analysis of phenomena in context, guaranteeing a high degree of internal validity – that is to say, the observed phenomena are authentic representations of reality. In short, the case study is applicable to both context and researcher. It also suffers from weaknesses, however. Firstly, it is time consuming for both parties. Secondly, the external validity of the results is problematic, because it is difficult for another researcher to replicate that case study. Finally, the case method has significant shortcomings when it comes to the degree to which the results can be generalised (Gagnon, 2010). The present researcher considers the case study method is not considered to be of primary interest, as the data collected from this method cannot necessarily be generalised to the wider population.

4.5.4 Survey

Survey has been defined as "a systematic method for gathering information from (a sample of) entities for the purposes of constructing quantitative descriptors of the attributes of the larger population of which the entities are members" (Groves et. al, 2009). Connaway & Powell (2010) see it as "the research strategy where one collects data from all or part of a population to assess the relative incidence, distribution, and interrelations of naturally occurring variables."

Surveys range from unstructured interviews to highly structured questionnaires. Irrespective of the form adopted to describe, compare and explain situations, the subject matter of the study must be introduced to the respondents. For a given sample size of responses required, particular consideration must be given to the number of responses obtained and the response rate (i.e. the percentage of subjects who respond). Consequently, appropriate procedures must follow determination of the sample size to help match the number of responses to the sample selected (Fellow & Liu, 2008).

Research methods are typically classified as qualitative or quantitative, but these two can also be combined. This is referred to as mixed methodology, and often also triangulation – especially when the aim is to validate the result of one methodology by carrying out the same research using another (Esteves, 2004). According to Creswell (2008), the use of the qualitative research method is recommended when the researcher "positions himself or herself, collects participant meanings, focuses on a single concept or phenomenon, brings personal values into the study, studies the context or setting of participants, validates the accuracy of the findings, makes interpretations of the data, creates an agenda for change or reform, and collaborates with the participants". Mulekezi (1994) sees the disadvantage of this approach:"it has previously lacked conceptual clarity and is less well established than rational-scientific approach in the field of project management research. The interpretative approach cannot claim the robustness of the rational-scientific proof in the sense that the latter may be used in an attempt to demonstrate 'best practice'."

Creswell also recommends the use of quantitative methods as the researcher "tests or verifies theories or explanations, identifies variables to study, relates variables in question or hypotheses, uses standards of validity and reliability, observes and measures information numerically, uses unbiased approaches, and employs procedures". Broome (1998) highlights the approach's weak point: "the reduction of information into a single figure or classification that leaves out detail and can consequently give, at best, a superficial insight or, at worst, a wrong conclusion."

However, Brewer and Hunter (2006) state that the multi-method research approach "is a strategy for overcoming each method's weaknesses and limitations by deliberately combining different types of methods within the same investigations". Hoare's (1996) examination of PhD research project management recognises that the implementation of the qualitative approach could be appropriate for good students. Nevertheless, he recommends that, for PhD students on time limited projects, the need for 'rigorous research', and a risk assessment means that it would be safer to combine elements of the quantitative and interpretative approaches.

The present researcher therefore combines quantitative and qualitative methods in this thesis. In order to understand Libyan construction professionals' perceptions of factors influencing cost and time overruns in the country's construction projects, this study adopted a quantitative approach firstly for data collection and analysis. In addition, in order to propose a solution that can be used to tackle the problem of project control in the country, the study later adopted qualitative methods for semi-structured interviews to explore problem study and solution postulation.

4.6 Descriptions of Methodology and Methods Adopted for the research

4.6.1 Research Methodology

Research methods are typically classified as qualitative or quantitative, but these two can also be combined. This is referred to as mixed methodology, and often also triangulation especially when the aim is to validate the result of one methodology by carrying out the same research using another. The present researcher therefore combines quantitative and qualitative methods in this thesis in order to understand the perception of construction professionals in Libya towards factors influencing cost and time overruns at construction projects in Libya and to develop a solution that will guide the practitioners in the Libyan construction project to the successful adoption of controlled time and cost.

Firstly, an extensive literature review was conducted to gain an understanding of the current state of knowledge about the research topic, and then the researcher adopted a quantitative approach using a survey strategy in the second stage of the data collection of this study. The survey was conducted in order to gather data from a random sample of practitioners of Libyan construction projects. A questionnaire survey (I) with Libyan construction professionals aimed to gather information, as well as determine the factors that influence time and cost overruns in project construction in Libya. This stage of the research also focused on the identification of the process (including tools and techniques) followed to guarantee that Libyan projects do not overrun in cost and time. Findings of this stage have been taken forward into the development of the framework for effective implementation of project (cost and time) control in the Libyan construction industry.

Because of the purpose of the inductive approach was to understand the nature of the problem and then make sense of data the researcher obtains, the author used the inductive research strategy to answer the research questions (1, 2 & 3), which seek successively to investigate the current situation regarding time and cost overruns in the LCI and clarify the most important factors that inhibit or contribute the ability of construction project professionals from efficiently managing the time and cost objectives of projects in Libya and to identify the process (including tools and techniques) followed in Libyan projects to inhibit cost and time overruns.

After the analysis of data from the questionnaires it was obvious that the findings of the analysis required building on to gain an insight into control practice of respondents, therefore the adoption of the semi-structured interviews was considered useful. The adopt of the qualitative approach in the third stage of the study seemed appropriate to achieve the objective that was to investigate the practices used by practitioners in Libyan construction projects during the process of time and cost control.

Basically, the development of the framework for the project (cost and time) control was based on the participant responds about the developed solution through semi-structured interviews. Moreover, the participant's clients, the consultants' and the contractors' perspectives about cost and time control current practices in Libya have been used as reference in developing the framework as an alternative solution in remedial activities to control cost and time overruns problems in Libyan construction projects. In this stage, the semi-structured interviews are analysed qualitatively to answer the research questions (4, 5 & 6). In this stage, the abductive approach has been employed because it is suitable for investigating the social context, for comparing the way people perceive that context with the body of relevant theory.

In the fourth stage of the study, the development of the framework for minimising cost and time overruns was evaluated using the perception of professionals (contractor, consultant and owner) involved in the Libyan construction industry.

The combination of inductive and abductive approaches have been utilised in this study. Although the inductive approach can take into account some existing informal hypotheses such as literature and previous experience and practice which means we do not have to start from a complete blank canvas, the approach does not allow access to human subjectivity, taking due account of people's internal logic regarding the phenomenon under study. Hence, the use of the abductive approach was deemed most appropriate to understand the concepts that Libyan experts use to structure their companies and which direct their practice. Therefore, mutually compatible inductive and abductive research approaches have been utilized in this study.

4.6.2 Data Collection Methods

The primary aim in data collection from respondents is to maximise the accuracy and the amount of meaning transferred (convergence) from the respondent to the researcher. The aim of selecting the most appropriate research method in the context of the LCI is to obtain an appropriate set of data that will allow the study to examine hypotheses, to meet the study's objectives and to address its research questions as rigorously as possible.

Data collection methods are a set of procedures and techniques for gathering data. In general the methods can be categorised as either one-way or two-way communications. Berg (2004) discriminated between quantitative and qualitative research arguing that quantitative research referred to the measures and counts of things, while qualitative research referred to the meanings, concepts, definitions, characteristics, metaphors, symbols and descriptions of things. During this selection process the following sections discuss the methods considered in this research in details.

4.6.2.1 *Method 1: Literature review*

An extensive literature review in the areas of project cost and time control was conducted to review and examine the factors which caused both time and cost overruns in various countries worldwide.

4.6.2.1.1 The Role of the Literature

The general purpose of the literature review is to gain an understanding of the current state of knowledge about the research topic. Naoum (1998) suggests that the literature review is a vital phase in conducting research projects, sometimes accounting for up to half of the project. This research involves evaluating what other authors have written about project cost and time control in order to help develop a framework for the successful adoption and implementation of time and cost control processes in the LCI.

The author has found that the literature is a fruitful source of concepts, theories and evidence regarding construction projects' cost and time overruns. Monographs provided a useful starting point because they provided a good introduction to and overview of the issues of importance in project cost and time control. Most literature searches were conducted by making use of the Internet, and most relevant information was found in journal articles and international conference papers.

A review of the extant literature on concepts and practices regarding project (cost and time) control was carried out. The literature review was conducted before the research questions were formulated, thus informing the design of those questions. In this study, the review of the literature helped the author to:

- formulate the research questions
- generate ideas as to how to proceed with and design the research
- identify methodological problems specific to the research questions
- identify appropriate data collection instruments
- identify different types of delay in construction projects
- determine critical risk factors causing time and cost overruns in construction projects in different countries in the world
- discuss the results of some previous studies
- identify the classified list of cost and time overrun factors from previous studies of various countries
- review the theories and risk management modelling approaches
- design the initial proposed project cost and time control framework

4.6.2.2 *Method 2: The Questionnaire (I)*

The main purpose of Questionnaire I was to determine time and cost overrun levels in Libyan construction projects (ref. Objective 1: "To examine the current situation of the time and cost overruns in Libyan construction projects") and factors influencing those overruns, in order to evaluate the critical factors contributing to them (ref. Objective 2: to identify the critical factors which affect cost and time within Libya construction projects) and the tools and techniques that currently being used by Libyan projects to control the cost and time (ref. Objective 3: to determine time and cost control tools and techniques utilized in Libya construction projects) . The process of the questionnaire I stage is presented in Fig.4.4.

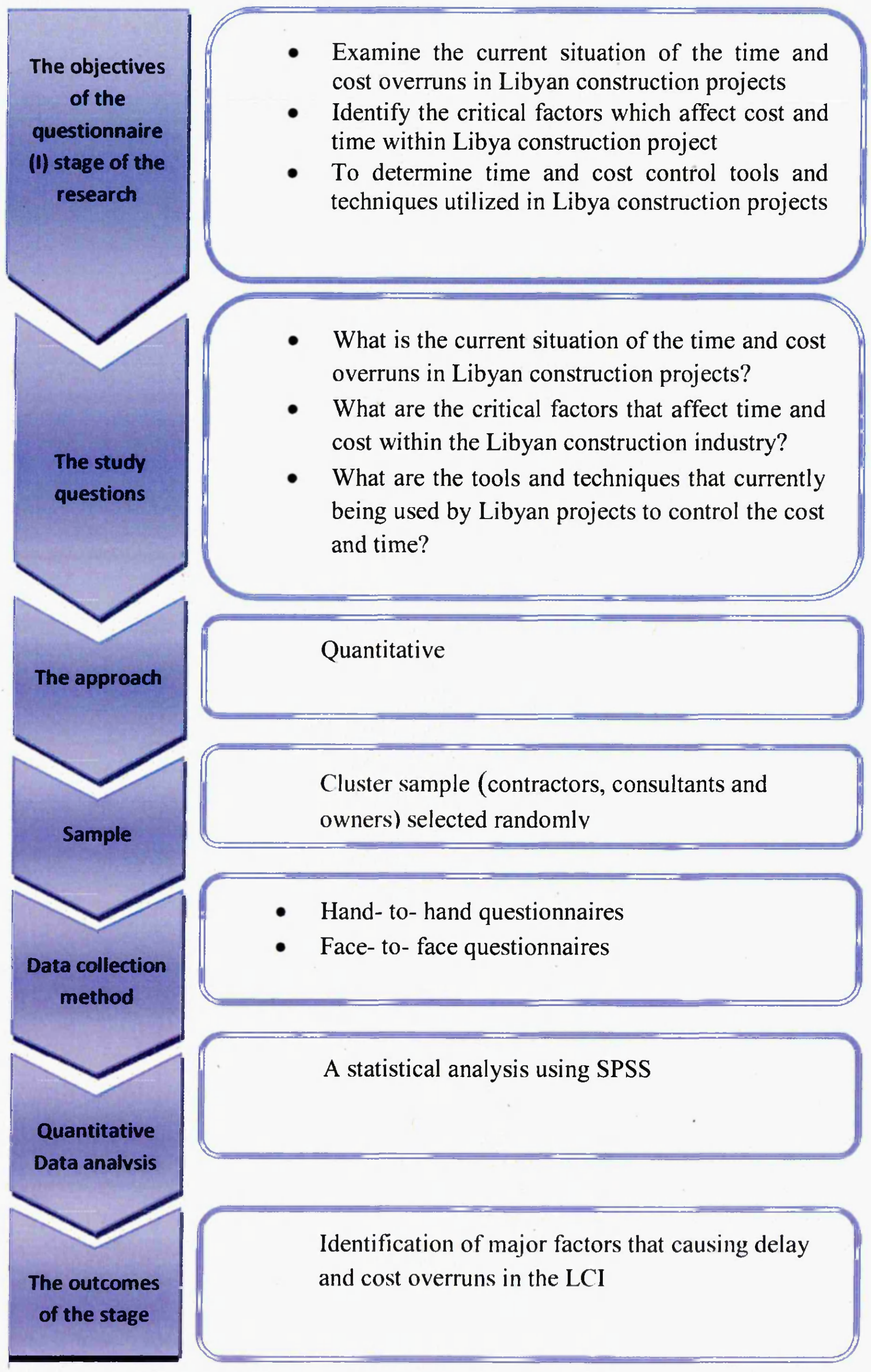


Figure 4-4: The Second Stage of the Study's Data Collection Phase

4.6.2.3 *Method 3: Semi-structured Interviews*

The outcomes of Questionnaire Survey I were further verified by the implementation of semi-structured interviews. Some Libyan professionals are interviewed in order to answer Research Questions 4, 5 and 6 in order to identify how the time and cost of construction projects are controlled by professionals in practice. The main purpose of the interviews approach is to meet Objectives 4 & 5 & 6. In addition to investigating the practices used by practitioners in Libyan construction projects during the process of time and cost control, the main purpose of the semi-structured interviews was to "To explore the perception of professionals (contractor, consultant and owner) involved in the LCI as to the important process of cost and time control of construction projects implemented in Libya and to gather and assess the respondents' views on the process of time and cost control of projects in the country" in order to propose a solution that can be used to tackle the problem of project control in the country. In this stage, qualitative methods are used that are analysed qualitatively. The process of the interviews stage is presented in Fig.4.5.

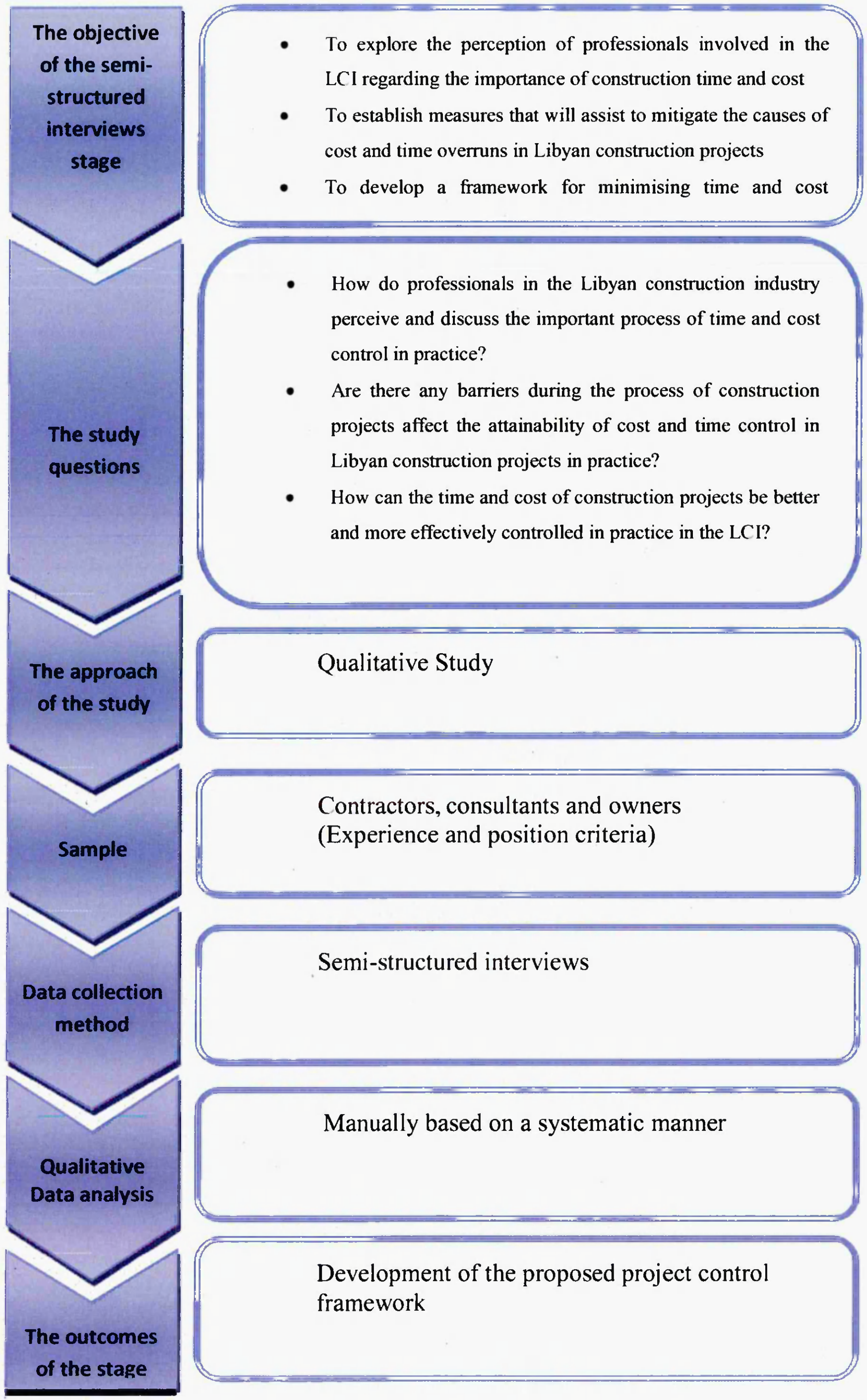


Figure 4-5: The Third Stage of the Data Collection Phase

4.6.2.4 *Method 4: Questionnaire Surveys (II) & (III)*

The evaluation of the framework for project (cost and time) control is based on the questionnaire (II) participants' responses regarding their perspectives on mitigation measures regarding cost and time control, which serve as reference points in the development of the proposed framework. Furthermore, questionnaire (III) was conducted to use the feedback of some of Libyan practitioners to evaluate the developed framework elements. See Fig.4.6.

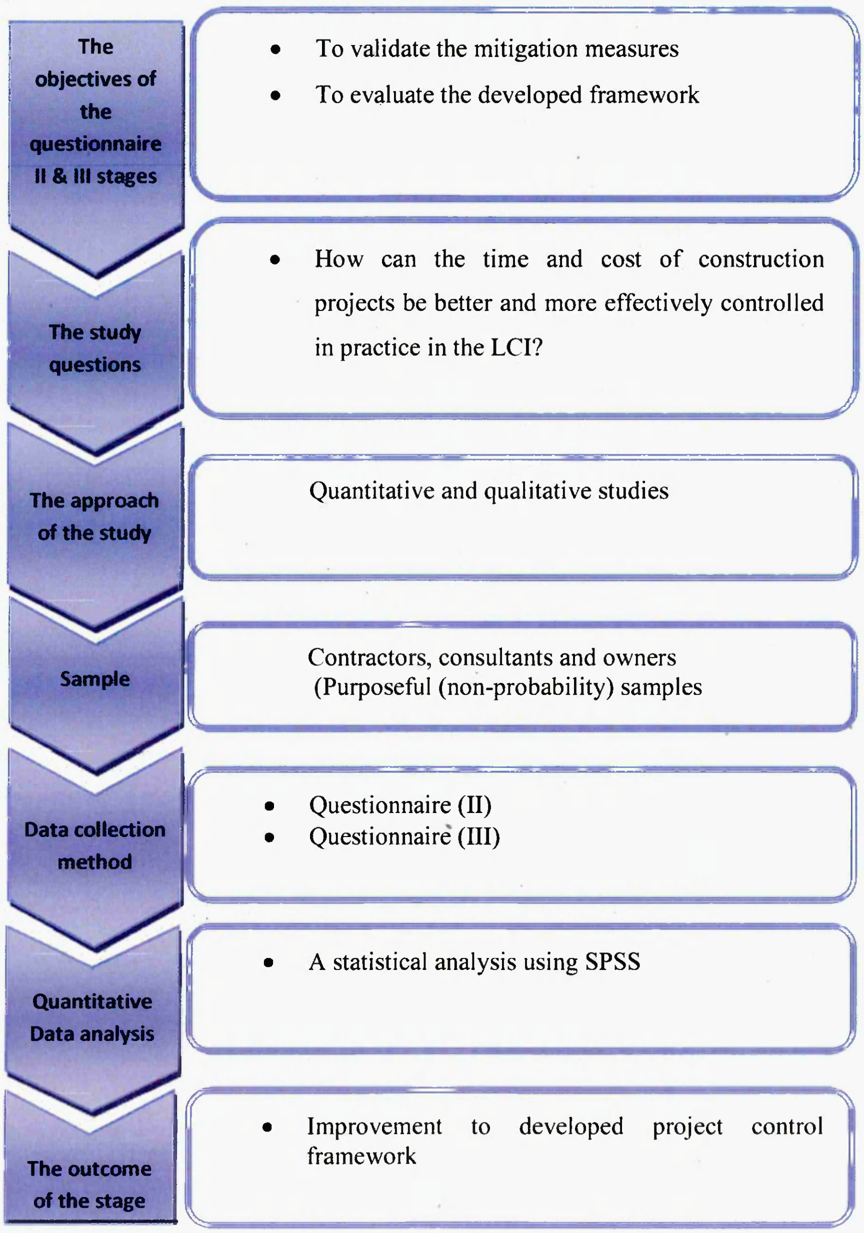


Figure 4-6: The fourth Stage of the Data Collection Phase

4.6.3 The Framework of the Research Study

Building a theoretical framework for research forces the researcher to think carefully about the constructs and variables to be included in the study (Miles and Huberman, 1994). Firstly, it is important to define the meaning of the term "framework" in the context of this study. Some researchers define it as a sound implementation plan helping the researcher to become familiar with the study context, what has been done, what she or he is trying to do and how he or she is going to do it, and identifying gaps in the research to date. The framework adopted in the present study covers strategic decisions including the choice of data collection and data analysis method in order to achieve the research objectives. The major methods of conducting the present research are:

- Literature review, which play an important role in the research process as it allows the boundary of knowledge and of the research topic to be identified and the research problem, questions, aim and objectives to be formulated.

- Data collection through questionnaire (I) survey to determine time and cost overrun levels in Libyan construction projects, the factors influencing those overruns, also to recognize the tools and techniques that currently being used by Libyan projects to control the cost and time.

- Data collection through semi-structured interviews to explore construction industry professionals' perceptions of the important process of construction time and cost control and to recognize the obstacles which affect this process of cost and time control in practice and subsequently establish measures that will assist to mitigate the causes of cost and time overruns in Libyan construction projects in order to develop a framework that will guide the Libyan construction project to the successful adoption of project control.

- Data collection through questionnaires (II) & (III) to validate and re-validate the framework for controlling construction projects in Libya. Fig.4.7 represents the constructs of this research framework.

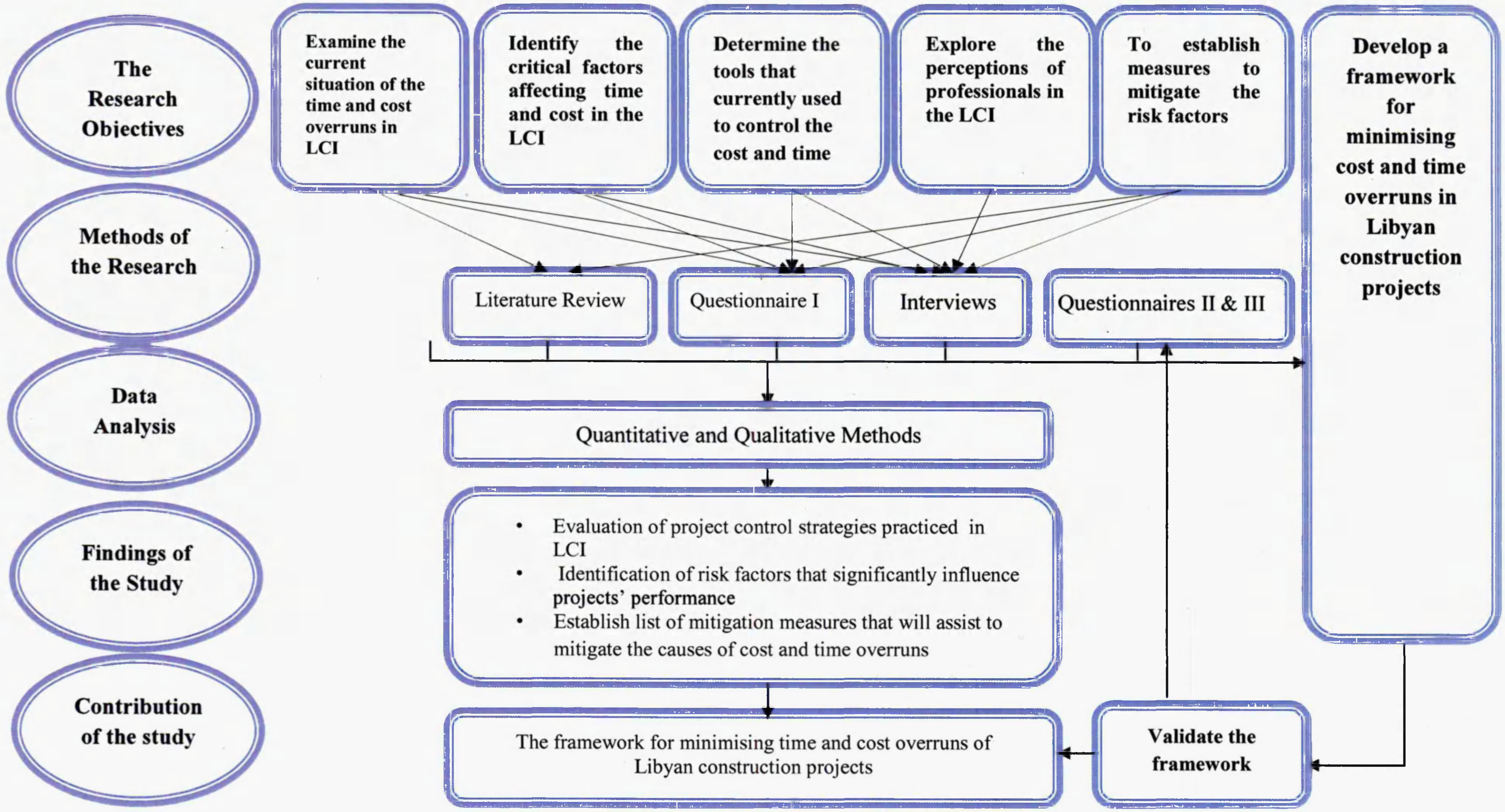


Figure 4-7: The Research Framework

4.6.4 Data Sample

It was decided that the sample population for questionnaire survey (I) would be construction project professionals in Libyan construction companies; contractors, consultants (Architects, civil & structural engineers, mechanical & electrical engineers and quantity surveyors) and clients.

The available data from (Association of Libyan Engineers' Magazine, 2010) showed that there were 4000 professionals cutting across academic institutions and construction firms in the country. A total of 132 responses were received from the participating companies/ professionals, with a response rate (33% of response rate). The size of Questionnaire Survey I sampling and the Questionnaire distribution is discussed in more details in Chapter (6).

Following the analysis of questionnaire survey (I), the semi-structured interviews were conducted to verify out some of the ambiguous matters that the researcher was unable to put forward in the questionnaire (I). The selection of interviewees was based on the positions they occupy in their organisations and their experience in the construction field. A total of 10 interviews were conducted lasting an average of 62 minutes aimed to investigate the research questions three, four, five and six. Finally, to evaluate the framework, the questionnaire surveys (II) & (III) were conducted with some experts of Libyan construction projects.

4.6.5 Data Analysis

The purpose of analysis is to obtain meaning from data. It is currently most common for collected data to be input into a computer package for analysis. That inputting is in addition to recording, transcribing, coding, classifying and other manipulations of data that may be necessary to facilitate analysis. Each and every process relating to data must be done accurately and with integrity; that is vital wherever judgements are involved (Fellow & Liu, 2008).

Triangulation can increase completeness when one part of the study presents results that have not been found in other parts (Ammenwerth et al., 2003). To investigate each objective from different perspectives, triangulation is used in the data analysis phase.

4.6.5.1 *Quantitative Data Analysis*

Quantitative content analysis extends the approach of the qualitative form to yield numerical values of the categorised data-ratings, frequencies and rankings, which may be subjected to statistical analyses. Comparisons may be made and hierarchies of categories may be examined. Structural content analysis concerns the determination and examination of relationships between data categories, as well as between groups where this is appropriate.

In this study, the quantitative dataset is analyzed using the statistical software package Statistical Package for the Social Sciences (SPSS). To clearly and methodically present and describe the data obtained, two main data analysis methods were used: Exploratory Data Analysis and Simple Correlation. Exploratory data analysis is used to describe the basic character of the underlying data; it shows the responses to a particular question and the number of respondents or the frequency of responses for each question. For the simple correlation, Spearman correlation is to be conducted. The data analysis methods will be revisited in the relevant chapter treating outcomes and discussion of the data, to clarify the research findings in accordance with the research questions.

To analyze the underlying data from the questionnaire (I), three principal phases are followed. The first phase of the analysis is implemented by recording of the responses for each question. The second phase of the analysis is based on categorizing each of the responses.

After the questionnaire responses are recorded and categorized, the results are organized and demonstrated in the table of results. For the final phase, the underlying data is transferred to statistical software; namely SPSS, in order to start the computations. For presenting and describing the data obtained clearly and methodically in accordance with the research question, data analysis is applied. In terms of data analysis, the aim is to answer the research questions.

The numerical scores from the questionnaire responses provided an indication of the varying degree of influence. To further investigate the data, a relative importance index (II) is used to rank the factors of cost and time overruns. This is calculated using the following formula: $\text{II} = \frac{\Sigma w}{AN}$

Where:

w = weighting given to each question by the respondents and range from 1 to 5 where 1 very low and 5 very high.

A =highest weight (5 in our case);

and N = total number of sample.

The RII ranges from zero to one.

4.6.5.2 *Qualitative Data Analysis*

Many qualitative approaches such as conversations and discourse analyses are not subject to particular analytic techniques with prescribed texts, as is common in quantitative analyses. Instead, they involve scrutiny of the transcribed text of such types of response as discussions and statements. Thus, not only is the content analysed but the linguistic context is considered, in order to establish the meanings, intentions and interpretations of the respondents. The emphasis in qualitative content analysis is on determining the meaning of the data, which are given coded allocations to categories. Groups of "respondents" from whom the data were obtained are matched to those categories, so that a matrix of categorised data against groups is obtained (Fellows & Liu, 2008).

In this study, a systematic approach was adopted in analysing the data obtained from interviews depicted in chapter (7). The process started with familiarisation of the data following transcription. After this familiarisation process, organisation of the responses, question by question was carried out followed by coding of the transcripts. Data were categorised using predetermined themes, and by discovering specific topics that emerged from the data. This was followed by the analysis of interviews where an index was devised for similar themes and concepts. Finally, the development of a diagram was produced in order to present the findings from the interviews.

4.7 Research Design Evaluation Criteria

Principally, validity can be defined and described as the degree to which a given test (e.g. questionnaire, interview, observation, experiment) measures what it is supposed to measure (David and Sutton, 2004). In this particular research, which employed questionnaires and semi-structured interviews as research instruments, validity is concerned with whether the questions presented ask or measure what they claim to ask or measure. Equally, it refers to whether the respondents, who completed the questionnaires and answer the interview' questions, do so accurately, honestly and correctly.

Reliability is concerned with whether a given research instrument yields the same results at different times over groups of respondents. In other words, it is concerned with consistency and reliability, precision and accuracy and dependability of the research instruments over time, over instruments and over the group of respondents (Robson, 1994)

4.7.1 Validity of the questionnaire

In order to ensure the validity and reliability of the questionnaire, all the necessary steps were undertaken. Firstly, the questionnaire was read and commented on by some experts, who have experience in the research field. Secondly, the questionnaire was translated in to Arabic by a professional translator. The purpose of piloting was to see the potential and limitation of a given research instrument on the sample research target. It helped to improve the research instruments and the data collection techniques before the main survey. Similarly, the purpose of piloting also helped to refine the chosen research instruments and the data collection techniques before. As such; the feedback received from piloting was useful, as it resulted in modification and removal of some question items.

In addition, during the piloting, the test items were tested for internal consistency. That means, the items must all quantify the same thing and must be correlated with each other. To measure internal consistency between the items, Cronbach's alpha is conducted. In other words, it enables the researcher to see how strongly related a set of items are as a group. Cronbach's alpha reliability coefficient ranges from zero to one. A high value of this measure is considered as indication that the items determine an underlying construct and reflects a higher degree of internal consistency. In terms of this study, the purpose, here, is to assess the validity of the designed items for each dimension using Cronbach's alpha. Table (4.1) showed the Cronbach's coefficient alpha was calculated for the category of time overrun factors of the questionnaire.

❖ Time factors

Dimension	Number of items	Cronbach's Alpha
Construction factors	33	0.870
Weather and Natural calamities	3	0.690
Equipment factors	3	0.738
Materials factors	6	0.785
Contractual procedures	4	0.726
Design change	3	0.659
Funding factors	4	0.706
Changes in Law Factors	7	0.834

Table 4-1:(Cronbach's Alpha) for evaluating the consistency of the time factors

As shown in the Table 4.1 above, it can be noticed that internal consistency of level of construction factor is relatively high (0.87), whereas it is acceptable (0.69) for views towards weather and natural calamities. Also, the values are good for the rest of factors. As result, all the items of the questionnaire show a good degree of internal consistency; and this means that the items are clear and will be incorporated in the study objectives. On other word, the researcher will not drop any question for the study.

- **Cost factors**

Dimension	Number of items	Cronbach's Alpha
Construction factors	33	0.903
Weather and Natural calamities	3	0.659
Equipment factors	3	0.789
Materials factors	6	0.792
Contractual procedures	4	0.692
Design change	3	0.752
Funding factors	4	0.678
Changes in Law Factors	7	0.738

Table 4-2:(Cronbach's Alpha) for evaluating the consistency of the cost factors

According to Table 4.2, the alpha is found to be very high, which is 0.903, for construction factors. The value of alpha for weather and natural calamities, contractual procedures and funding factors lies between 0.65 and 0.69 which is acceptable. For the remaining factors, the value of alpha is noted to be good (0.70-0.79). Overall, all the factors are consistent, and hence all the items are to be included in the analysis.

4.7.2 Validity of the interview

To ensure that the interviews covered subjects as fully as possible, the interview structure was piloted by conducting two interviews with professionals in Libyan organisations who provided their valuable comments which highlighted the importance of focussing on government strategies for project control and the barriers encountered in the process of cost and time control. In addition, these pilots helped the researcher to check for ambiguities in the questions and to get an idea of the times involved. As a result, this enhanced the subsequent interviews to obtain clearer, more specific and more reliable responses.

4.8 Ethics in research

According to Fellows & Liu (2008), research ethics is not only that a diversity of ethical theories exists but, further, that ethics means different things in different places and so, lead to differences in common, acceptable practices which may change over time. In addition, the ESRC (Economics and Social Research Council) (2007) in the UK defines research as " any form of disciplined inquiry that aims to contribute to a body of knowledge or theory" and continues that " research ethics" refers to the moral principles guiding research, from its inception through to its completion and publication of results and beyond".

Through all the research stages, ethical issues have been taken into account. This research uses highly confidential and private data. During and after this study the researcher also followed the ethical code of Sheffield Hallam University. The participants have been informed of the objectives of the study before being asked to answer the questionnaire and interview questions. They were also assured that their responses would be kept confidential. They were not asked to provide their names or that of their organizations, thus ensuring anonymity. Individual differences concerning understanding and interpretation of the research questions have been respected.

4.9 Summary

This chapter has discussed ethnographic, action research, survey and case study research methods. This was followed by a discussion of the quantitative, qualitative and mixed methodological processes used in this research. The present study is driven mainly by the study objectives, and is planned to answer the research questions. In this study, the researcher first examines the literature to derive an initial proposed framework for the adoption and implementation of a project control process from it. To identify the categories that populate the conceptual framework initially used an inductive approach, the study then uses an abductive approach because it is suitable for investigating the social context – in particular for comparing the way people perceive that context with the body of relevant theory.

The research framework was provided in Fig.4.7 to illustrate the research stages and the choice of data collection and data analyse methods to achieve specified research objectives and the study's outcomes. The research methods considered in this study are literature research, questionnaires (I), (II) and (III), and semi-structured interviews to develop a framework to minimise cost and time overruns in Libyan construction projects.

Literature review and questionnaires and semi-structured interviews play an important role in the research process, as they allow the identification of the boundary of knowledge on the research topic, and the formulation of the research problem, research study questions, the research aim and its objectives. Data are collected through questionnaire (I) in order to determine the levels of time and cost overruns in Libyan construction projects, and factors influencing cost and time overruns (through a questionnaire survey I). To develop a framework that will help Libyan construction projects successfully adopt project management, data is collected (through semi-structured interview questions) to establish construction industry professionals' perceptions of the importance of construction time and cost. Data analysis is carried out using Statistical Package for the Social Sciences (SPSS), as data analysis software package for quantitative and manually based on systematic manner for qualitative data.

Chapter 5 Theoretical Framework for Project Time and Cost Control

5.1 Introduction

Project management is not about predicting the future. It is about understanding a project and making better decisions regarding the control of that project in the immediate future. One of the objectives of this study is to develop a framework for minimising time and cost overruns in Libyan construction projects, and this chapter begins by contextualising this by means of a comprehensive overview of project control techniques in the construction industry. Later sections establish the initial proposed project time and cost control framework based on documentary analysis of previous studies and monographs.

5.2 Concept Definition of Project Control

At the present time concerns over risk have been rising due to the increase in technical complexity and the demand for political and economic viability in modern society. These concerns in turn generate a demand for more efficient project control. Nonetheless, despite the enormous development of information and knowledge, the majority of risk control is not planned, but only reflects a reaction to events after they have occurred. It is consequently necessary to organise project risk control.

In general, the aims of project risk control are considered to be geared towards identifying, analysing and responding to risks. Risk control must be broader than this, becoming integrated into the organisation and project environments as a means of providing safety measures against risks.

Risk control is a broad concept with no standard definition. The various definitions of project management all agree on the necessity for project control as an essential part of the definition of project management. The primary control areas of a project are quality, on time, and within budget. The Association of Project Management (1997) defines it as " the process whereby responses to the risks are formulated, justified, planned, initiated, progressed, monitored, measured for success, reviewed, adjusted and (hopefully) closed". For the British Standards Institute's "Guide to Project Management" (BS6079,

1996) it is "the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence". The Royal Society, the independent scientific academy of the UK charged with promoting excellence in science, is not directly involved in construction, but nevertheless defines risk control as "the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence" (1992). Another definition of risk control by the Construction Industry Research and Information Association (CIRIA) states that risk control should help to

- save money
- reduce accidents
- deliver projects to time
- reduce the chances of litigation
- improve the morale of employees
- enhance corporate reputation. (CIRIA, 2002)

A number of writers take project control as embracing certain functions. Flanagan & Norman (1993) state that project control is a discipline for living with the possibility that future events may cause adverse effects. They also suggest that a project risk control system must be practical, realistic and cost effective. In Ritz's (1994) view, project control is "the work of constraining, coordinating, and regulating action in accordance with plans to meet the project goals successfully. Hossen & Hicks (2000) define Project Risk Management (PRM) as the process of taking management actions with the aim of maximising the chance of achieving project objectives, taking into consideration all the risks that can be identified. Monitoring risk exposure and adjusting project strategy are key approaches to keeping the risks within an acceptable level and achieving the project's objectives.

Anthony Mills (2001) argues that project control is an important part of the decision-making process for all construction companies. Merna and Njiru (2002) summarise it as "any set of actions taken by individuals or corporations in an effort to alter the risk arising from their business". Harris & McCaffer (2006) see it as the process of managing uncertainty that arises in the normal course of activities, including those related to business ventures, while Young (2006) defines it as managing the numerous problems that arise in order to maintain the project schedule by supervising the work, that is checking what is happening; recognizing and determining the issues that arise, evaluating the plan and updating the records, and taking the action required to realise or exceed the objective. According to Baguley (2008) control of a project is "an implicit part of managing. It is applied to all sorts of things; people, costs, schedules, deliveries etc. when you control something your aim or objective is to make sure that the future you want actually happens! In addition to this it is a continuous process; forward looking; very closely linked with planning".

For Saleh (2010) it is a process designed to examine uncertainties occurring during project delivery and to implement actions dealing with those uncertainties in order to achieve project objectives. Wysocki (2011) points out that project control helps complete a project successfully by comparing the actual progress against the plan. It focuses on three major components of a project: time, cost and quality standards. Controlling the project:

- tracks progress toward completion
- detects deviations from the plan
- it takes corrective action (Gilley, 2001)

In short, the controlling function can be considered as the totality of actions and all organised processes intended to increase the probability of the successful achievement of a project's objectives, in particular regarding schedule and budget. Project control involves the coordination and development of plans, cost and schedules for a project, the obtaining of the pertinent approvals from the responsible managers and participants, and the checking, monitoring and preparation of forecasts or actual expenditures, trends and progress against figures and established plans.

5.3 Project Cost and Time Controls

5.3.1 Project cost control

Well-designed systems of cost control that conform with the board spectrum of the capital projects industry have been developed over the years. According to Ritz (1994), in spite of the simple name of cost control, it means different things to different people. To Ritj, cost control means "the purposeful control of all project cost in every way possible". The control system of a project should involve some feature that ensures the successful implementation of such aspects as:

- A simple system with a complete code of accounts
- The assignment of certain responsibilities in the project's organisational structure regarding cost control
- The utilisation of standard formats and forms based on a standard code of accounts throughout the estimation, construction, design, procurement and cost-control groups
- A sound budget (based on sound estimates)
- A developed system for managing the date on medium and large-size projects

Greenhalgh & Squires (2011) see cost control as the activity that compares actual cost or expenditure against planned costs, adjusting one or the other dynamically by reference to the project's financial environment. The cost control process guarantees that all the relevant parties in a project agree to any changes to the cost baseline.

The main purposes of using a cost control system are:

- To provide instant advice of uneconomic operations, in the short and long term of work
- To give the appropriate feedback, carefully qualified in detail by all the conditions under which the project work has been done
- To provide information to help in the assessment of those variations that will arise during the period of the work

- To support cost awareness
- To summarise progress of work. (Pilcher, 1985)

5.3.2 Project time control

Time control of project work is also often referred to as schedule control. To control the schedule, progress must be monitored against the schedule, taking into consideration that every specific task must be weighted according to its percentage of the whole project. According to Phillips (2006) time/schedule control is concerned with the three following processes:

- The project manager works with the factors that can cause schedule changes and confirms that these changes are agreed. Factors can include project team members, stakeholders, management, customers and the project's condition
- The project manager examines the work results and conditions to determine whether the schedule has changed
- The project manager manages the actual changes in the schedule

Schwalbe (2010) states that the main causes of changes to a project's schedules are:

- the project schedule management plan
- the project schedule baseline
- work performance reports
- changing requests

The main outputs of time/schedule control include:

- project work performance measurements
- organisational process assets updates, such as lessons-learned reports related to schedule control
- changing requests
- project management plan updates
- project document updates

In short, control of the work schedule is maintained by monitoring work-in-progress and planning future tasks. The purpose of schedule control is to identify the status of the project work schedule, defining the factors that cause schedule changes, and controlling changes in the schedule.

5.4 Tools to Control Project Time and Cost

The control of project time and cost represent forward thinking in how work is to be carried out. This includes checking on work progress against programme; and identifying problem areas in progress in order to consider any action required. Several progress-reporting techniques can be adopted that are commonly used in practice. Each has a specific purpose generally distinguished by the type of information being communicated. The following section concentrates on the various tools or techniques that are used to monitor the progress of activities and avoid time and cost overruns of a project.

5.4.1 Bar Charts

Bar charts are the single most popular information presentation tool for project control. They are also called Gantt charts. They are a way to graphically show progress of a project. Gantt charts are used to present information to management, team members, and customers at a variety of different levels. Bar charts show when the project is and each activity start and end against a horizontal timescale. A Gantt chart consists of a list of project activities, coordinated with a horizontal bar chart to reflect activity duration. The quality of the Gantt chart is firmly rooted in quality inputs about the following:

- Project scope
- Responsibilities
- Available resources
- Schedule management system

According to Ritz (1994) Bar charts (Gantt charts) are the simplest form of scheduling and have been in use the longest of any of the systems that are available. They offer the advantage of being cheap and simple to prepare; they are easy to read and update, and they are readily understood by anyone with a basic knowledge of the capital project business. The main disadvantage of the bar chart is its inability to show enough detail to cover all the activities on larger, complex projects. However, many contractors use them for all stages of programming, including large and small projects (Griffith et al., 2000). Bar charts are widely used today for project scheduling because they are relatively easy to construct and are the best diagramming technique to visually represent activity progress in the project. Patrick (2004) suggested that the main advantages of Bar charts are:

- Simple and quick to generate
- Easy to use and interpret
- Great communication tool at all organisational levels
- Project plan and schedule can be shown together
- Project progress can be represented graphically

Meanwhile the main disadvantages of Bar charts are:

- Planning and scheduling are considered simultaneously
- Not easily modified
- Do not show activity dependency relationships
- Awkward for large projects

5.4.2 Element trend analysis (Line of Balance)

According to Badiru (2008), LOB is a graphical method of scheduling; and it focuses on critical activities. It identifies points that do not conform to expectations and drives corrective actions. It also encourages the management by exception approach to handling project problems. The main objective of LOB is to develop a report on the progress of a project. The requirements of LOB are to achieve the following:

- Identify objectives
- Establish a plan to meet the objectives
- Measure progress against the plan

Harris and McCaffer (2006) suggested that the basis of the LOB method is to find the required resources for every phase or process of a construction project so that the following phases are not interfered with and the target output can be achieved. Hamilton (2001) further explains that LOB charts fill a void between bar charts and the preferred scheduling method of network schedules:

- They are easier to prepare than a network schedule;
- They provide more information than a bar chart
- Each line on a LOB chart indicates the rate of progress of an activity; the intention is to keep all activity progress lines as close and parallel as possible
- Simplicity in conveying a detailed work schedule

5.4.3 Critical Path Method (CPM)

The critical path method is a management tool that is used to predict total project duration and helps the project manager recognise where in the project schedule his or her management effort should be applied. The critical path method involves of series of activities that determines the earliest time by which the project can be completed and the longest path through the network diagram, which has the least amount of slack time. If any activity on the critical path takes longer than planned, then the project schedule will slip unless corrective action is taken. According to Badiru (1996) & Patrick (2004), the network of activities contained in a project provides the basis for scheduling the project. The basic project network analysis is typically implemented in three phases:

- Network planning: this involves the identification of the relevant activities for the project
- Network scheduling is performed by using forward-pass and backward-pass computational procedures
- Network control: involves the progress of a project on the basis of the network schedule and taking corrective actions when needed. The overall process of this method is summarised in the steps below:

  Step 1: Activity Planning: define the tasks or activities making up the project and determine their interdependencies or precedence relationships

  Step 2: Activity network drawing: represent the tasks or activities that were defined in previous step in the form of a network diagram

Step 3: Basic scheduling: perform the basic scheduling computations through forward-pass and backward-pass rules

Step 4: If the project analyst is interested in determining the cost of reducing the project length, time-cost trade-offs analysis should perform

Step 5: Constrained resource allocation: to completing tasks or activities in the project, limited resources should allocating

Step 6: Resource levelling: to reduce period-to-period fluctuations in resource requirements, activity shifting or arrangement should perform

Step 7: Control phase: the project progress and performance are monitored by comparing the actual project status to the prevailing schedule

5.4.4 S-curve

The S-curve is a tool for helping with the conceptual understanding of the project. The S-curve figure represents the project budget baseline against which actual cumulative budget expenditures will be evaluated. The figure also represents project progress: slow at the start, a subsequent pickup of momentum, a tailing off at the end. According to Venkataraman & Pinto (2008), the S-curve helps project managers understand the correlation between project duration and budget expenditures, and provides a good sense of where the highest levels of budget spending are likely to occur. Forecasting the S-curve can also help project managers generate estimates of expenditures during various stages of project duration.

The cost curve is called the S-curve named for the characteristic shape of the curve that plots the distribution of project cost as a function of time. Knapp (2010) suggests that, to make a cost management plan useful, the accumulated cost of the project must always be available by looking at the cost baseline, which is displayed on the S-curve. The stakeholders can then compare the approved budget to the cost baseline to determine if the project costs are on target.

The cumulative cost curve is valuable because:

- it can help the project manager see the total planned budget and communicate it in a shorthand way
- It can serve as an excellent briefing tool because most people can easily read the graph.
- It can also serve as an excellent way of summarising progress, since both planned and actual cost curves can be tracked on the same graph for comparison purposes. Taylor (2008)

However, Rubin *et al.* (1999) state that the S-curve does not show the causes of the differences between the planned and actual spend although the intended S-curve can give some rough idea of progress; it is not as accurate as the CPM, but it is more accessible.

5.4.5 Graphical Evaluation and Review Technique (GERT)

Graphical Evaluation and Review Technique is a network analysis methodology that allows for non-sequential activities, such as loops (e.g., a test that must be repeated more than once) or conditional branches (e.g., design update that is needed only if the inspection detects errors). Harrington (2006) pointed out that this technique allows for a probable treatment of both work networks and activity duration estimates. The processes employed in using Graphical Evaluation and Review Technique are as follows:

- Conversion of the qualitative description of the project action plan into a network.
- Collection of the necessary data to describe the arc of the network, focusing not only on the specific activity being modelled, but also on such characteristics of the activity as the likelihood it will be realised, the chance it might fail, any alternative activities that exist, and the like.
- Determination of the equivalent function of the network.
- Conversion of the equivalent function of the network into the following two performance measures: the probability that specifics nodes are realised and the moment generating function of the arc times.
- Analysis of the result and making of inference (Meredith and Mantel, 2000).

According to Longman & Mullins (2005), the network technique has the advantages of allowing you to omit certain portions of the network, complete certain work packages partially, or repeat certain work packages several times. This technique allows for looping, in which the network path passes through the same node more than once. It also allows for branching in which the network path can split in one of two or more directions depending on the results of an event or work package. De Marco (2011) suggested that GERT is a network modelling for high-complex projects where CPM or PERT are unsatisfactory to provide an accurate scheduling under uncertain conditions, ongoing decision making and process options

5.4.6 Programme Evaluation and Review Technique (PERT)

Programme Evaluation and Review Technique is another method used in monitoring, controlling and managing of projects. The PERT method of critical path planning and scheduling is the most commonly used technique for project management control. It is based on representing the activities in a project by boxes (or nodes) that contain essential information calculated about the project (Young, 2007).

Dhillon (2002) point out that, in basic theory, CPM and PERT are largely the same. For both methods, the arrow diagram is the graphic model and the mathematics is also quite similar. However, their important differences are as follows:

- CPM is used in situations where the duration times of activities are quite certain (e.g., in construction projects)
- PERT is used in situations where the duration times of activities are quite uncertain (e.g., in research and development projects)

Dhillon illustrates the general steps associated with Programme Evaluation and Review Technique is as follows:

- Break down a given project into various jobs or tasks and identify each of these jobs or tasks.
- Determine the sequence of these jobs or tasks and develop a network

- Estimate the duration time of each activity
- Obtain each activity's expected duration time
- Determine the time variance of each activity
- Determine the network's critical path
- Calculate the probability of project completion on a given time or date.

According to Young (2007), Programme Review and Evaluation Technique (PERT) is a valuable tool of project management. This technique allows analysing the logic diagram to confirm:

- The critical path-confirmation of your inspection;
- The start and finish times of all the key stages;
- The amount of "spare time" available in the non-critical key stages

All these data are very useful for optimising the project schedule and, more importantly, for the control of the project work once this starts. In addition, Tiku (2002) suggest that the most useful results of PERT without doubt are the analytic and critical approaches it brings to bear on a project being examined for the first time; the initial review of a project by PERT is probably the most useful attribute. For time planning and resource planning, PERT is an excellent practical device. For cost planning and more elaborate resource planning PERT is even more useful, but probably requires a greater understanding to fully succeed in presenting information in a digestible form. Fay (2011) concluded that the central idea of PERT is to manage a project step by step from beginning to end in the shortest time possible

Meanwhile, Bidgoli (2004) suggested that the main disadvantages of PERT are that it attempts to address the risk associated with duration estimates. PERT has three disadvantages:

- It involves more work because it requires several duration estimates
- There are better probabilistic methods for assessing risk (such as Monte Carlo simulation)
- It is complex and rarely used in practice

5.4.7 Arrow Diagram

In the Arrow diagram, activities are representing by arrows and events. The arrow is usually drawn from left to right, with events drawn as circles at the beginning and end of the arrow.

According to Dale (2003), this method applies systematic thinking to the planning and execution of a complex set of tasks. It is used to establish the most suitable plan and schedule for a series of activities in a project, and to monitor its progress in an efficient manner to ensure adherence to the schedule. The key steps in constructing an arrow diagram are:

- Identify all activities needed to complete the plan
- Decide the feasible sequence of the activities:
  - Which activities must precede certain activities (consecutive activities)
  - Which activities must follow an activity (consecutive activities)
  - Which activities can be done at the same time (concurrent activities)
- Arrange the diagram from left to right according to the above logic with each activity represented by an arrow
- The beginning or end of an activity or group of activities is called an event or node and these are represented as circles at the tail and head of an arrow. The events should be numbered in the order in which activities occur.

According to Newell (2005), the one advantage of this diagramming method is that, since the arrow is a line, the length of the line can be varied in proportion to the duration of the activity. This can be helpful in recognising the magnitude of the duration of the activity. However, most project management professional feel that the complexity and difficulty in using this diagramming method is not compensated for by this feature.

5.5 Project Control Framework

This section discusses the theoretical aspects of project cost and time control in detail and discusses the practices based on previous studies in controlling the construction project process.

5.5.1 The Purpose of the Project Cost and Time Control Framework

The project framework is a sound plan for execution that identifies what the organisation should do, describes how it is going to do it, and ensures that every step of the project work builds on the previous one (Struebing and Klaus, 1999). Therefore, in order to achieve the project objective, the framework describes an implementation of procedures and processes for what works need to be done and how to carry those works out in good time and cost project control.

Aalbregtse et al. (1991) suggest that the main characteristics of a project control framework are:

- It supports the application of management work standards and makes it more likely that the implementation of management standards will be successful.
- The organisation and implementation of the framework make the participants more aware, and it can be adopted in much more controlled, comprehensive and timely manner.

Najmi, Kehoe, & Dennis (2000) state that the main advantages of a framework are:

- to provide a guideline
- it is result-oriented
- it is empirically supported and based on the literature
- it is time dependent
- it is oriented towards continuous development

In short, using a structured framework serves to improve construction performance by reducing waste activities in project work. The framework also provides a guideline for project risk management in order to ensure the efficiency and effectiveness of work activities during changes in construction projects. Nevertheless, the framework for project cost and time control should be adaptable and flexible in order to meet the specific needs of each stage of the project. By implementing such a framework, the project workforce will identify their needs and responsibilities, monitor progress and provide information on cost and implementation of project work according to schedule.

5.5.2 Framework for Project Time and Cost Control

The framework is about the procedures and practices necessary to attain a particular objective. As pointed out earlier, project control is a broad concept with no standard definition: different researchers take it to mean different things. They generally see project control as embracing certain functions. A systematic approach to project control consists of three stages: risk identification, risk analysis and evaluation, and risk response. Some writers have divided the approach into four categories: the identification, classification and assessment of risk, and the response to it.

The literature review shows that project control is broadly accepted as an approach that consists of official processes. Many writers have provided the perspectives offered by efficient frameworks for project risk control of construction processes and practices. The most common methods of handling cost and time overruns in the construction industry are initiation, planning and control throughout the projects' life, as detailed in following sections.

5.5.2.1 The Framework for the Project Cost and Time Control Process

In order to control the time and cost of construction projects, the proposed framework would help to determine the appropriate actions to minimise time and cost overruns in construction projects. The needs of a framework for project control have been described above. The proposed framework is intended to identify the needs of the project workforce, monitor progress and provide information on cost and schedule implementation of project work. Within the framework it is very important to build a structure according to experience and attempts at supporting construction companies' projects in their performance.

To increase the potential for a project's success, a framework design must at least:

- Provide efficient data gathering on the methods and processes of construction projects.

- Provide a series of logical procedures based on a general problem-solving approach.
- Select the appropriate methods and tools to complete the improvement activities process during the project.

The project control process is an important and necessary part of performing the project. According to Gido & Clements (2009), project management is a proactive approach to managing a project in order to ensure that the project's objectives are achieved even when things are not proceeding according to plan. There are various types of existing framework that can be use by projects to control cost and time. The main steps of controlling of a project as stated by many researchers are discussed in the following section.

5.5.2.1.1 Process of Project Control

To measure a project's performance, and accurately and correctly evaluate project work, the implementation of a project control system is essential. The process of project risk control is composed of the steps that keep the project work on target to achieve the objectives. Ritz (1994) presents the basic mechanism of the management function (see Fig 5.1).

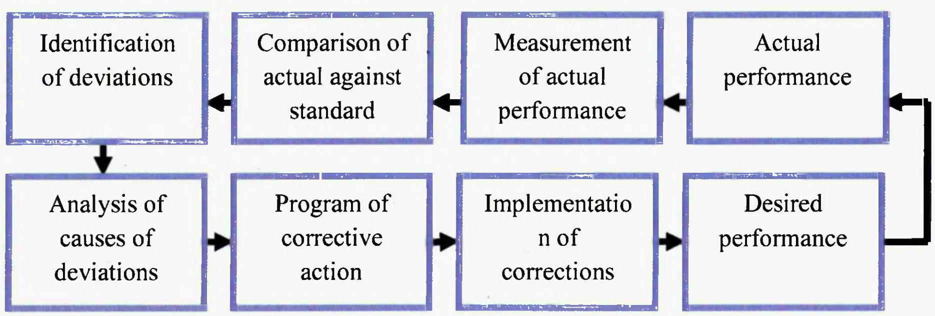


Figure 5-1: The Control Process (Ritz, 1994)

According to Peter and Pinto (2007), the common process of project control in the US has been stipulated by the U.S. Departments of Defense. It consists of five basic steps: risk strategy, its identification and analysis, and the response to and control of it. This process is shown in Fig.5.2.

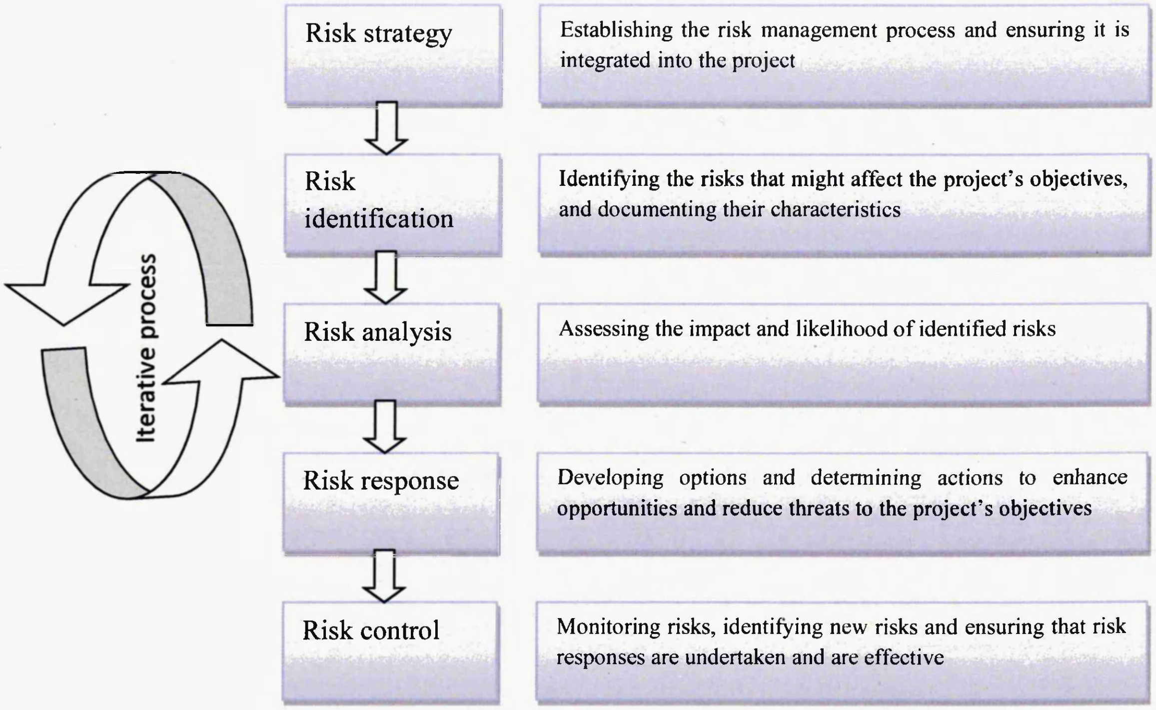


Figure 5-2: The Process of Risk Management (Peter & Pinto, 2007)

For Vancataraman & Pinto (2008) the project risk control process measures project progress and performance against a project plan to ensure that the project is completed on time, within budget and to the satisfaction of the customer as shown in Fig.5.3. The process of project risk control is intended to:

- Provide the essential features for measuring performance of project work. To achieve this, the process must establish a project baseline plan. The project team should lay out each of the discrete tasks such as budgets, resources and time-phases of all work in order to create this baseline plan.
- Measure and monitor improvement and performance of the work being undertaken. For project measurement, the first step in creating accurate mechanisms is the establishment of a control system that measures the ongoing status of different project activities in real time, and provides project managers with relevant information as quickly as possible. The second step is to determine what should be measured. For project monitoring, both qualitative and quantitative means are used to measure progress.

- Compare actual work performance against the plan. It is known that the smaller the deviation between the actual performance and the baseline plan, the easier it is to take appropriate action.
- Take corrective action. In some project work, the action required may be relatively small; in others, it may need significant and serious corrective measures.

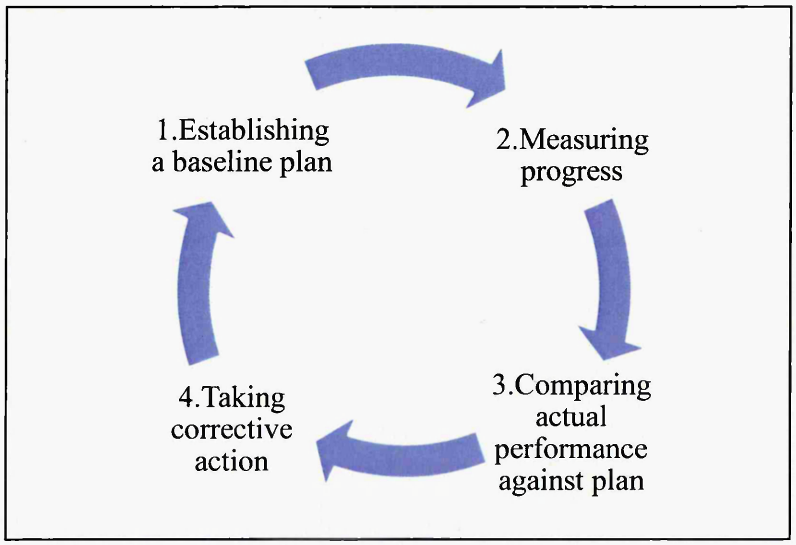


Figure 5-3: The Project Control Process (Venkataraman & Pinto, 2008)

Jalote (2008) states that the three main levels of monitoring are:

- Activity-level monitoring, which guarantees that each separate scheduled activity has been performed correctly and to the specified time.
- Status reports are often organized each week to take stock of what has happened and what still needs to be done. The reports usually include a summary of the activities successfully achieved since the last report, any issues in the project that need attention and any activities that have been deferred, and to determine whether all activities are in place for the following week. The aim of status reports is to ensure that the project is proceeding according to schedule.
- The milestone analysis is done every few weeks or at each milestone.

He concludes that the aim of project measurement is to provide information to project management about progress, so that they can effectively control and monitor the project and guarantee that its aims are met.

Baguley (2008) stipulates that the actions constituting work must be:

- Appropriate to the project, its stakeholders and its results
- Proportionate to the size of the observed deviations from the budget or the work plan
- Quick acting and prompt to guarantee that variation does not get out of project control
- Cost effective to guarantee that the cost of project control doesn't overrun
- Ability of results that go against the factors that are guiding the project off-course and their causes

Harpum (2010) maintains that project control is basically about managing development cost, development time, and resources of organisations in the most efficient manner. It is essentially a set of processes that work together to reach the project's objectives. The process of project control interacts with other parts of the project management process. Planning, measuring, monitoring, and taking corrective action are all usually included in the control cycle. The standard of project control processes, based on measuring progress against the plan and utilizing a negative feedback loop to ensure appropriate control inputs, is shown in Fig 5.4.

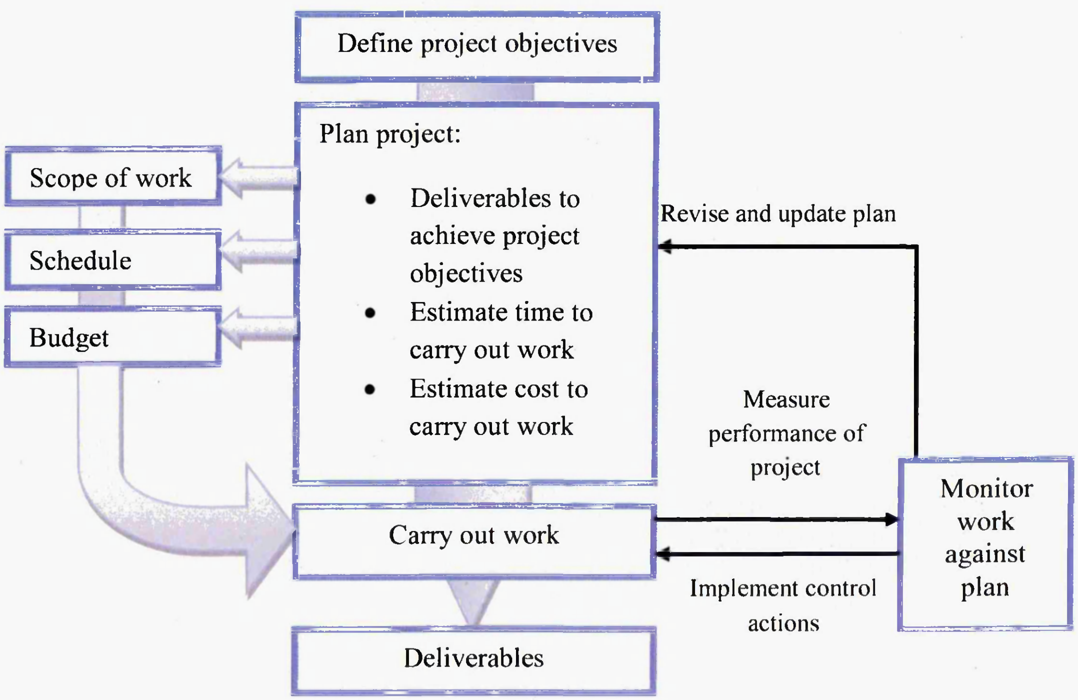


Figure 5-4: Standard Project Control Processes (Harpum, 2010)

In Mubarak's (2010) view project control comprises the following continuous process:

- Monitoring the progress of project work
- Comparing the progress with the baseline budget and schedule
- Identifying deviations, determining their extent and location, and analysing them to discover their causes
- Taking corrective action wherever and whenever necessary to bring the project back into conformity with the schedule and the budget

According to Camilleri (2011) a control process takes into consideration a wide range of activities and incorporates a number of key activities:

- Generating a network of actions that depicts the relationship between them and their order of occurrence
- Project scheduling that links a plan into a time frame as well as smoothing out resource level variations
- Measuring job progress, reviewing the plan and rescheduling when conditions change

To meet the performance objectives outlined in the project management plan, monitoring involves reviewing everything in the initiation, planning, execution and closing processes (Heldman & Mangano, 2011).

The frameworks designed by Ritz (1994), Peter & Pinto (2007), Vancataraman & Pinto (2008) and Harpum (2010) have the same cyclical steps of project work control. The first framework designed by Ritz (1994) starts the cycle by measuring actual performance, which is then compared against planned performance. The next step is analysing the causes of deviations, if there are any, after which corrective action is formulated and implemented if required to correct such deviations. The cycle is then repeated until the deviation has been "tuned out".

The process proposes a formal application of risk management in the US. In Peter & Pinto's (2007) view projects are typically undertaken within demanding timeframes. In such circumstances there is a temptation to deal with risk reactively, which means with its actual consequences; there is no opportunity to mitigate or even avoid the risk.

It is important to note in Venkataraman & Pinto's (2008) framework that this monitoring and control process is not a one-time fix, but a continuous cycle of goal setting, measurement, correction, improvement and re-measuring, as shown in Fig.5.3.

The fourth framework designed by Harpum (2010), as presented in Fig.5.4, shows that the standard of project control processes, based on measuring progress against the plan, utilises a negative feedback loop to ensure appropriate control inputs.

Previous standard processes for project control provide a suitable approach to providing an overview of the existing practices in construction procedures, especially in terms of cost and time overruns and problems based on frameworks for projects control as described above, because these frameworks present all the steps involved in project control and describe the methodology of project control by which construction performance procedures and processes in general are carried out.

5.6 An Initial Proposed Project Control Framework

The researcher state that it is good to refer to other practices because it will help in finding a better way or develop new ways to achieve the best results. The discussion above has been focused on the practices as suggested by several researches and writers to carry out project time and cost control to reduce the time and cost overrun problems, consequently, all the project work could be completed on time and within budget.

The present initial proposed framework for project control design is based on previous studies; other practices regarding project cost and time control are derived from the findings in the literature. The initial proposed framework is presented in Fig.5.5. First, the researcher organized the processes of project control that have been identified from the literature into phases. Every phase of the initial proposed framework is represented in a list of a mix of proven project control practice worldwide. The initial proposed framework suggests that the process of project control includes:

- Planning phase: identification of cost and time schedule is very important when conducting the plan. Therefore, the framework at this phase suggested include the project activities such as identification of the right people and the availability of right resources for the various tasks when needed in order to help control cost and time effectively which results in completing the project as planned.

- Implementing and execution phase: this phase relies heavily on the project plan developed in the planning phase. The process of executing branches down to the monitoring, evaluating and taking corrective actions phases. The execution process is not a one-time fix, but a continuous cycle of goal setting, monitoring, evaluating, correction, improvement and re-evaluating. It is worth mentioning that the initial proposed project control framework referenced to that during the project execution phase the project plan must be revised and updated when necessary.

The researcher's aim was not only the organization of processes into phases, but also the inclusion of some more widely used practices regarding the country that is the subject of this study in order to fit with the situation of the construction sector in Libya and to make the framework more realistic and applicable. Therefore, the study subsequently will combine theory and practice through a literature review and the involvement of practitioners in an attempt to develop the initial framework for minimizing cost and time overruns in Libyan construction projects.

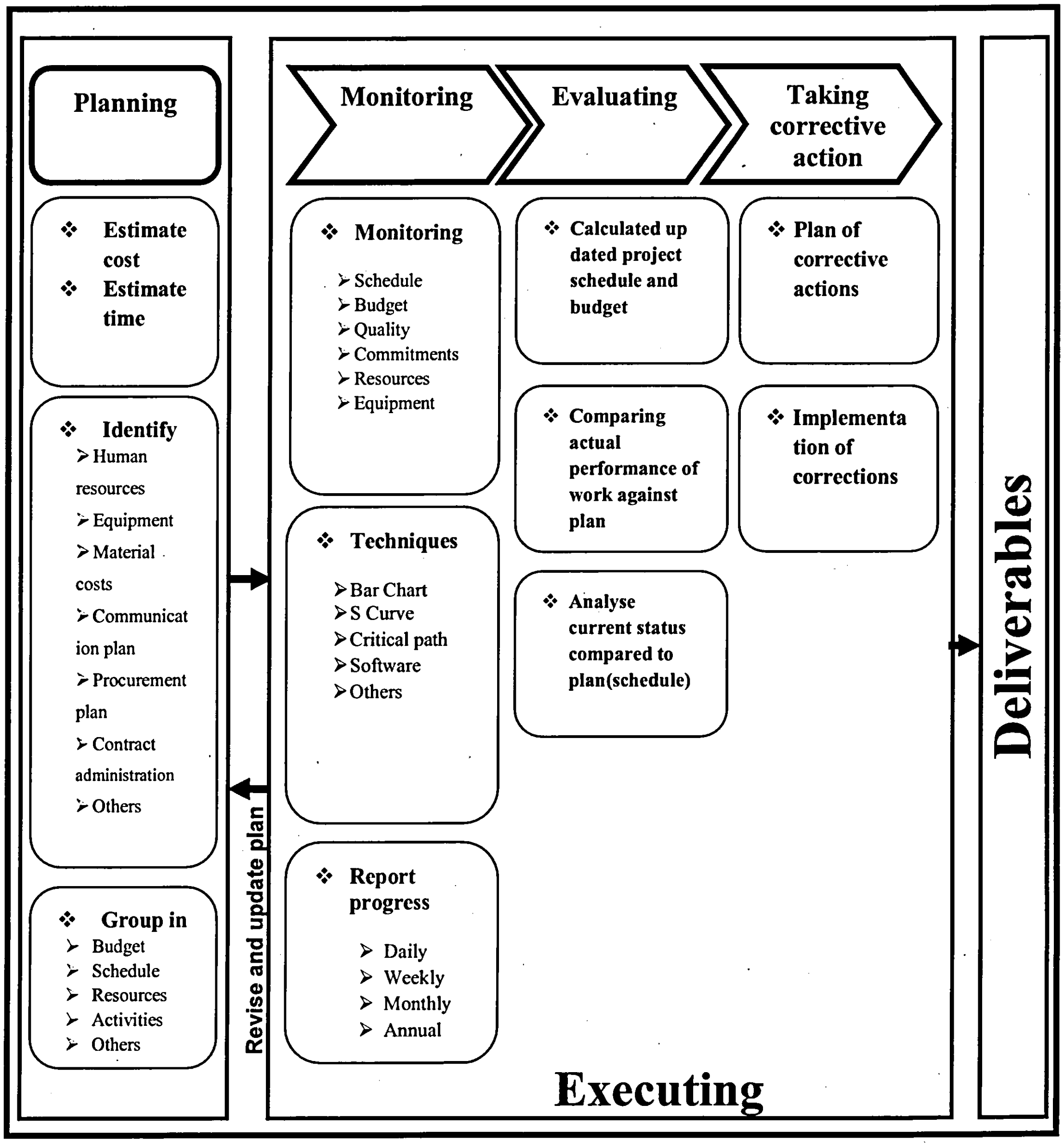


Figure 5-5: An Initial proposed Project cost and time control Framework

5.7 Summary

The chapter has identified various definitions of project control that all agree on the necessity for project control as the process of identifying risks, estimating their possible consequences and determining the most effective ways of responding to them and/or controlling them.

The chapter has defined the framework and detailed its purpose, and has extensively examined the theory of project time and cost control and management. It has also presented those practices involved in project cost and time control outlined in previous studies that could be of use in designing the author's proposed framework for construction project control. This framework is based on the four processes in project control: planning, monitoring, analysing and taking corrective actions.

Further development of the initial framework for project (cost and time) control will be based on the questionnaire and interviews participants' responses regarding their perspectives on current Libyan practices regarding cost and time control, which serve as reference points in the development of the proposed framework.

Chapter 6 Quantitative Study (Questionnaire Survey I)

6.1 Introduction

This chapter focuses on describing the process of data collection and data analysis that was adopted during the first quantitative stage of this study. Questionnaire Survey I was used to collect data on cost and time overruns from a large sample population involved in Libyan construction projects, in order to generalise from the data collected.

This chapter seeks to present the results and discussions from Questionnaire Survey I from the viewpoints of owners, consultants and contractors of Libyan construction projects on cost and time overruns. A survey questionnaire I with some of Libyan construction professionals aims to gather information, as well as determine the factors that influence such time and cost overruns. Questionnaire survey I also focuses on the identification of the methods used to determine the time and cost of the activities involved in construction projects in Libya. The findings of Questionnaire Survey I have been taken forward into the development of the proposed framework for the effective implementation of cost and time control in Libyan construction projects.

6.2 Questionnaire I Approach

The quantitative study for this research was carried out first through the survey questionnaire I. This questionnaire was intended to gather information from Libyan construction professionals, as well as to determine the factors influencing time and cost overruns in Libyan construction projects. This stage of the research also identifies the methods used to determine the times and costs of activities involved in construction projects. The findings are used to inform the development of the framework for the effective implementation of cost and time control in the LCI.

6.2.1 Justification of the selection of the questionnaire survey method of data collection

The present researcher's intention was to gather enough data to satisfy the research objectives and to give the reader a full picture of the phenomenon being studied. The survey methods were chosen with this purpose in mind. The survey questionnaire is one of the most important sources of information for quantitative research (Collis and Hussey, 2003). It is considered as the most suitable and productive method of answering exploratory questions related to a particular context (Galliers, 1992). The selection of the data collection method is highly significant, since it impacts on research survey design and the quality of the data collected. The selection of the data collection tool has been influenced by sample size and location.

Questionnaires are usually administered in a structured format on paper or through computer networks. According to Oppenheim (2003) they must elicit all the information desired by the researcher, should not be biased and should be easy for the respondent to understand. He also suggests that the content must be presented clearly and that the words used should be suitable (Oppenheim, 2003).

The questionnaire as a data collecting instrument has the following advantages:

- It allows for the collection of significant amounts of data and is capable of covering large sample sizes and geographical areas
- It examines the perceptions of the sample
- It is cheaper and less time consuming than interviews
- It is quicker to administer, since self-completed questionnaires can be sent out by post or otherwise distributed in very large quantities at the same time
- There is no variability related to the same question being posed differently to different respondents by the interviewer
- It is suitable for statistical analysis because the raw data collected can be easily interpreted using various types of statistical method
- It permits anonymity
- It is relatively inexpensive
- It is a very useful data collection tool, as it can be used to gather specific, key pieces of information
- It is convenient for respondents
- Respondents have time to check facts and think about their answers
- Its format is structured

On the other hand, it also has disadvantages: it is, for example, open to misinterpretation. It can lack clarity, and the response rate can be low. Dillman (2000) points out those respondents may be deterred from answering personal questions of, say, a sexual or financial nature, thereby affecting the response rate. Bryman & Bell (2007) and Collis & Hussey (2003) argue, however, that careful design can ameliorate these weaknesses.

In this study, the personal distribution of the questionnaire has been chosen as the most appropriate distribution method, for the following reasons:

- The method is the most commonly used data collection technique in construction management research
- A large number of professionals can be surveyed easily
- This approach is widely used in Libya, so respondents are familiar with it
- In the context of Libyan culture, respondents are less likely to respond to survey questionnaires sent through the mail by people they do not know
- The problem of poor response rates can be reduced by handing questionnaires directly to respondents
- The highly complicated postal addresses in Libya means that non-receipt of postal questionnaires is quite likely

6.2.2 Piloting the questionnaire I of the study

According to Dillman (2000) the pilot study plays an important role in the questionnaire. A researcher should conduct a pilot study to seek more clarification regarding the wording of questionnaires. In the literature, pre-testing has been defined as an activity related to the questionnaire or measurement instrument to be used in a survey or an experiment (Saunders et al, 2009; Collis and Hussey, 2003). It provides a critical means for reducing ambiguity and bias in determining the meaning of measures. This phase of the research was carried out to identify defects in the survey design and to evaluate the questionnaire to ensure that it fulfils the study's objectives. The purpose of the pilot is to refine the questionnaire so that respondents will have less problems answering the questions, and to eliminate difficulties in recording the data. Bryman & Bell (2007) note that the desirability of piloting such instruments is not solely to do with trying to ensure that survey questions operate well, but that it also has a role in ensuring that the research instrument as a whole functions well. Three pilot studies were conducted at different stages for different purposes as following:

❖ ***Pilot Study one***

In order to fit the conditions of the Libyan construction industry, the initial research pilot study was carried out on a number of random selected professional including architects, engineers, managers and directors of construction and consultancy firms and clients of Libyan construction projects. While visiting construction sites throughout the country, some interviews were conducted with members of the construction industry. They were asked about the processes by which the costs and timings of construction projects were controlled and managed, the most important and frequent problems they have faced, and the people they would turn to when seeking help.

This pilot study aimed to familiarise the researcher with the research environment, identify the significance of the research and enable the researcher to obtain the principal information about the strategy by which project target times and costs in the LCI is controlled, as well as to critically analyse the list of causes for delays and cost overruns in Libyan construction projects, and to suggest any others. This pilot study was conducted via informal conversations with sixteen randomly selected project teams in some local Libyan construction companies. The factors compiled from the literature review were subjected to two main questions:

- *"Do you think, from your expert opinion, this cause leads to time and cost overruns in construction projects in Libya?" and*
- *"Are there any further causes you might like to add?"*

The resulting list of causes was subjected to a survey questionnaire I for quantitative confirmation and identification of the most important causes of delays and cost overruns. The primarily finding is that the determinants of project control resulted in a long list of causes of delays and cost overruns relevant to the LCI. During the meetings, some of the causes' descriptions were slightly changed. The interview outcomes concerned each of the cause described in the literature; during the discussion the experts said that it was necessary to make modifications to the final list of causes of cost and time overruns.

The following is a discussion of the informal conversation outcomes for each cause, categorized by group and based on the experts' feedback.

- **Construction:** many causes in this group were found to be applicable. Specifically, the causes of "lack of new technology or new construction methods" and "adopting old construction methods" were seen to be represented by "inappropriate construction methods". Five of the causes were merged into "mistakes during construction". These causes were "equipment allocation problems", "failure in testing", "slowness in giving instruction", "use of unemployment programs in projects" and "dependence on a newly-graduated engineer to bear the whole responsibility on the site". The causes of "national flood insurance program" and "different site conditions" are not common in Libya, and were thus deleted.

- **Weather and natural calamities:** three causes in this group were selected, two of which ("hot/cold weather effect on construction activities" and "rain effect on construction activities") were merged into "unpredictable weather conditions".

- **Material factors:** six causes in this group were found to be appropriate; the factor, "use of defective materials", had no great effect on project duration.

- **Equipment:** in this group, three causes were selected. "Slow delivery of equipment" and "equipment failure" were represented by "shortages of tools and equipment on site", while "lack of high-technology equipment" was deleted because construction projects in Libya usually use similar technology.

- **Design changes:** three causes were found to be appropriate; it was suggested that "poor documentation and no detailed written procedures" had a major effect on project duration.

- ❖ **Contractual procedures:** three of the four causes selected in this group, "inappropriate overall organizational structure linking all parties to the project" could represent "poor contract management", and "inadequate contractor experience" could represent "inadequate definition of the responsibilities of parties within contract clauses". "Inadequate payment modalities (e.g. fixed price and cost plus)" was deleted because it is not common in Libya.

- ❖ **Funds:** four causes of this group were selected. The cause of "change in taxation" was seen to be represented in the materials group under the "difficulties in obtaining construction materials at official current prices, and was thus deleted.

- ❖ **Legal changes:** the seven given causes were suitable.

From the feedback of participants, the researcher noted that the perceptions of the three main parties in a project (i.e. owner, consultant and contractor) constitute the most important delaying and cost overrun group. The researcher has relied on the categorization of causes identified by the existing literature. In addition, the parties responsible for each cost and time overrun factor have been identified based on four categories:

- Contractor-related causes
- Consultant-related causes
- Client-related causes
- External party-related causes

❖ ***Designing the early draft of the questionnaire***

Questions in the draft were of the closed type. In such questions the researcher determines a set number of responses and asks the respondents to select only from the options provided. Survey questionnaire I consists of three parts: general information related to respondents; the extent of the application of project time and cost control; the 63 selected factors, and requests to the respondents to identify the degree of influence of each factor using a five-point scale.

❖ ***Pilot Study Two***

To ascertain the suitability and adequacy of the research questionnaire I and design planned for the research data collection, it was useful for questionnaire I to be piloted a second time, being completed by a small sample of respondents. Sending the pilot study is a sub-stage of the process of research data collection.

The main objectives of this pilot study were to:

- estimate how long the questionnaire would take to complete
- determine if respondents would find any questions difficult to answer
- test the adequacy of the language
- estimate how reliable the questionnaire was
- identify which questions, if any, were unclear or ambiguous
- determine if the layout was clear and attractive

The questionnaires was translated into Arabic in order to accomplish this stage of the study, as most of the respondents were Arabic speakers and were not proficient in either spoken or written English. In order to make sure that the questionnaire was comprehensible, it was translated into Arabic by a professional translator. Consequently two versions of the questionnaire were available: one in English for English speakers, the other in Arabic for Arabic speakers.

The questionnaire saw the distribution of six drafts to colleagues at Sheffield Hallam University and the University of Sheffield and to some PhD Libyan students in other UK universities in the UK. They were selected based on their experience in the construction industry in Libya and had adequate knowledge of the activities involved in construction project performance. Most of comments of their reviews were that the questionnaire was excessively lengthy, and that some questions needed to be reconsidered and additional ones incorporated. These comments led to modifications, after which the research supervisor at Sheffield Hallam University reviewed them; his comments were taken into account to improve the wording of the questions.

❖ ***Pilot Study Three***

The third pilot was carried out by sending Questionnaire Survey I to 12 Libyan construction project professionals. They were contacted beforehand and asked to respond to the questionnaire as logically as possible, as well as being requested to complete a form commenting on the clarity of the questionnaire's wording, its degree of ambiguity, its validity and consistency, as well as noting any difficulties encountered and a statement of the time required for completion. The feedback was collected personally. It should be observed that the responses from this pilot studies were not included in the analysis.

6.2.3 Questionnaire design

Good questionnaires ease the task of responding to respondents' questions, thus minimising their burden. According to Dillman (2000), well-designed questionnaires include the following:

- an informative title that induces respondents to open the questionnaires
- a graphic design that helps identify the survey
- the name of the sponsor
- the address to which the questionnaire is to be returned

Researchers devise questionnaires to assess attitudes in various social circumstances, to measure opinions on a wide range of social and political issues and to explore various demographic permutations (Creswell, 2009). Very large samples are consequently made practicable, which enhances the probability that statistically significant results will be returned, even when multiple variables are investigated; standardised surveys ensure that uniform data from various groups can be collected, interpreted and compared in a precise manner (Babbie, 2004).

Consequently, a number of parameters will determine any questionnaire's design. The questions must be geared towards answering the study's aims and objectives, they should cover the range of possible answers reflecting different situations, and they should not be confusing.

Questions are either closed or open. In the former, the researcher allows respondents to select only from the options provided, while open questions permit respondents to answer in full, in whatever form, giving as much content as they wish. (In interviews, the researcher may probe further.) The questions must be easy enough for respondents to understand, they should not need extensive data gathering by the respondent, and the answers must be accepted as final. The present questionnaire is designed to obtain information specific to this study. It comprised three sections:

- The first section explored general information regarding the respondent's experience and the associated company.
- In the second, consultants, owners and contractors were asked to give their opinions of the methods used to determine the times and costs of the activities involved in construction projects.
- The third dealt with the probability of risks occurring. It included the selected list of 63 delay and cost overruns factors outlined in appendix (I), and requested respondents to identify the degree of influence of each factor using a five-point scale. These factors were further classified into eight categories according to the sources of cost and time overruns. The degree to which each cause was felt as being responsible for these overruns was ranked on a scale of 1 to 5 on the Likert scale, where 1 = low, 2 = somewhat low, 3 = medium, 4 = high and 5 = very high).

6.2.4 Sampling

Collis and Hussey (2003) define "sample" as "a subset of a population [which] should represent the main interest of the study". Saunders et al. (2009) suggest that a sampling frame is a complete list of all the cases in the population from which a sample can be drawn, and see sampling techniques as providing a range of methods that enable reduction of the amount of data required by considering only data from a subgroup rather than all possible cases or elements.

Collis and Hussey (2003) suggest several criteria for good sampling:

- The sample should be random (every member of the population must have an equal chance of being chosen)
- It should be large enough to satisfy the needs of the investigation being undertaken
- It should be unbiased
- It must contain a list of members of the defined population
- It must be complete and up to date
- No element must be listed more than once
- Information given on the sample should provide sufficient means for stratifying that sample

The sampling process involves the selection of individuals or entities in a population in such a way as to allow that sample to provide an overview of the phenomena of interest. The most important aspect of the sampling process is to ensure that it should be assembled in such a way as to be representative of the population from which it is taken (Malhotra, 2009). There are many types of sampling techniques for the study in research investigation. Social scientists use many sampling strategies to find a representative sample, including statistical and non-statistical approaches. In this study the sample was carefully selected to represent the population of construction projects in the LCI. It was based on the time available for the researcher to finish this study, as well as the study's context. The important point was to avoid a biased sample.

6.2.4.1 *Methods of questionnaire I sampling*

Efficient questionnaire sampling required a proportionate stratified random sampling method to make an accurate and fair representation of the study population. The best way to obtain a representative sample was therefore to choose a proportion of the population at random, without bias. A random sampling method was adopted for the distribution of Questionnaire Survey I, with questionnaires distributed to the cluster sample (contractor, client and consultant) being selected randomly from within the LCI.

6.2.4.1.1 The size of Questionnaire Survey I sampling

It was decided that the sample population for Questionnaire Survey I would be construction project professionals in Libyan construction companies: contractors, consultants (architects, civil and structural engineers, mechanical and electrical engineers and quantity surveyors) and clients.

The size of the sample in this research was influenced by the availability of data, the backgrounds of the respondents, the time available and the circumstances of the study. Krejcie and Morgan (1970) have produced a table (Table 6.1) for determining sample sizes that is applicable to any population of a defined size. The available data from the Association of Libyan Engineers' Magazine (2010) showed that there were about 4,000 professionals across academic institutions and construction firms in the country. This size of population was thus adopted for this study. According to Krejcie and Morgan's table, the population size of 4,000 requires that a minimum of 351 questionnaires be distributed. However, Martin and Bateson (1986) indicate that, up to a point, the more data collected the better, since statistical power is improved with increasing sample size. In order to increase the rate of response, 400 questionnaires were therefore distributed instead of 351 so as to enable the data to reveal the true nature of the phenomena being studied. More important than sample size, however, was the selection of the participants to ensure that the sample was representative of the population. In order to ensure that each population member has a calculable and non-zero chance of being selected, the questionnaires were distributed to professionals from the LCI in every zone of the country, north, south, west and east, in order to avoid biased responses. They were also sent to respondents with relevant construction project experience.

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Table 6-1: Determining sample size from a given population

Note: "N" is population size; "S" is sample size. Krejcie, Robert V., Morgan, Daryle W., "Determining Sample Size for Research Activities", *Educational and Psychological Measurement*, 1970

6.2.5 Questionnaire distribution

As stated in chapter (3) section (3.2.1), the distribution of the Libyan population has historically been influenced by geographical factors. Libya has four dominant regions in terms of concentration of population and social and economic activities, as well as the size and scale of construction output. These are the Tripoli, Benghazi, Al-kalig and Sabhah regions (Grifa, 2006).

Tripoli, Libya's capital has the country's main port and largest concentration of housing. According to Ali (2012), the region covers 13 per cent of the country's total area. It is a fast-growing city, with new high-rise apartment buildings steadily taking the place of single-floor dwellings. It contains 55 per cent of Libya's population. The second region, Benghazi, accounts for only eight per cent of the country's land area, but about 25 percent of its population. The Alkaleg region, between Benghazi and Tripoli, comprises forty per cent of the country's area, but only about eight percent of the population. The remaining 12 per cent dwells in the southern region of Sebhah, whose deserts cover 30 per cent of Libya. It is thus obvious that geographical features influence cultural and human activities, and that the social and economic environment must be considered when conducting research into construction activities and operations in Libya.

The distribution of construction companies in these regions is influenced by demographic and geographical features. Based on the review of documents and data obtained from the General Association of Libyan Engineers (ALE) in August 2012, 60 per cent of the total workforce, 49 per cent of construction firms and 62 per cent of consultancy firms were based in the Tripoli region in 2009. Most construction activity in Libya is thus concentrated in the Tripoli region in general and in Tripoli city in particular. In wider terms, nearly 88 per cent of all Libyan construction companies are based in the northern regions of Tripoli, Benghazi and Al-kalig, implying that a large number of professionals, clients and contractors also work in these coastal regions.

Analysis of documents and data obtained from the General Council for Planning (GCP, 2012) shows that around 75 per cent (i.e. 5,425) of construction projects in 2008 were concentrated in the northern regions, with the rest of the projects being in the southern region. 55 per cent (3,403) of projects were in Tripoli, 25 per cent (1,534) in Benghazi, 12 per cent (735) in Sebhah and eight per cent (488) in Al-kalig. It can thus be reasonably concluded that there is a strong relationship between the number of professionals working in the construction industry and the distribution of construction companies and the locations of projects.

The copies of Questionnaire Survey I were distributed in many cities throughout the country such as Tropili, Sirte, Sebha, Zawa, Al-Jfara, Musratha and Benghazi. As well as reasons of geography, these cities have been chosen because they are the most important regions in the country both in terms of social, economic and construction activities and of their population concentrations. Furthermore, recent statistical indicators show that some of these cities are the largest and fastest growing in the country (Jumaili, 2008). Therefore, a total of 400 questionnaires were administered to Libyan construction professionals as follows:

Region	**%**	**Number of questionnaires**
Tripoli	55	220
Benghazi	25	100
Sebhah	12	48
Al-kalig	8	32
Total	**100**	**400**

Table 6-2: Distribution of Survey Questionnaire I by location

130 valid responses were received from the participating companies and professionals, constituting a 33 per cent response rate. Dulami & Hwa (2001) stated that the typical response rate for a survey questionnaire is between 20 and 40 per cent. The response rate for this survey has thus been considered reasonable for what this study hopes to achieve. However, a large number of surveys were discarded because the recipients were not used to dealing with researchers, and were therefore not interested in participating in the questionnaire. Some that contained frivolous responses or whose data was missing also had to be discarded, as shown in Table 6.3.

Region	Distributed	Returned	Valid	Invalid	Return rate
Tripoli	220	113	79	34	35.9%
Benghazi	100	36	25	11	25%
Sebhah	48	23	14	9	31.1%
Al-kalig	32	16	12	4	37.5%

Table 6-3: Return rate of Questionnaire Survey I

6.2.6 Forms of the questionnaires selected for this study

In this study, questionnaires fall into three categories:

- Hand to hand questionnaires take into account the fact that the use of mail is unfamiliar to some respondents. Personal delivery increases the response rate and provides some information about non-responses
- Face-to-face questionnaires have the participant and researcher in the same location, with the latter asking questions personally. These questionnaires meant that the researcher was able to explain unfamiliar terms and clarify the meaning of the questions in cases where the respondent had difficulty comprehending them.
- Mail questionnaires aim to cover the widest geographical area and achieve high rates of response

6.3 The characteristics of the target population of Survey Questionnaire I

The first section of Questionnaire I contains exploratory questions in relation to general information about the respondent's experience and their associated companies.

6.3.1 Types of respondents' organizations for Survey Questionnaire I

As Fig.6.1 shows, a total of 130 employees participated in this study of which 28 per cent were contactors, 33 per cent clients and 39 per cent consultants. No significant difference is observed between the distributions of organisation type.

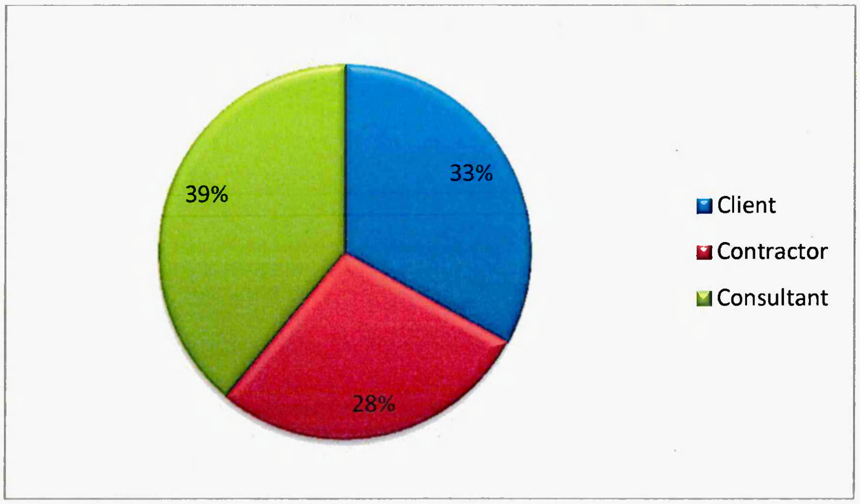


Figure 6-1: Organisations by type

6.3.2 Designations of respondents

In relation to the type of business, 63 per cent of the participants were engineers, architects or planners. Quantity surveyors constituted 20 per cent, while project and construction site managers comprised the smallest percentages (7.69 and 3.85 per cent respectively). No company had a project risk manager. It is therefore obvious that introducing risk management practices in the LCI has become an urgent requirement for the application of project management. The breakdown of response by role is shown in Fig.6.2.

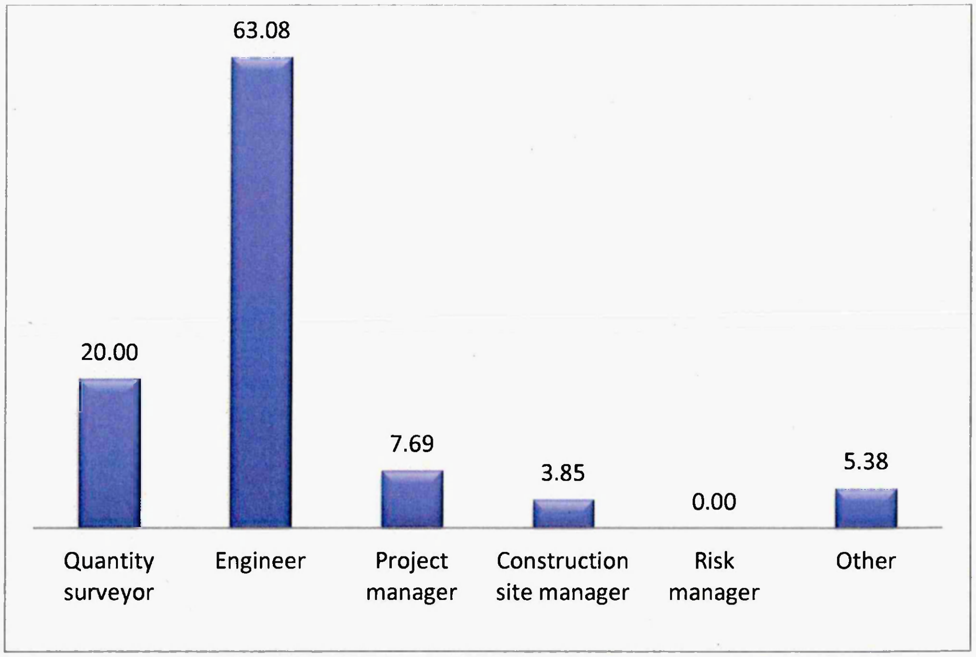


Figure 6-2: Businesses by type

6.3.3 Type of organisation

Fig.6.3 shows that more than three quarters (76.92 per cent) of participants work in the government sector. Although the private sector comes second, the percentage is an order of magnitude lower, at about 17 per cent. It does not seem that the foreign-owned sector relies to any marked degree on companies surveyed: it only employs 4.62 per cent of the respondents.

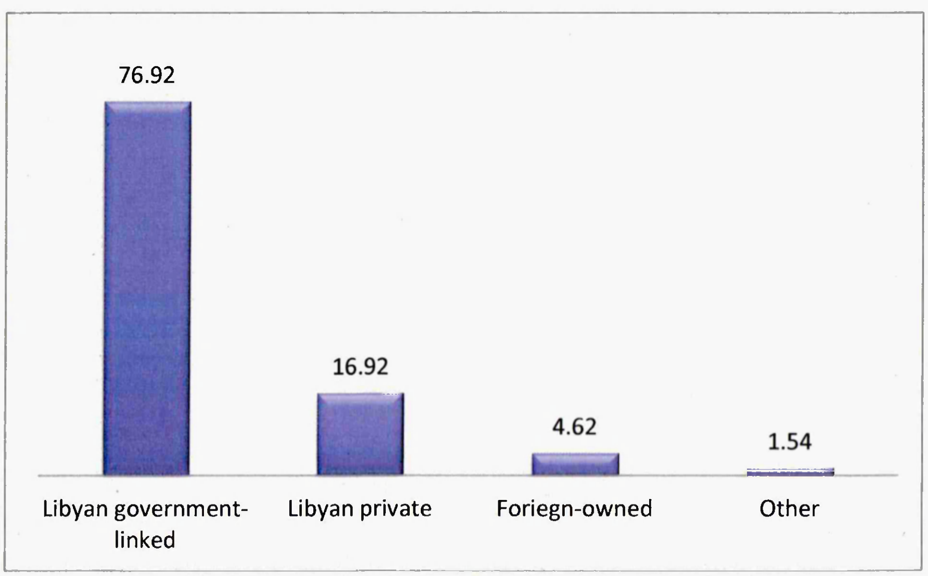


Figure 6-3: Employment of respondents by sector type

6.3.4 Respondent's experience

The involvement in the projects on which the respondents were currently engaged when they completed the survey is shown in Fig.6.4. The majority of participants (42.31 per cent) had engaged in their projects over a period of 11 to 20 years, then five to ten years and thirdly more than 20 (30 per cent and 18.46 per cent respectively). Less than five years was represented by the smallest number (9.23 per cent).

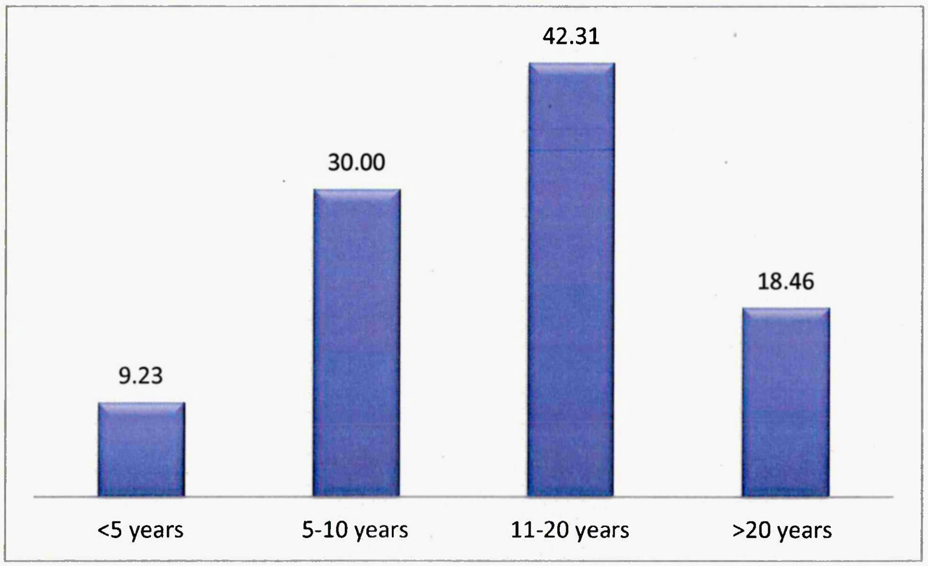


Figure 6-4: Period of involvement in construction projects

6.3.5 Construction industry speciality

By looking at the specialization in building, Fig.6.5 shows that housing predominates at 40.77 per cent. Civil projects are next with 25.38 per cent, industrial building is third at 16.15 per cent and commercial building is last at 10.77 per cent.

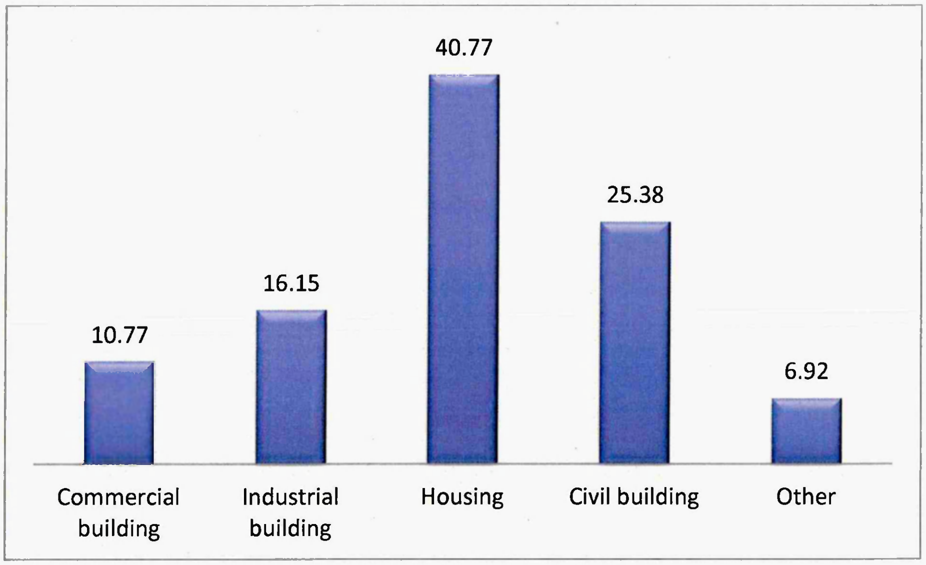


Figure 6-5: Specialization by building sector

6.3.6 Annual turnovers of respondents' organisations

The results shown in Fig.6.6 indicate that most projects (26.15 per cent) cost less than £5m or £5 to £10m (22.3 per cent). The number of projects declined as the cost rose, with just 10.77 per cent each costing more than £20m and £100m respectively.

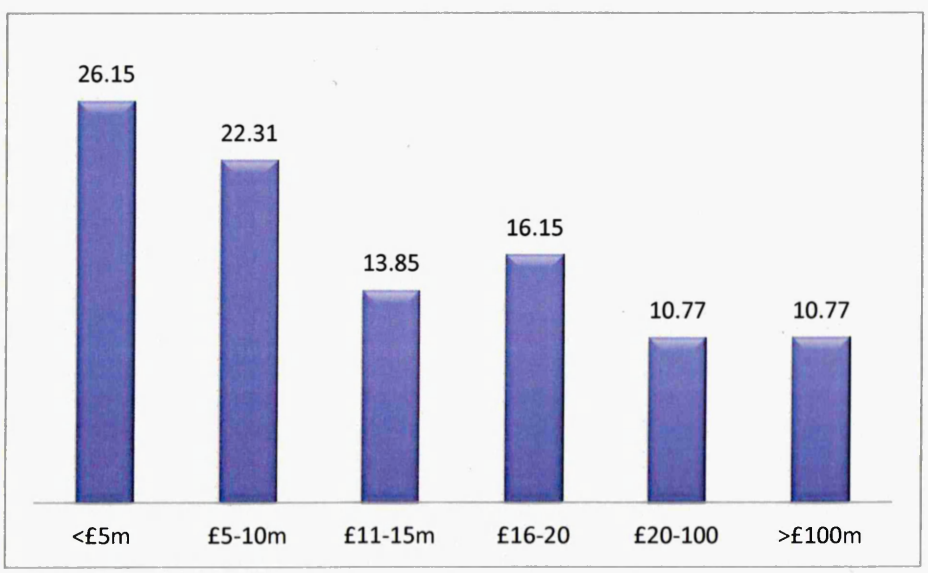


Figure 6-6: Projects by value

6.3.7 Sizes of respondents' organisations

As shown in Fig.6.7, most companies employed between 50 and 250 (31.54 per cent) or 10 to 49 (30 per cent) people. Just 15.35 per cent of companies employed less than 10 employees, while 17.69 per cent had more than 250.

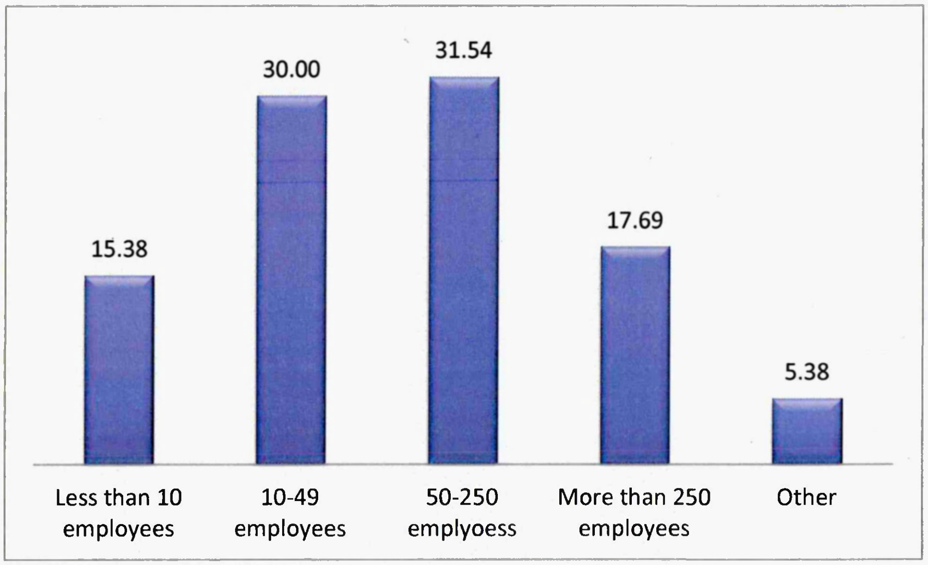


Figure 6-7: Organizations by numbers of employees

6.3.8 The importance of project control in Libyan construction projects

Participants ranked the importance of project control in their projects on a 5 point scale (see Fig.6.8). No clear trend emerged: the distribution seemed to be fairly uniformly distributed. 27.69 per cent of respondents ranked their projects as highly important and 26.15 per cent as important, while 23.08 per cent each saw their projects as slightly important and not important.

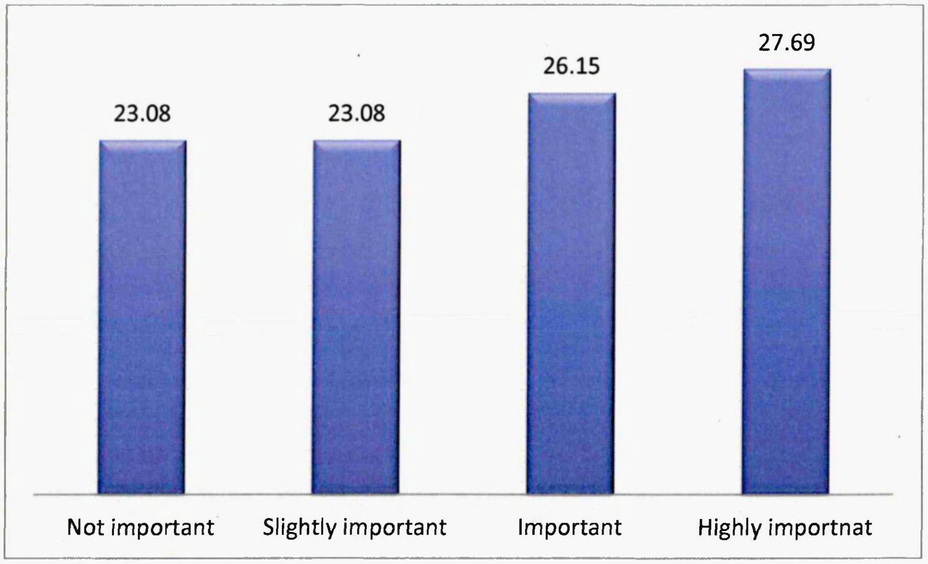


Figure 6-8: Projects ranked by importance given to time and cost control

6.4 Project time and cost control practices in Libyan construction projects

The results of the analysis of this part of Survey Questionnaire I will present the frequency with which Libyan organisations encounter problems of time and cost overruns and the methods used to determine the times and costs of the activities involved in Libyan construction projects.

6.4.1 Frequency with which Libyan organisations encounter problems of time and cost overruns

The results of this analysis are shown in Fig.6.9. The data indicates that more participants "often" encountered such problems (39.23 per cent), with 24.62 per cent "sometimes" doing so. 21.54 per cent of respondents indicated that they were "always" in this situation, while 14.62 per cent were "rarely".

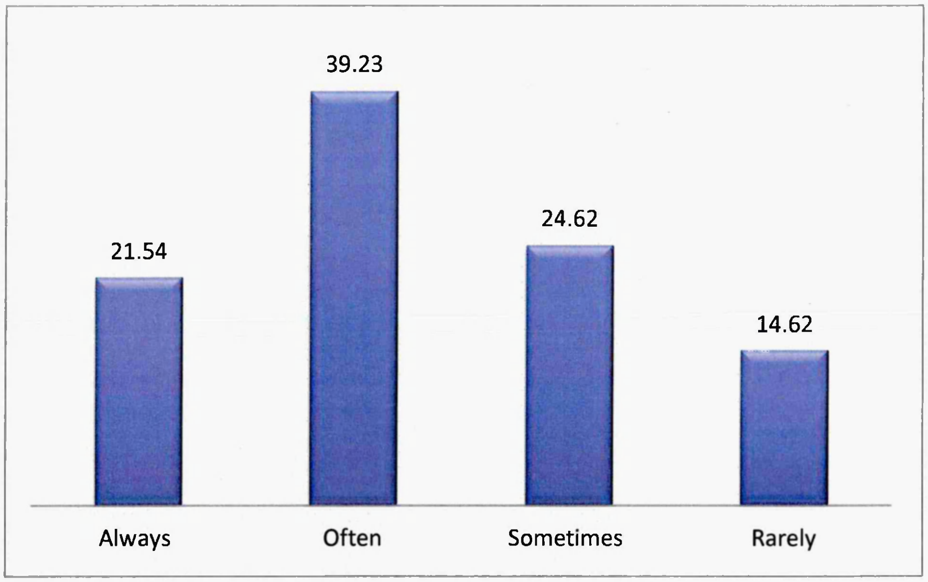


Figure 6-9: Frequency with which Libyan organisations encountered problems of time and cost overruns

6.4.2 Methods to determine the times and costs of activities involved in construction projects

Fig.6.10 shows the proportion of participants that used various methods for this purpose. 45.38 per cent used experience, 33.85 per cent made calculations, 6.92 per cent used other techniques and 13.85 per cent did not use any specific method.

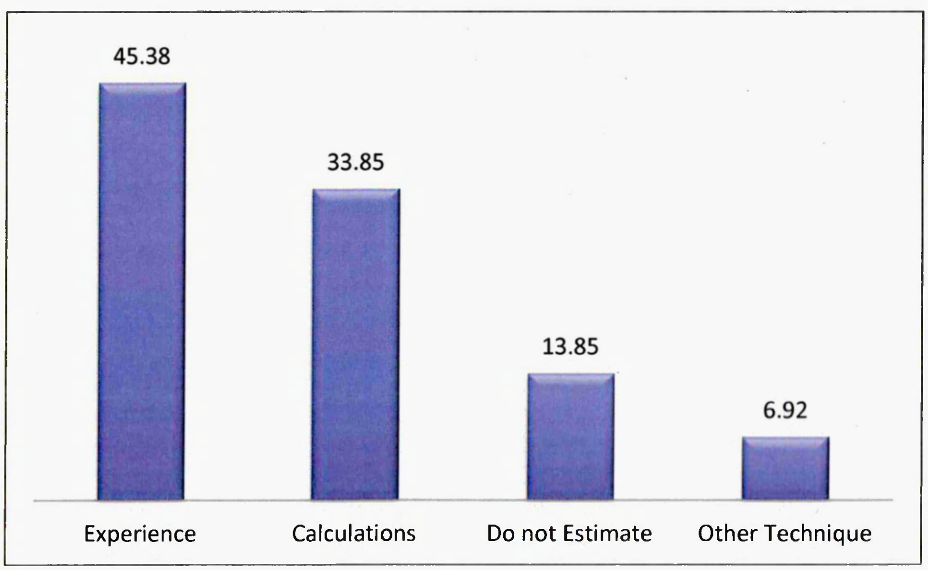


Figure 6-10: Methods to determine the times and costs of activities involved in construction projects

6.5 Factors causing time overruns in Libyan projects

The section consists of the results of the third part of Survey Questionnaire I. These results were grouped into eight; factors related to construction, weather and natural calamities, equipment, materials, contractual procedures, design changes, funding and legal changes.

6.5.1 Construction

Contractors' perceptions of construction factors

Table 6.4 shows that the respondent contractors gave priority to "lack of experience and performance of project management team" and "inaccurate estimates" with an importance index (I.I) of 74.44 per cent. This is a strong indication that lack of experience of project team will cause delays. This result is in line with the results of Assaf et al. (1995), Kuruooglu and Ergen (2000), Iyer and Jha (2005), Arditi et al. (1985), Kartam et al. (2000), Frimpong et al. (2003) and Ling (2004). The agreement of the respondents' results indicates the importance given to this factor.

The next factor, "poor subcontractor skills and performance" (I.I. = 74.43 per cent), was regarded almost as seriously as the first two. The findings of Manfield et al. (1994), (Kumaraswamy & Chan (1998), Yogeswaran et al. (1998), Odeh & Battaineh (2002) and Ling (2004) are in line with the present results.

The fourth most important factor was "Deficiencies in coordination between parties (clients, consultants and contractors)", with an importance index of 73.33 per cent. The results of Kumaraswamy & Chan (1998), Al-Momani (2000), Kartam et al. (2000) and Iya & Jha (2005) are compatible with these findings. As shown in Table 3, the respondent contractors ranked the few regular sessions to address work problems" (I.I. = 52.22 per cent) as the least important factor causing delays in this group.

Clients' perceptions of construction factors

Table 6.4 shows that client respondents ranked "lack of experience and performance of project management team" first, with an importance index of 91.16 per cent. This is the same position as given by contractors, but with a higher I.I. than either of the other two groups. Clients next concern was "lack of timely decisions and corrective actions (I.I=73.95 per cent). In this case the client's opinion completely contradicts that of the contractors and consultants, a result that can be explained their ranking of the third factor, "low labour productivity" (I.I=71.63 per cent).

The issue of least concern to them as a cause of delays was "lack of regular sessions to address work problems" (I.I. = 52.56 per cent). This belittling of such sessions as a factor affecting time overruns demonstrates a misunderstanding among respondents of the role of those meetings, which are very important in finding appropriate solutions to work problems.

Consultants' perceptions of the construction factor

Table 6.4 shows that respondents ranked "low labour productivity" as the leading cause of delays, with an importance index of 72.55 per cent, but clients only rated it third. The most appropriate interpretation of this is that a lack of commitment on the part of contractors in Libyan construction projects leads to delays. Consultants next concern was "lack of experience and performance of project management team" with an importance index of 70.98 per cent. Clients and contractors put the same emphasis on this factor.

"Deficiencies in coordination between parties (client, consultant and contractor)" (I.I=70.59%) was the third factor. Findings by Iya & Jha (2005), Kumaraswamy & Chan (1998), Kartam et al. (2000) and Al-Momani (2000) agree that any previous disputes or bad relationships between these parties can affect the progress of construction work. Consultants ranked "delay in subcontractors' work" as the least important factor (I.I=54.51 per cent). They largely discounted this factor because each of the project's parties had an interest in completing it on schedule.

Table 6-4: Construction-related factors leading to time overruns

1. Construction	Contractor		Client		Consultant	
	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
Lack of experience and performance of project management team	74.44	1	91.16	1	70.98	2
Inaccurate estimates	74.44	1	69.3	5	66.67	10
Poor subcontractor skills and performance	74.43	3	67.91	7	63.13	18
Deficiencies in coordination between parties (client, consultant and contractor)	73.33	4	64.19	14	70.59	3
Poor management and supervision in the site	72.22	5	65.57	10	64.71	16
Poor communications and misunderstanding	71.67	6	65.58	11	68.62	7
Slowness in giving instruction	71.11	7	71.16	4	66.27	11
Poor judgment in estimating time and resources	70.55	8	67.44	8	67.84	8
Lack of technically skilled staff	69.44	9	65.58	12	65.49	14
Non-commitment to consultant instructions	68.89	11	62.79	17	65.49	15
Low labour productivity	68.88	10	71.63	3	72.55	1
Mistakes during construction	67.21	12	62.32	19	62.74	19
Lack of a strong organizational culture	67.22	13	62.33	18	61.96	23
Indecision by the supervising team in dealing with the contractor's queries	66.66	14	67.44	9	65.88	13
Unrealistic contract expiry dates imposed by owner	66.67	15	62.79	16	62.35	21
Lack of new technology or new construction methods	66.11	16	65.59	13	65.87	12
High quality of work required	65.54	17	68.84	6	70.19	5
Improvements to standard drawings during the construction stage	65.55	18	60	23	62.74	20
Lack of timely decisions and corrective actions	65	19	73.95	2	69.8	6
Wrong choice of site	65	20	53.95	32	57.65	29
Required of external work	64.44	21	60.47	21	62.36	22
Absence of consultant's site staff	63.89	22	59.07	25	58.82	27
Shortages of craftsmen	63.33	23	58.6	26	59.23	26

Table 6-4: Construction-related factors leading to time overruns (cont.)

1. Construction	Contractor		Client		Consultant	
	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
Inadequate construction planning	63.33	24	59.34	24	67.45	9
errors and omissions in the bills of quantities	62.78	25	57.67	27	70.58	4
Shortage of site workers	62.22	26	60.46	20	64.31	17
Lack of job security for the consultancy team	60.55	27	57.21	28	58.04	28
Delay in subcontractors' work	60	28	55.81	30	54.51	33
Centralized consultants' decision-making processes	59.44	29	64.17	15	61.57	25
Rework of bad quality performance	58.33	30	60	22	55.29	32
Inappropriate construction methods	54.44	31	56.28	29	56.86	30
Lack of detailing of information	53.89	32	55.35	31	61.57	24
Little regular sessions to address work problems	52.22	33	52.56	33	55.29	31

Nonparametric correlations

Non-parametric techniques are ideal when data are measured by categórical and ranked scales (Pallant, 2001). In this study correlation is used as the measure of agreement for ranking the underlying factors in the same order. The Spearman's rank correlation coefficient is calculated as

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Where ρ = Spearman's rank correlation coefficient, d_i^2 = difference in paired ranks and n = the number of factors.

Spearman's rank correlation coefficient of construction factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	correlation	p-value
.784	<.001	.657	<.001	.747	<.001

Table 6-5: Time correlation of construction factors among contractors, consultants and clients

According to Table 6.5, the correlation between contractors and clients is positive (.784) and of very high significance (p-value of <.001), indicating that there is a high level of agreement between them in terms of ranking the important items. The same can be observed between contractors and consultants, where the correlation is (.657) with a p-value of <.001. The correlation is also positive (.747) and highly significant (p-value of <.001) between client and consultant. Generally, there is significant agreement between the consultants for ranking the items involved in construction factors.

6.5.2 Weather and natural calamities

Contractors' perceptions

It is clear from Table 6.6 that the resulting I.I. was not high, at less than 66 per cent. Contractors viewed the most important factor leading to delay in time as "unpredictable weather conditions" (I.I. = 63.33 per cent). Findings by Kamring et al. (1997), Koushki et al. (2005), Al-Momani (2000), Frimpong et al. (2003), Iyer & Jha (2005) and Yogeswaran et al (1998) concur. "Level of uncertainty of soil conditions" (I.I=61.11 per cent) and "storms and heavy dusty winds" (I.I=50 per cent) came second and third respectively.

Clients' perceptions

Clients' concerns reflected those of contractors: "unpredictable weather conditions" came first (I.I. = 61.39 per cent), "level of uncertainty of soil conditions" second (I.I=56.28 per cent) and "storms and heavy dusty winds" third (I.I. = 52.56 per cent).

Consultants' perceptions

Consultants likewise saw "unpredictable weather conditions" as the leading factor causing delays in this group (I.I. = 65.09 per cent), "level of uncertainty of soil conditions" (I.I. = 62.74 per cent) as the second and "storms and heavy dusty winds" as the least important factor causing delay in this group. While the ranking agrees with those of clients and contractors, the rate of I.I. is higher. This assumes that consultants are more technically aware of the impact of these factors.

2. Weather and natural calamities	**Contractors**		**Clients**		**Consultants**	
	RI.I.	**Rank**	**RI.I.**	**Rank**	**RI.I.**	**Rank**
Unpredictable weather conditions	63.33	1	61.39	1	65.09	1
Level of uncertainty of soil conditions	61.11	2	56.28	2	62.74	2
Storms and heavy-dusty winds	50	3	52.56	3	56.47	3

Table 6-6: Weather and natural calamity-related factors leading to time overruns

Spearman's rank correlation coefficient of weather and natural calamity-related factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	correlation	p-value
1.00	<.001	1.000	<.001	1.000	<.001

Table 6-7: Time correlation of weather and natural calamity-related factors among contractors, consultants and owners

Table 6.7 shows that there is a perfect correlation between all the responses, a correlation that is very highly significant (p-value of <.001). In other words, they agree completely as regards the ranking of the factors by order of importance.

6.5.3 Equipment

Contractors' perceptions

Table 6.8 shows that contractors ranked "shortages of tools and equipment on site" first, with an importance index of 66.11 per cent, a result that indicates the high importance attributed by them to the provision of the tools and equipment required to finish the project to time. Shortages of tools and equipment constitute many obstacles including difficulty of execution, dependence on workers instead of tools and equipment and a decline in productivity, all of which can lead to time overruns. Shortages of tools and equipment on site are one of the major causes of time overruns, although Assaf et al. (2006) disagree. Meanwhile, Alwi et al. (2002) and Alaghbari et al. (2007) conducted a study in Saudi Arabia which found that in cases of such shortages, projects would indeed be exposed to time overruns. Alwi et al. (2002) and Alaghbari et al. (2007) concur with these findings.

The second most important factor was lack of equipment maintenance (I.I. = 62.78 per cent), while equipment allocation problems were regarded as the least (I.I=52.78 per cent). According to this result, contractors do not see allocation as affecting delay. This outcome is in full conformity with those of clients and consultants.

Client's perceptions

These returned the same rankings observed by the respondents' contractors was ranked by the respondents' client but with different values in the RI.I.

Consultant perception

The same can be said for consultants as for clients.

3. Equipment	**Contractors**		**Clients**		**Consultants**	
	RI.I.	**Rank**	**RI.I.**	**Rank**	**RI.I.**	**Rank**
Equipment allocation problems	52.78	3	51.63	3	58.82	3
Shortages of tools and equipment on site	66.11	1	61.86	1	64.31	1
Lack of equipment maintenance	62.78	2	61.39	2	60.39	2

Table 6-8: Equipment-related factors leading to time overruns

Spearman's rank correlation coefficient of equipment factors

Contractors and clients		Contractors and consultant		Clients and consultants	
correlation	p-value	Correlation	p-value	correlation	p-value
1.00	<.001	1.000	<.001	1.000	<.001

Table 6-9: Time correlation of equipment factors among contractors, consultants and owners

Table 6.9 demonstrates a positive correlation among all the responses, a highly significant result (p-value of <.001). In other words, they completely agree in their ranking of the importance of equipment factors.

6.5.4 Materials

Contractors' perceptions

According to Table 6.10 contractors ranked "market shortages of construction materials" as the most important factor leading to time overruns, with an importance index of 70.56 per cent. Such shortages constitute one of the major factors causing time overruns. In Libyan construction projects, especially in the light of the extraordinary political situation, it is proving extremely difficult to obtain construction materials.

Abudul-Rahman et al. (2006), Alaghbari et al. (2007) and Sambasivan & Soon (2007) concur with this observation, although Odeh & Battaineh (2002), Alwi et al. (2002), Assaf et al. (2006) and Fong et al. (2006) do not. In many developing countries such as Jordan, Indonesia, China, Lebanon and Saudi Arabia there is no difficulty in obtaining construction materials. Both "changes in prices of materials" and "delays in material deliveries to site had importance indices of 68.89 per cent. These results are also the result of the extraordinary developments in Libyan politics. This result also obtains for consultants.

"Difficulties in obtaining construction materials at official current prices" (I.I= 68.33 per cent) was regarded as the third factor, while "poor quality materials" and "damage to materials in storage" (both I.I= 58.33 per cent) was seen as the least important factors in this group. The most appropriate interpretation of this ranking is that contractors view these last two factors as posing little risk to a project's timely completion.

Clients' perceptions

Table 6.10 shows that clients ranked "changes in prices of materials" first, with an importance index of 70.23 per cent). The second factor was "market shortages of construction materials" (I.I= 69.30 per cent). These results conform to those of the consultants.

"Delays in material deliveries to site" (I.I= 68.37 per cent) came third, and like the contractors, clients saw "poor quality materials" (I.I= 58.60 per cent) as the least likely to cause delays.

Consultants' perceptions

The consultants' views were closer to those of clients to contractors. The same first and second rankings were observed by both, but with different RI.I. values.
Table 6.10 shows that the consultants ranked "changes in prices of materials" (I.I.= 69.80 per cent) and "market shortages of construction materials" (I.I.= 67.06 per cent) as the first and second most prominent causes of delay respectively. These results accords with those of the respondent's clients. The consultants as shown in Table 4

ranked “damage to materials in storage” (I.I.= 56.47 per cent) as the least important such factor.

4. Materials	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Market shortages of construction materials	70.56	1	69.30	2	67.06	2
Changes in prices of materials	68.89	2	70.23	1	69.80	1
Damage of materials in storage	58.33	5	59.07	5	56.47	6
Delays in material deliveries to site	68.89	2	68.37	3	64.71	5
Poor quality materials	58.33	5	58.60	6	67.07	4
Difficulties in obtaining construction materials at official current prices	68.33	4	65.12	4	67.06	2

Table 6-10: Materials-related factors leading to time overruns

Spearman’s rank correlation coefficient of materials factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	Correlation	p-value	correlation	p-value
.90	.015	.512	.299	.652	.160

Table 6-11: Time correlation of materials-related factors among contractors, consultants and owners

For material factors, Table 6.11 shows that the correlation between contractors and clients is very strong (.90), with a highly significant relationship (p-value =015). On the other hand, the low correlation between contractors and consultants (.512) is not significant. The correlation between clients and consultants is neither strong nor weak (.652), and as such is not significant (p-value =.160).

5. Contractual procedures	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Inappropriate types of contract used	67.22	3	61.86	3	63.14	2
Unethical contractor behaviour in order to achieve the highest possible level of profit	48.89	4	51.63	4	61.57	4
Inadequate contractor experience	72.78	1	69.30	1	64.71	1
Poor contract management	70.56	2	62.33	2	62.33	3

Table 6-12: Contractual procedures leading to time overruns

6.5.5 Contractual procedures

Contractors' perceptions

Table 6.12 shows agreement between all three types of respondent that the first cause of delay in construction projects was "inadequate contractor experience", although the RI.I values differ. For contractors it was 72.78 per cent. This was one of the clearest views on any factor causing time overruns. Contractors must have adequate experience in order to maximize productivity. Odeh and Battaineh (2002) concur with this result. The second most important factor was "poor contract management" (I.I. = 70.56 per cent), a finding with which Frimpong et al. (2003) agree. Contractors may implement some project activities incorrectly which consultants then reject , resulting in delays.

The contractors as shown in Table 4 view "unethical contractor behaviour in order to achieve the highest possible level of profit" (I.I.= 48.89 per cent) as the least important factor in delays in this category. This outcome agrees with those of both clients and contractors.

Clients' perceptions

Clients' results were similar to those of contractors. "Inadequate contractor experience" was ranked first (I.I= 69.30 per cent), "poor contract management" second (I.I=62.33 per cent) and "unethical contractor behaviour in order to achieve the highest possible level of profit" (I.I.= 51.63 per cent) last.

Consultants' perceptions

Table 6.12 shows complete agreement between all three types of respondent: "inadequate contractor experience" was rated first (I.I=64.71 per cent), "inappropriate types of contract used" (I.I= 63.14 per cent) second and "unethical contractor behaviour in order to achieve the highest possible level of profit" last. This outcome agrees with the rankings of the other two types of respondent.

Spearman's rank correlation coefficient of contractual procedure factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	correlation	p-value
1.00	<.001	.80	.200	.80	.200

Table 6-13: Time correlation of contractual procedures among contractors, consultants and owners

Table 6.13 shows that the correlation between contractors and clients as regards contractual procedures is perfect (1.00), with a highly significant relationship (p-value of <.001). A high correlation, which is not significant, is also observed between contractors and consultants (.80), with a p-value of .20. The correlation between clients and consultants is also strong (.80), with a non-significant p-value of .20. Hence, all the responses tend to assign the same ranks.

6.5.6 Design changes

Contractors' perceptions

Table 6.14 showed that contractors ranked "lack of design team experience" as the most important factor leading to time overruns, with an importance index of 75 per cent).

Poor experience on the part of design teams causes many problems such as incomplete drawings, difficulty of execution, unsafe designs and inaccuracy of tender documents, which collectively make it highly likely that a project will exceed its schedule. "Lack of co-ordination between design team and contractor" (I.I. = 62.22 per cent) came second, and "complexity of design" (I.I. = 58.89 per cent) came third.

Clients' perceptions

Like contractors, clients identified "lack of design team experience" as the most important factor (I.I. = 68.84 per cent), "lack of co-ordination between design team and contractor" (I.I. = 66.98 per cent) second and complexity of design third (I.I. = 59.53 per cent). These outcomes agree fully with those of the contractor' respondents.

Consultants' perceptions

Unlike the contractors and clients, consultants saw "lack of co-ordination between design team and contractor" as the greatest cause of delays (I.I. = 66.67 per cent), "lack of design team experience" second (I.I. = 62.33 per cent) and "complexity of design" (I.I. = 53.33 per cent) third. This outcome does not agree with those of the other two respondent types.

6. Design changes	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Lack of design team experience	75	1	68.84	1	62.33	2
Lack of co-ordination between design team and contractor	62.22	2	66.98	2	66.67	1
Complexity of design	58.89	3	59.53	3	53.33	3

Table 6-14: Design change-related factors leading to time overruns

Spearman's rank correlation coefficient of design changes factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	Correlation	p-value
1.00	<.001	.50	.667	.50	.667

Table 6-15: Time correlation of design changes-related factors among contractors, consultants and owners

Table 6.15 shows that the correlation between contractors and clients as regards design changes is perfect (1.00), with a highly significant relationship (p-vale<.001). On the other hand, the correlation between contractors and consultant is low (.50 and not significant. The same result is also observed between clients and consultants.

6.5.7 Funding

Contractors' perceptions

Table 6.16 shows that the contractors ranked "delay in contractors' payment upon completing work" as the most important factor in this group (I.I. = 68.89 per cent). The second most important factor was "Lack of proper financial appraisal of the project" (I.I. = 67.78 per cent), which is in line with Arditi et al. (1985), Mansfield et al. (1994), Assaf et al. (1995), Ogunlana et al. (1996), Faniran (1999) and Frimpong et al. (2003).

"Slow payment for completed work", with an importance index of 64.44, was ranked third factor and "lack of cost reports during construction stage" last.

Clients' perceptions

Table 6.16 shows that the client's opinions differ from those of the contractors: they ranked "Lack of proper financial appraisal of the project" first (I.I. = 62.79 per cent), "delay in contractors' payment for completing work" second (I.I. = 59.53 per cent), "slow payment for completed works" (I.I. = 53.95 per cent) third and "lack of cost reports during construction stage" (I.I. = 52.56 per cent) last. Both of their two lowest rankings agreed with those of the other two respondent types.

Consultants' perceptions

The same rankings were observed for consultants as for clients, but with different RI.I. values, as shown in Table 6.16.

7. Funding factors	Contractor		Client		Consultant	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Lack of proper financial appraisal of the project	67.78	2	62.79	1	76.47	1
Delay in payments to contractors of completing work	68.89	1	59.53	2	68.23	2
Slow payment of completed works	64.44	3	53.95	3	64.71	3
Lack of cost reports during construction stage	53.89	4	52.56	4	60.39	4

Table 6-16: Funding-related factors leading to time overruns

Spearman's rank correlation coefficient of funding factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	correlation	p-value
.80	.200	.80	.200	1.00	<.001

Table 6-17: Time correlation of funding-related factors among contractors, consultants and owners

Regarding funding factors, a strong correlation (.80) with a non-significant p-value of .20 can be observed between contractors and clients, and also between contractors and consultants (Table 6.17). The correlation becomes perfect and highly significant (p-value of <.001) between clients and consultants (1.00).

6.5.8 Legal and regulatory changes

Contractors' perceptions

Table 6.18 shows that contractors regarded "strikes and border closures" (I.I. = 72.78) as the most important cause of delays. In such cases, markets run out of construction materials, the price of materials increase noticeably and materials can be damaged or monopolized by suppliers. All these elements contribute to delays. The second factor for contractors was "difficulties in obtaining construction licences", with an importance index of 68.33 per cent), and "delays in decision-making by government" came third (I.I. = 67.87 per cent). "Lack of communication by donors to compensate for any bad results that may come from the political situation" (I.I. = 55 per cent) came last.

Client perception

Table 6.18 shows that clients saw changing government policies and regulations (I.I. = 67.91 per cent) as the leading cause of delay, whereas it was only fourth for contractors. On the other hand, clients ranked "political instability" second, with an importance index of 65.59 per cent. Clients as shown in Table 8 as viewing "lack of communication by donors to compensate for any bad results that may come from the political situation" (I.I. = 52.09 per cent) as the factor least likely to cause delays.

Consultants' perceptions

Consultants saw "strikes and border closures" as the leading cause of delays, with an importance index of 72.16 per cent), the same as that for contractors. "Delays in decision-making by government" (ranked third by both contractors and clients) came second (I.I. = 65.49 per cent). There was complete agreement about the positions of the last two, "different political affiliations of workers" (I.I. = 54.51 per cent) and "lack of communication by donors to compensate for any bad results that may come from the political situation" (I.I. = 53.33 per cent).

8. Legal and regulatory changes	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Different political affiliation of workers	56.11	6	52.56	6	54.51	6
Lack of communication by donors to compensate for any bad results that may come from the political situation	55	7	52.09	7	53.33	7
Delays in decision making by Government	67.78	3	64.19	3	65.49	2
Political instability	66.67	5	65.59	2	60	4
Strikes and border closures	72.78	1	63.26	4	72.16	1
Government changing policies and regulations	67.22	4	67.91	1	60.78	3
Difficulties in obtaining construction licences	68.33	2	61.39	5	58.82	5

Table 6-18: Changes in legal factors leading to time overruns

Spearman's rank correlation coefficient of change in legal factors

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	Correlation	p-value
.357	.432	.786	.036	.676	.094

Table 6-19: Time correlation of changes in legal factors among contractors, consultants and owners

For change in legal factors, a weak and (.357) and non-significant (p-value=.432) correlation can be observed between contractors and clients (Table 6.19). However, the correlation between contractors and consultants is very good (.786) and of significance (.036). The correlation between clients and consultants was also very good but not significant (p-value=.094).

6.5.9 Ranking of all factors causing time overruns from the perceptions of contractors, clients and consultants

Table 6.20 illustrates the rankings by contractors, clients and consultants of all factors causing delays. A total of 63 such factors have been categorized into eight groups. The ranking was based on the importance of index values.

Table 6-20: Factors causing time overruns as ranked by contractors, clients and consultants

Factors	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Lack of design team experience	75	1	68.84	9	62.33	39
Lack of experience and performance of project management team	74.44	2	91.16	1	70.98	4
Inaccurate estimates	74.44	2	69.3	6	66.67	17
Poor standard of subcontractor's skills and performance	74.43	4	67.91	12	63.13	33
Deficiencies in coordination between parties (clients, consultants and contractors)	73.33	5	64.19	23	70.59	5
Strikes and border closures	72.78	6	63.26	26	72.16	3
Inadequate contractor experience	72.78	6	69.3	6	64.71	26
Poor management and supervision on site	72.22	8	65.57	21	64.71	26
Poor communications and misunderstanding	71.67	9	65.58	19	68.62	7
Slowness in giving instruction	71.11	10	71.16	4	66.27	19
Market shortages of construction materials	70.56	11	69.3	6	67.06	15
Poor contract management	70.56	11	62.33	30	62.33	39
Poor judgment in estimating time and resources	70.55	13	67.44	14	67.84	12
Lack of technically skilled staff	69.44	14	65.58	19	65.49	22
Lack of commitment to consultants 'instructions	68.89	15	62.79	27	65.49	22
Changes in prices of materials	68.89	15	70.23	5	69.8	8
Delays in material deliveries to site	68.89	15	68.37	11	64.71	26
Delay in payment on completing work	68.89	15	59.53	42	68.23	11
Low labour productivity	68.88	19	71.63	3	72.55	2
Difficulties in obtaining construction materials at official current prices	68.33	20	65.12	22	67.06	15
Difficulties in obtaining construction licences	68.33	20	61.39	35	58.82	50
Lack of proper financial appraisal of the project	67.78	22	62.79	27	76.47	1
Delays in decision-making by government	67.78	22	64.19	23	65.49	22
Inappropriate types of contract used	67.22	22	61.86	33	63.14	32

Table 6-20 : Factors causing time overruns as ranked by contractors, clients and consultants (cont.)

Factors	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Changing government policies and regulations	67.22	22	67.91	12	60.78	45
Lack of a strong organizational culture	67.22	22	62.33	30	61.96	41
Mistakes during construction	67.21	27	62.32	32	62.74	34
Political instability	66.67	28	65.59	17	60	48
Unrealistic contract expiry dates imposed by owners	66.67	28	62.79	27	62.35	38
Indecision by the supervising team in dealing with the contractor's enquiries	66.66	30	67.44	14	65.88	20
Shortages of tools and equipment on site	66.11	31	61.86	33	64.31	30
Lack of new technology or new construction methods	66.11	31	65.59	17	65.87	21
Improvements to standard drawings during the construction stage	65.55	33	60	40	62.74	34
High quality of work required	65.54	34	68.84	9	70.19	7
Lack of timely decisions and corrective actions	65	35	73.95	2	69.8	8
Wrong choice of site	65	35	53.95	55	57.65	54
Requirements for external work	64.44	37	60.47	38	62.36	37
Slow payment for completed work	64.44	37	53.95	55	64.71	26
Absence of consultant's site staff	63.89	39	59.07	45	58.82	51
Shortages of craftsmen	63.33	40	58.6	47	59.23	49
Unpredictable weather conditions	63.33	40	61.39	35	65.09	25
Inadequate construction planning	63.33	40	59.34	44	67.45	13
Errors and omission in the bills of quantities	62.78	43	57.67	49	70.58	6
Lack of maintenance of equipment	62.78	43	61.39	35	60.39	46
Shortage of site workers	62.22	45	60.46	39	64.31	30
Lack of co-ordination between design team and contractors	62.22	45	66.98	16	66.67	17
Level of uncertainty of soil conditions	61.11	47	56.28	51	62.74	34
Lack of job security for the consultancy team	60.55	48	57.21	50	58.04	53
Delay in subcontractors' work	60	49	55.81	53	54.51	60
Centralization of consultant's decision-making process	59.44	50	64.17	25	61.57	42
Complexity of design	58.89	51	59.53	42	53.33	62
Rework of bad quality performance	58.33	52	60	40	55.29	58
Damage of materials in storage	58.33	52	59.07	45	56.47	56
Poor quality materials	58.33	52	58.6	47	67.07	14
Different political affiliation of workers	56.11	55	52.56	57	54.51	60

Table 6-20 : Factors causing time overruns as ranked by contractors, clients and consultants (cont.)

Factors	Contractors		Clients		Consultants	
	RI.I.	Rank	RI.I.	Rank	RI.I.	Rank
Lack of communication by donors to compensate for any bad results that may come from the political situation	55	56	52.09	61	53.33	63
Inappropriate construction methods	54.44	57	56.28	51	56.86	55
Lack of detailed information	53.89	58	55.35	54	61.57	42
Lack of cost reports during construction stage	53.89	58	52.56	57	60.39	46
Equipment allocation problems	52.78	60	51.63	62	58.82	52
Lack of regular sessions to address work problems	52.22	61	52.56	57	55.29	58
Storms and heavy dusty winds	50	62	52.56	57	56.47	56
Unethical contractor behaviour in order to achieve the highest possible level of profit	48.89	63	51.63	63	61.57	42

6.5.10 Comparison between contractors, clients and consultants involved in Libyan construction projects regarding the important factors in time overruns

Table 6-21: Comparison between parties involved in Libyan construction projects regarding the important factors in time overrun

Factor	RI.I.	RI.I.	RI.I.	Rank	Rank	Rank	Group
	Contractors	Clients	Consultants	Contractors	Clients	Consultants	
Lack of design team experience	75	68.84	62.33	1	9	39	Design changes
Lack of experience and performance of project management team	74.44	91.16	70.98	2	1	4	Construction
Inaccurate estimates	74.44	69.3	66.67	2	6	17	Construction
Poor standard of subcontractor's skills and performance	74.43	67.91	63.13	4	12	33	Construction

Table 6-21 :Comparison between parties involved in Libyan construction projects regarding the important factors in time overruns (cont.)

Factor	RI.I.	RI.I.	RI.I.	Rank	Rank	Rank	Group
	Contractors	Clients	Consultants	Contractors	Clients	Consultants	
Deficiencies in coordination between parties (clients, consultants and contractors)	73.33	64.19	70.59	5	23	5	Construction
Strikes and border closures	72.78	63.26	72.16	6	26	3	Legal changes
Inadequate contractor experience	72.78	69.3	64.71	6	6	26	Contractual procedures
Poor management and supervision in the site	72.22	65.57	64.71	8	21	26	Construction
Poor communications and misunderstanding	71.67	65.58	68.62	9	19	7	Construction
Slowness in giving instructions	71.11	71.16	66.27	10	4	19	Construction
Market shortages of construction materials	70.56	69.3	67.06	11	6	15	Materials
Poor contract management	70.56	62.33	62.33	11	30	39	Contractual procedures
Poor judgment in estimating time and resources	70.55	67.44	67.84	13	14	12	Construction
Lack of technical skills by staff	69.44	65.58	65.49	14	19	22	Construction
Lack of commitment to consultant instructions	68.89	62.79	65.49	15	27	22	Construction
Changes in prices of materials	68.89	70.23	69.8	15	5	8	Materials
Delays in material deliveries to site	68.89	68.37	64.71	15	11	26	Materials
Delay in contractor payment on completing work	68.89	59.53	68.23	15	42	11	Funding
Difficulties in obtaining construction materials at official current prices	68.33	65.12	67.06	19	3	2	Materials
Difficulties in obtaining construction licences	68.33	61.39	58.82	20	22	15	Legal changes
Low labour productivity	68.88	71.63	72.55	20	35	50	Construction
Lack of proper financial appraisal of the project	67.78	62.79	76.47	22	27	1	Funding
Delays in decision-making by government	67.78	64.19	65.49	22	23	22	Legal changes
Inappropriate types of contract used	67.22	61.86	63.14	22	33	32	Contractual procedures
Changing government policies and regulations	67.22	67.91	60.78	22	12	45	Legal changes
Mistakes during construction	67.21	62.32	62.74	22	30	41	Construction
Lack of a strong organizational culture	67.22	62.33	61.96	27	32	34	Construction
Political instability	66.67	65.59	60	28	17	48	Legal changes
Indecision by the supervising team in dealing with contractor's enquiries	66.66	67.44	65.88	28	27	38	Construction

Table 6-21 :Comparison between parties involved in Libyan construction projects regarding the important factors in time overruns (cont.)

Factor	RI.I.	RI.I.	RI.I.	Rank	Rank	Rank	Group
	Contractors	Clients	Consultants	Contractors	Clients	Consultants	
Unrealistic contract expiry dates imposed by owner	66.67	62.79	62.35	30	14	20	Construction
Shortages of tools and equipment on site	66.11	61.86	64.31	31	33	30	Equipment
Lack of new technology or new construction methods	66.11	65.59	65.87	31	17	21	Construction
High quality of work required	65.54	68.84	70.19	33	40	34	Construction
Improvements to standard drawings during the construction stage	65.55	60	62.74	34	9	7	Construction
Lack of timely decisions and corrective actions	65	73.95	69.8	35	2	8	Construction
Wrong choice of site	65	53.95	57.65	35	55	54	Construction
Requirements for external work	64.44	60.47	62.36	37	38	37	Construction
Slow payment for completed work	64.44	53.95	64.71	37	55	26	Funding
Absence of consultant's site staff	63.89	59.07	58.82	39	45	51	Construction
Shortages of craftsmen	63.33	58.6	59.23	40	47	49	Construction
Unpredictable weather conditions	63.33	61.39	65.09	40	35	25	Climatic changes
Inadequate construction planning	63.33	59.34	67.45	40	44	13	Construction
Errors and omissions in bills of quantities	62.78	57.67	70.58	43	49	6	Construction
Lack of equipment maintenance	62.78	61.39	60.39	43	35	46	Equipment
Shortage of site workers	62.22	60.46	64.31	45	39	30	Construction
Lack of co-ordination between design team and contractors	62.22	66.98	66.67	45	16	17	Design changes
Level of uncertainty of soil conditions	61.11	56.28	62.74	47	51	34	Climatic changes
Lack of job security for the consultancy team	60.55	57.21	58.04	48	50	53	Construction
Delays in subcontractors' work	60	55.81	54.51	49	53	60	Construction
Centralized consultant decision-making processes	59.44	64.17	61.57	50	25	42	Construction
Complexity of design	58.89	59.53	53.33	51	42	62	Design changes
Rework of bad quality performance	58.33	60	55.29	52	40	58	Construction
Damage to materials in storage	58.33	59.07	56.47	52	45	56	Materials
Poor quality of materials	58.33	58.6	67.07	52	47	14	Materials

Table 6-21: Comparison between parties involved in Libyan construction projects regarding the important factors in time overruns (cont.)

Factor	RI.I.	RI.I.	RI.I.	Rank	Rank	Rank	Group
	Contractors	Clients	Consultants	Contractors	Clients	Consultants	
Different political affiliation of workers	56.11	52.56	54.51	55	57	60	Legal changes
Lack of communication by donors to compensate for any bad results that may come from the political situation	55	52.09	53.33	56	61	63	Legal changes
Inappropriate construction methods	54.44	56.28	56.86	57	51	55	Construction
Lack of detailing of information	53.89	55.35	61.57	58	54	42	Construction
Lack of cost reports during construction stage	53.89	52.56	60.39	58	57	46	Funding
Equipment allocation problems	52.78	51.63	58.82	60	62	52	Equipment
Lack of regular sessions to address work problems	52.22	52.56	55.29	61	57	58	Construction
Storms and heavy dusty winds	50	52.56	56.47	62	57	56	Climatic changes
Unethical contractor behaviour in order to achieve the highest possible level of profit	48.89	51.63	61.57	63	63	42	Contractual procedures

Table 6.21 shows that there is consensus between contractors, clients and consultants regarding the importance of some of the factors affecting time overruns. An example is agreement that "lack of experience and performance of project management team" is one of these factors. However, Table 6.21 reveals some differences between the parties. One example is that contractors and clients agree on "lack of design team experience" being one such factor, which contrasts consultant's viewpoint.

Consultants also saw "Lack of proper financial appraisal of the project" as a major factor causing time overruns, as opposed to both contractors and clients. The explanation for these differences is that the nature of work differs from party to party, each of whom considers that they exert their utmost efforts to avoid project time overruns.

6.5.11 Ranking of factors causing delays in Libyan construction projects as perceived by all parties (contractors, clients and consultants)

The ranking of all the factors causing delays in Libyan projects that have been investigated in this research according to all types of respondent is shown in Table 6.22.

Table 6-22: Factors causing delays in Libyan construction projects as ranked by respondents

Factors	I.I.	Rank	Group
Lack of experience and performance of project management team	78.61	1	Construction
Low labour productivity	71.23	2	Construction
Lack of timely decisions and corrective actions	69.85	3	Construction
Inaccurate estimates	69.69	4	Construction
Changes in prices of materials	69.69	4	Materials
Lack of proper financial appraisal of the project	69.54	6	Funding
Strikes and border closures	69.38	7	Legal changes
Slowness in giving instructions	69.23	8	Construction
Deficiencies in coordination between parties (clients, consultants and contractors)	69.23	8	Construction
Market shortages of construction materials	68.77	10	Materials
Poor communications and misunderstanding	68.46	11	Construction
High quality of work required	68.46	11	Construction
Poor judgment in estimating time and resources	68.46	11	Construction
Inadequate contractor experience	68.46	11	Contractual procedures
Lack of design team experience	68.00	15	Design changes
Poor subcontractor skills and performance	67.85	16	Construction
Poor management and supervision on site	67.08	17	Construction
Delay of material deliveries to site	67.08	17	Materials
Difficulties in obtaining construction materials at official current prices	66.77	19	Materials
Lack of technically skilled staff	66.62	20	Construction
Indecision by the supervising team in dealing with the contractor's queries	66.62	20	Construction
Lack of new technology or new construction methods	65.85	22	Construction
Delays in decision making by Government	65.69	23	Legal changes
Lack of commitment to consultants' instructions	65.54	24	Construction
Lack of co-ordination between design team and contractors	65.54	24	Design changes
Delay in payments to contractors on completing work	65.54	24	Funding
Changing government policies and regulations	64.92	27	Legal changes
Poor contract management	64.62	28	Contractual procedures
Errors and omissions in bills of quantities	64.15	28	Construction

Table 6-22: Factors causing delays in Libyan construction projects as ranked by respondents (cont.)

Factors	I.I.	Rank	Group
Shortages of tools and equipment on site	64.00	30	Equipment
Mistakes during construction	63.85	31	Construction
Inappropriate types of contract used	63.85	31	Contractual procedures
Unrealistic contract expiry dates imposed by owners	63.69	33	Construction
Inadequate construction planning	63.69	33	Construction
Political instability	63.69	33	Legal changes
Lack of a strong organizational culture	63.54	36	Construction
Unpredictable weather conditions	63.38	37	Weather and natural calamities
Improvements to standard drawings during the construction stage	62.62	38	Construction
Shortages of site workers	62.46	39	Construction
Requirements for external work	62.31	40	Construction
Difficulties in obtaining construction licences	62.31	40	Legal changes
Consultants' centralized decision-making processes	61.85	42	Construction
Poor quality of materials	61.85	42	Materials
Lack of equipment maintenance	61.38	44	Equipment
Slow payment for completed work	61.08	45	Funding
Absence of consultants' site staff	60.31	46	Construction
Shortage of craftsmen	60.15	47	Construction
Level of uncertainty of soil conditions	60.15	47	Weather and natural calamities
Wrong choice of site	58.46	49	Construction
Lack of job security for the consultancy team	58.46	49	Construction
Damage to materials in storage	57.85	51	Materials
Rework of bad quality performance	57.69	52	Construction
Lack of detailed information	57.38	53	Construction
Complexity of design	56.92	54	Design changes
Delay in subcontractors' work	56.46	55	Construction

Table 6-22: Factors causing delays in Libyan construction projects as ranked by respondents (cont.)

Factors	I.I.	Rank	Group
Inappropriate construction methods	56.00	56	Construction
Lack of cost reports during construction stage	56.00	56	Funding
Equipment allocation problems	54.77	58	Equipment
Unethical contractor behaviour in order to achieve the highest possible level of profit	54.77	58	Contractual procedures
Different political affiliation of workers	54.31	60	Legal changes
Too few regular sessions to address work problems	53.54	61	Construction
Storms and heavy dusty winds	53.38	62	Weather and natural calamities
Poor communication by donors to compensate for any bad results that may come from the political situation	53.38	63	Legal changes

The ranking of factors causing time overruns in Libyan construction projects by the parties involved in this study (contractors, clients and consultants) is shown in Table 6.22. The respondents ranked “lack of experience and performance of the project management team” in first position. “Low labour productivity” was second and “lack of timely decisions and corrective actions” was third. The major factors influencing delays in Libyan projects have already been discussed in this chapter.

6.6 Factors causing cost overruns in Libyan projects

The section consists of the results of factors causing cost overruns. The results were grouped into 8 groups, these groups are; construction factors, weather and natural calamities, equipment, materials, contractual procedures, design change, funding and change in law factors.

6.6.1 Construction

Contractors’ perceptions on the construction factor

Table 6.23 shows that respondents contractors ranked “Poor management and supervision in the site” “in the first position with importance index (I.I = 76.67 %). The second important factor ranked by respondents contractors to cause cost overrun at this group was “Deficiencies in coordination between parties- (client, consultant and Contractor)” (I.I=75%) and the third factor ranked was “Poor judgment in estimating time and resources” within importance index (I.I=74.44%). The respondents’ contractors as shown in table 6.23 ranked the “Delay in subcontractors' work” (I.I = 49.44 %) as the least factor causes cost overrun at this group.

Clients’ perceptions on the construction factor

Table 6.23 shows that respondents clients ranked “Lack of experience and performance of project management team " in the first position with importance index (I.I = 73.02 %). The second important factor ranked by respondents’ clients to cause cost overrun at this group was “Inaccurate estimates” (I.I=70.23%). The respondents clients ranked “Poor management and supervision in the site” in third factor with importance index (I.I=68.39%). The respondents’ clients as shown in table 6.23 ranked the “lack of detailing of information" (I.I = 48.37 %) as the least factor causes cost overrun at this group.

Consultants' perceptions on the construction factor

Table 6.23 shows that respondent's consultants ranked "Poor management and supervision in the site" in the first position with importance index (I.I = 71.76%). This result is identical in terms of order with the contractors, which reflects the importance of this factor regarding to the view of contractors and consultants. The second important factor ranked by respondents consultants was "Lack of timely decisions and corrective actions" with importance index (I.I = 70.19 %). "Inaccurate estimates" was ranked as the third factor cause cost overrun in construction projects within importance index (I.I= 68.63%). Respondents' consultants ranked "Delay in subcontractors' work" as the lowest important factor, of cost overrun at this group (I.I=48.63%).

Table 6-23: Construction-related factors leading to cost overruns

NO.	Construction factors	Contractor		Client		Consultant	
		Relative importance index (R.I.I)	Rank	**Relative importance index (R.I.I)**	Rank	**Relative importance index (R.I.I)**	Rank
1.1	Lack of experience and performance of project management team	71.11	5	73.02	1	65.49	9
1.2	Poor management and supervision in the site	76.67	1	68.39	3	71.76	1
1.3	Mistakes during construction	57.22	26	60.46	24	58.43	19
1.4	Lack of timely decisions and corrective actions	59.44	23	68.37	5	70.19	2
1.5	lack of detailing of information	55.55	29	48.37	33	56.08	25
1.6	Inappropriate construction methods	60	21	61.38	22	67.84	4
1.7	Poor communications and misunderstanding	70	6	68.38	4	67.06	8
1.8	Slowness in giving instruction	59.44	23	61.39	21	57.65	21
1.9	Little periodical sessions to address work problems	53.89	31	51.16	32	51.76	29
1.10	Lack of technical skills of staff	66.11	11	62.79	18	60	18
1.11	High quality of work required	62.78	17	63.26	17	67.45	6
1.12	Poor judgment in estimating time and resources	74.44	3	66.51	8	62.74	12
1.13	Lack of a strong organizational culture	51.67	32	59.07	25	54.12	26
1.14	Shortages of craftsmen	55	30	60.93	23	50.59	31
1.15	Lack of new technology or new construction methods	66.67	10	65.12	11	67.84	4
1.16	Shortage of site workers	68.33	7	63.72	16	62.35	14
1.17	Rework of bad quality performance	65	13	67.44	7	63.92	13
1.18	Inaccurate estimates	72.78	4	70.23	2	68.63	3
1.19	Indecision by the supervising team in dealing with the contractor's queries	58.89	25	65.12	11	61.18	15

Table 6-23 :Construction-related factors leading to cost overruns (cont.)

NO.	Construction factors	Contractor		Client		Consultant	
		Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
1.20	Deficiencies in coordination between parties- (client, consultant and Contractor)	75	2	67.91	6	67.45	6
1.21	Improvements to standard drawings during construction stage	67.78	9	61.38	20	64.31	11
1.22	Wrong choice of site	60	21	56.74	27	57.25	22
1.23	Errors and omission in the bills of quantities	68.33	7	65.12	11	65.09	10
1.24	Delay in subcontractors' work	49.44	33	46.05	30	48.63	33
1.25	Unrealistic contract durations imposed by owner	60.56	19	54.88	29	58.14	20
1.26	Non commitment to consultant instructions	63.33	15	58.14	26	56.86	23
1.27	Poor of subcontractor's skills and performance	66.11	11	64.65	15	56.86	23
1.28	low labour productivity	63.89	14	62.79	18	62.35	12
1.29	Absence of consultant's site staff	62.79	18	65.58	10	53.72	27
1.30	Lack of job security for the consultancy team	57.22	26	55.81	28	52.55	28
1.31	Centralization of decision making process from consultant party	60.56	19	52.56	30	50.19	32
1.32	Required of external work	57.22	26	52.09	31	51.37	30
1.33	Inadequate construction planning	63.33	15	66.05	9	60.39	17

6.6.2 Weather and Natural Calamities

Contractor' perception

Regarding the view of contractors the most important factor leading to cost overrun, "Level of uncertainty of soil conditions" was ranked first (I.I=67.22%), then followed "Unpredictable weather conditions" (I.I=63.33%) and "storms and heavy-dusty wind" (I.I=55.56%).

Client

The results given in Table 6.24 show that the respondents clients ranked "unpredictable weather conditions" was the first factor (I.I=72.56%) while "level of uncertainty of soil conditions" was the second factor (I.I=65.11%). the third factor "storms and heavy-dusty wind" was ranked third as the pervious result (I.I=59.07%).

Consultant

Based on Table 6.24, the results of responses of consultants completely agreed with the results of respondents client, the factor "unpredictable weather conditions" was ranked as the first factor causing cost overrun in the weather and natural calamities group(I.I=62.74%). The second group was "level of uncertainty of soil conditions" (I.I= 57.25%). Respondents' consultants ranked "storm and heavy- dusty wind" as the lowest important factor, of delay at this group.

NO	2. Weather and Natural calamities	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
2.1	Unpredictable weather conditions	63.33	2	72.56	1	62.74	1
2.2	Level of uncertainty of soil conditions	67.22	1	65.11	2	57.25	2
2.3	Storms and heavy-dusty wind	55.56	3	59.07	3	49.80	3

Table 6-24: Weather and natural calamity-related factors leading to cost overruns

6.6.3 Equipment

Contractor

Table 6.25 shows that respondents contractors ranked "Lack of maintenance for the equipment" in the first position with importance index (I.I=68.33%). The second important factor ranked by respondents' contractors was Shortage of tools and equipments on site (I.I=67.22%), while Equipment allocation problems were considered as the least factor that cause cost overrun (I.I=60.56%).

Client

The same rank observed by the respondents' contractors was ranked by the respondents' client but with different value in RII.

Consultant

No change was observed here where the order was the same as the respondents consultant and contractors but difference in the values of RII, see Table 6.25.

NO	3. Equipment factors	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
3.1	Equipment allocation problems	60.56	3	59.53	3	63.53	1
3.2	Shortage of tools and equipments on site	67.22	2	63.72	2	58.82	2
3.3	Lack of maintenance for the equipment	68.33	1	64.65	1	55.67	3

Table 6-25: Equipment-related factors leading to cost overruns

6.6.4 Materials

Contractors

Table 6.26 shows that respondents contractors ranked the most important factor leading to cost overruns was "shortage of construction material in markets" with importance index (I.I=72.22%). The second important factor ranked by respondents contractors to cause cost overrun at this group was "Difficulties in obtaining construction materials at official current prices" (I.I=76.11%). "Delay of material delivery to site" (I.I= 71.67%) is the third factor of cost overruns ranked by contractor. Respondents contractors as shown in table 4 ranked the "Damage of materials in storage" (I.I = 66.67%) as the less important factor of cost overrun at this group.

Clients

Table 6.26 shows that respondents clients ranked "Changes in prices of materials" in the first position with importance index (I.I = 72.09%).

The second important factor ranked by respondents clients was "Low quality of materials" with importance index (I.I = 70.69 %). "Delay of material delivery to site" (I.I = 70.23 %) was ranked as the third factor to cause cost overrun at this group. Like respondents contractors, according to the respondents clients the less important factor of cost overrun at this group the "Damage of materials in storage" (I.I= 63.23%).

Consultant

Table 6.26 shows that the respondents consultants ranked the "Low quality of materials" (I.I = 68.63%) as the first and second factors causes of cost overrun was "Delay of material delivery to site" with importance index (66.67). The respondents' consultants as shown in table 6.26 ranked the "Changes in prices of materials" (I.I = 63.92 %) as the least factor causes cost overrun at this group.

NO	4. Materials factors	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
4.1	Shortage of construction material in markets	77.22	1	67.91	4	65.09	5
4.2	Changes in prices of materials	68.89	5	72.09	1	63.92	6
4.3	Damage of materials in storage	66.67	6	63.26	6	65.49	3
4.4	Delay of material delivery to site	71.67	3	70.23	3	66.67	2
4.5	Low quality of materials	71.11	4	70.69	2	68.63	1

4.6	Difficulties in obtaining construction materials at official current prices	76.11	2	65.58	5	64.31	4

Table 6-26: material-related factors leading to cost overruns

6.6.5 Contractual procedures

Contractor

Table 6.27 shows that the respondents contractors ranked the "Inappropriate type of contract used" in the first position with importance index (I.I= 73.33%). The second important factor ranked by respondents contractors was the "Inadequate contractor experience" (I.I=66.11%). The respondents contractors as shown in table 6.27 classify the "unethical behaviours used by contractors to achieve the highest possible level of profit" (I.I = 61.67 %) as the least factor to cause cost overrun in this category.

Clients

The "Poor contract management" was ranked in the first position with importance index (I.I= 69.77%). The second important factor ranked by respondents contractors was the "Inadequate contractor experience" (I.I=68.84%). The respondents contractors as shown in table 6.27 classify the "unethical behaviours used by contractors to achieve the highest possible level of profit" (I.I = 57.67 %) as the least factor to cause cost overrun in this category.

Consultant

The factor "Poor contract management "was ranked as the first factor causing cost overrun in this group (I.I=67.84%). The second group was "Inappropriate type of contract used" (I.I= 65.88%). Respondents' consultants ranked "unethical behaviours used by contractors to achieve the highest possible level of profit" as the lowest important factor, of cost overrun at this group.

NO	5. Contractual procedures	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
5.1	Inappropriate type of contract used	73.33	1	67.91	3	65.88	2
5.2	Unethical behaviours used by contractors to achieve the highest possible level of profit	61.67	4	57.67	4	49.80	4
5.3	Inadequate contractor experience	66.11	2	68.84	2	63.92	3
5.4	Poor contract management	63.33	3	69.77	1	67.84	1

Table 6-27: Contractual procedures leading to cost overruns

6.6.6 Design Change

Contractor

Table 6.28 shows that respondents contractors ranked the most important factor leading to cost overruns was "poor experience of design team" with importance index (I.I=71.67%). The second important factor ranked by respondents' contractors to cause cost overrun at this group was "lack of co-ordination between design team and contractor" (I.I=68.37%). "Complexity of design" (I.I = 63.33 %) was ranked as the third factor to cause cost overrun at this group.

Clients

The respondents clients identify "Complexity of design" factor comes as the first (I.I=60.46%), while Poor experience of design team was the second (I.I=56.67%), and Lack of co-ordination between design team and contractor was the third (I.I=55.53%).

Consultant

Unlike to respondents' contractors and clients, the factors "Poor experience of design team" was classified the first (I.I=63.33%) and "Complexity of design" factor comes as the second (I.I=58.82%). The respondents consultants ranked "Lack of co-ordination between design team and contractor" (I.I = 54.90 %) as the third factor to cause cost overrun at this group.

NO	6. Design change	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
6.1	Poor experience of design team	71.67	1	56.67	2	63.33	1
6.2	Lack of co-ordination between design team and contractor	68.37	2	55.35	3	54.90	3
6.3	Complexity of design	63.33	3	60.46	1	58.82	2

Table 6-28: design change-related factors leading to cost overruns

6.6.7 Funding

Contractor

Table 6.29 shows that, the respondents' contractors ranked "Financial problems" as the first factor of this group with importance index (I.I=73.89%). The second important factor ranked by respondents contractors to cause cost overrun at this group was "Delay in contractors payment of completing work" (I.I=60%). "Lack of cost reports during construction stage" with importance index (I.I=58.89%) was ranked the third factor and "Slow payment of completed works" at the least factor to cause cost overrun in this category.

Clients

Table 6.29 shows that the first factor was ranked "Financial problems" with importance index (I.I=68.73%). The second important factor ranked by respondents clients to cause cost overrun at this group was "Delay in contractors' payment of completing work" as the first factor of this group with importance index (I.I=59.70%). Full agreement about the least factor of delay factor was among respondents clients and consultants which is "Lack of cost reports during construction stage" (I.I=58.60%)

Consultant

The similar ranks of first and second factors were observed by the respondents' contractors was ranked by the respondents' consultants but with different order of last two factors cause cost overrun as shown in the table 6.29

NO	7. Funding factors	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
7.1	Lack of proper financial appraisal of the project	73.89	1	68.37	1	70.59	1
7.2	Delay in contractors payment of completing work	60	2	59.07	2	59.61	2
7.3	Slow payment of completed works	53.89	4	59.07	2	59.22	3
7.4	Lack of cost reports during construction stage	58.89	3	58.60	4	56.47	4

Table 6-29: Funding-related factors leading to cost overruns

6.6.8 Legal and regulatory changes

Contractor

Based on the respondents contractors in table 6.30, the delay was firstly caused by "strikes and borders closures" (I.I=71.67%), and the second factor ranked by contractors was "Political instability" with importance index (I.I= 68.33%). "Delays in decision making by government" was ranked as the third factor cause delay (I.I=67.78%). The respondents contractors as shown in table 7 classify the "Difficulties in obtaining construction licences" (I.I = 52.22 %) as the least factor to cause cost overrun in this category.

Clients

The table 6.30 shows that Political instability was found to be, here, the first (I.I=72.56%), while was the second factor cause cost overrun regarding the respondents' clients "Delays in decision making by Government" with importance index (I.I=69.77%) Also, the respondents clients as shown in table 6.30 classify the "Difficulties in obtaining construction licences" (I.I = 50.23 %) as the least factor to cause cost overrun in this category.

Consultant

The results show that "Political instability" was classified as the first factor causing cost overrun regarding the respondents consultants within importance index (I.I=76.47 %), which was the same order of the respondents client. Meanwhile, the respondents consultants ranked "Delays in decision making by Government" as the second factor (I.I=73.33%). The respondents consultants as shown in table 8 classify the "Difficulties in obtaining construction licences" (I.I = 50.98 %) as the least factor to cause cost overrun in this category.

NO	8. Changes in Law Factors	Contractor		Client		Consultant	
		RII	Rank	RII	Rank	RII	Rank
8.1	Different political affiliation of workers	53.33	6	56.28	6	52.16	6
8.2	Low communication of donors to compensate any bad results that may come from the political situation	60.56	5	60.93	4	65.09	3
8.3	Delays in decision making by Government	67.78	3	69.77	2	73.33	2
8.4	Political instability	68.33	2	72.56	1	76.47	1
8.5	Strikes and borders closures	71.67	1	66.51	3	63.53	4
8.6	Government changing policies and regulations	61.67	4	59.53	5	61.96	5
8.7	Difficulties in obtaining construction licences	52.22	7	50.23	7	50.98	7

Table 6-30: changes in low-related factors leading to cost overrun

6.6.9 Ranking of all factors causing cost overruns from the perceptions of contractors, clients and consultants

Table 6-31: All factors causing cost overruns investigated in this study, as ranked by respondent types

Factors	Contractors		Clients		Consultants	
	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
Market shortages of construction materials	77.22	1	67.91	15	65.09	18
Poor management and supervision on site	76.67	2	68.39	11	71.76	3
Difficulties in obtaining construction materials at official current prices	76.11	3	65.58	22	64.31	21
Deficiencies in coordination between parties (clients, consultants and contractors)	75	4	67.91	15	67.45	11
Poor judgment in estimating time and resources	74.44	5	66.51	19	62.74	29
Lack of proper financial appraisal of the project	73.89	6	68.37	13	70.59	4
Inappropriate types of contract used	73.33	7	67.91	15	65.88	15
Inaccurate estimates	72.78	8	70.23	6	68.63	6
Delays in deliveries of materials to site	71.67	9	70.23	6	66.67	14
Lack of design team experience	71.67	9	56.67	53	63.33	26
Strikes and border closures	71.67	9	66.51	20	63.53	26
Lack of experience and performance of project management team	71.11	12	73.02	1	65.49	16
Poor quality materials	71.11	12	70.69	5	68.63	6
Poor communications and misunderstandings	70	14	68.38	12	67.06	13
Changes in prices of materials	68.89	15	72.09	4	63.92	23

Table 6-31: All factors causing cost overruns investigated in this study, as ranked by respondent types (cont.)

Factors	Contractors		Clients		Consultants	
	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
Lack of co-ordination between design team and contractors	68.37	16	55.35	56	54.90	51
Shortage of site workers	68.33	17	63.72	30	62.35	31
Errors and omissions in bills of quantities	68.33	17	65.12	24	65.09	18
Lack of equipment maintenance	68.33	17	64.65	28	55.67	50
Political instability	68.33	17	72.56	2	76.47	1
Improvements to standard drawings during the construction stage	67.78	21	61.38	37	64.31	11
Delays in decision making by government	67.78	21	69.77	8	73.33	2
Level of uncertainty of soil conditions	67.22	23	65.11	27	57.25	44
Shortages of tools and equipment on site	67.22	23	63.72	30	58.82	39
Lack of new technology or new construction methods	66.67	25	65.12	24	67.84	8
Damage of materials in storage	66.67	25	63.26	32	65.49	16
Lack of technically skilled staff	66.11	27	62.79	34	60	36
Poor of subcontractor's skills and performance	66.11	27	64.65	28	56.86	46
Inadequate contractor experience	66.11	27	68.84	10	63.92	23
Rework of bad quality performance	65	30	67.44	18	63.92	23
Low labour productivity	63.89	31	62.79	34	62.35	31
Lack of commitment to consultants' instructions	63.33	32	58.14	50	56.86	46
Unpredictable weather conditions	63.33	32	72.56	2	62.74	29
Inadequate construction planning	63.33	32	66.05	21	60.39	35
Poor contract management	63.33	32	69.77	8	67.84	8
Complexity of design	63.33	32	60.46	41	58.82	39

Table 6-31: All factors causing cost overruns investigated in this study, as ranked by respondent types (cont.)

Factors	Contractors		Clients		Consultants	
	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
Absence of consultant's site staff	62.79	37	65.58	22	53.72	53
High quality of work required	62.78	38	63.26	32	67.45	11
Unethical contractor behaviour in order to achieve the highest possible level of profit	61.67	39	57.67	51	49.80	61
Government changing policies and regulations	61.67	39	59.53	43	61.96	33
Equipment allocation problems	60.56	41	59.53	43	63.53	26
Unrealistic contract expiry dates imposed by owners	60.56	41	54.88	57	58.14	42
Centralization of consultants' decision-making processes	60.56	41	52.56	58	50.19	60
Lack of communication by donors to compensate any bad results that may come from the political situation	60.56	41	60.93	39	65.09	18
Inappropriate construction methods	60	45	61.38	37	67.84	8
Wrong choice of site	60	45	56.74	52	57.25	44
Delay in payments to contractors of completing work	60	45	59.07	45	59.61	37
Lack of timely decisions and corrective actions	59.44	48	68.37	13	70.19	5
Slowness in giving instructions	59.44	48	61.39	36	57.65	43
Indecision by the supervising team in dealing with the contractor's inquiries	58.89	50	65.12	24	61.18	34
Lack of cost reports during construction stage	58.89	51	58.60	49	56.47	48
Mistakes during construction	57.22	52	60.46	24	58.43	41
Lack of job security for the consultancy team	57.22	52	55.81	55	52.55	54
Requirements for external work	57.22	52	52.09	59	51.37	57
Storms and heavy dusty winds	55.56	55	59.07	45	49.80	61
Lack of detailed information	55.55	56	48.37	62	56.08	49
Shortages of craftsmen	55	57	60.93	39	50.59	59

Table 6-31: All factors causing cost overruns investigated in this study, as ranked by respondent types (cont.)

Factors	Contractors		Clients		Consultants	
	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank	Relative importance index (R.I.I)	Rank
Lack of regular sessions to address work problems	53.89	58	51.16	60	51.76	56
Slow payment of completed works	53.89	58	59.07	45	59.22	38
Different political affiliation of workers	53.33	60	56.28	54	52.16	55
Lack of a strong organizational culture	51.67	61	59.07	45	54.12	52
Difficulties in obtaining construction licences	52.22	62	50.23	61	50.98	58
Delay in subcontractors' work	49.44	63	46.05	63	48.63	63

Table 6.31 illustrates the ranking by contractors, clients and consultants of all the factors causing cost overruns that have been investigated in this study. A total of 63 such factors have been classified into eight groups. The ranking is based on I.I. values.

Contractors' perceptions

Table 6.31 shows that the contractors ranked "market shortages of construction materials" as the leading cause of cost overruns (I.I. = 77.22 per cent). The uniqueness of the majority of construction projects in Libya makes the management of materials a challenge that continues to cause cost overruns. According to Enshassi et al. (2003), materials account for about 70 per cent of the total value of a project. The lack of construction materials when required on site is normally the single most frequent problem that causes construction delays (Alzohbi et al., 2011). Regarding the extraordinary political situation, when the market runs out of materials, suppliers tend to increase costs. Table 6.31 shows that the contractors ranked "poor management and supervision on site" as the second major factor causing cost overrun in Libyan construction projects, with an importance index of 76.67 per cent). Poor site management and supervision leads to cost overruns in Libyan construction projects. Long et al. (2008) agrees that poor supervision reflects the weakness and incompetence of contractors. The third major factor was "difficulties in obtaining construction materials at official current prices" (I.I. = 76.11 per cent). These results are due to the extraordinary political situation in the country. "Deficiencies in coordination between parties (clients, consultants and contractors)", with an importance index of 75 per cent, was ranked fourth most likely to cause cost overruns, a finding with which Kumaraswamy & Chan (1998), Al-Momani (2000), Kartam et al. (2000) and Iya & Jha (2005) would agree. Table 6.31 shows that contractors viewed "delay in subcontractors' work" (I.I. = 49.44 per cent) as the factor least likely to cause cost overruns. This finding indicates that the contractor regards this factor as having less effect on project cost overruns.

Clients' perceptions

Table 6.31 shows that clients ranked "lack of experience and performance of project management team" first, with an importance index of 73.02 per cent), a result echoed by

Kartam et al. (2000), Frimpong et al. (2003), Ling (2004) and Chan & Park (2005), which demonstrates that project management teams are largely inexperienced, especially in financial management, and that as a result the distribution of project costs is not well planned. This may therefore cause projects running over budget.

Table 6.31 shows that "political instability and unpredictable weather conditions" were seen by clients as the second major factor contributing to cost overruns (I.I. = 72.56 per cent). This also holds for the results of studies by Kaming et al. (1997), Koushki et al. (2005), Al-Momani (2000), Frimpong et al. (2003), Iyer & Jha (2005) and Yogeswaran et al. (1998). Table 6.31 shows that clients ranked "changes in prices of materials" fourth (I.I. = 72.09 per cent). Purchasing construction materials from the best source, at the right price and with timely delivery poses challenges to many Libyan construction organisations. According to Table 6.31, client classified "delay in subcontractors' work" (I.I. = 46.05 per cent) as the factor least liable to cause cost overruns.

Consultant's perceptions

The results show that consultants regarded the clients' second choice, "political instability" as the leading factor causing cost overruns, with an importance index of 76.44.16 per cent. This reflects the importance of this factor overall, particularly at the time of writing, owing to the 10-month civil war sparked by the Arab Spring followed by years of Internal conflicts in Libya. The majority of private companies that do restart operations in Libya after the civil war are likely to see the benefits of a softer approach; local contacts, as well as partnerships with local firms, may well form the backbone of any in-country business plan. The current political uncertainty also means that many companies are currently seeking the financial benefits of a low profile. Studies by Sonuga et al. (2002), Kuruooglu & Ergen (2000), Baloi & Price (2003) and Iyer & Jha (2005) agree that unstable government policies constitutes a very important factor in cost overruns.

Table 6.31 shows that consultants ranked "delays in decision-making by Government" as the second major factor causing cost overruns, with an importance index of 73.33 per cent. Timely decision-making is important in preventing delays to construction projects. The decision-making process is key to effective project management, especially in value and risk analysis (Stuckenbruck, 1981). Libyan public departments' job cultures are mostly driven by regulations and restrictive procedures. The flexibility of public departments in managing public construction projects is highly dependent on the State's regulatory bodies and on the people who are in charge of managing these departments.

Table 6.31 shows that consultants ranked "poor management and supervision on site" as the third major factor causing cost overruns, with an importance index of 71.76 per cent). Contractors saw this as even more important, placing it second. Long et al., (2008) would agree with this general assessment. The most appropriate interpretation of this result is that the lack of an effective monitoring and control system throughout the lifetime of a construction project will lead to double-invoicing and over-charging, which in turn will contribute significantly to project time and cost overruns.

Table 6.31 shows that consultants ranked "Lack of proper financial appraisal of the project" fourth in this group, with an importance index of 70.59 per cent. The results of studies by Al-Khalil & Al-Ghafly (1999), Elinwa & Joshua (2001), Odeh & Battaineh (2002) and Rahman et al. (2006) are compatible with this finding. The clearest interpretation of this ranking is that all three respondent types are responsible for project control processes. Owners should payments regularly to contractors so that delays can be avoided, and to improve the contractor's ability to deliver the project on time and to standard. The contractor should manage financial resources and plan cash flow by utilising progress payments and managing the contingency budget to cover expenses resulting from climate factors and market price fluctuations. The consultant should also be asked to review the contractors' monthly payment certificates, which might involve presenting a monthly report on the progress of the work that should outline the rate of progress, and identify and account for any delays.

Overall correlation

Contractors and clients		Contractors and consultants		Clients and consultants	
correlation	p-value	correlation	p-value	correlation	p-value
.675	<.001	.654	<.001	.757	<.001

Table 6-32: Cost correlation among contractors, consultants and client for all factors

By measuring the correlation for the rank of all factors, Table (6.32) reveals that a good positive correlation (.675), which is very highly significant (p-value<.001), is observed between contractors and clients. Contractors also correlate positively (.654) with consultants, a correlation that is highly significant (p-value<.001). Similarly, there is a positive correlation (.757) with a p-value of <.001 between clients and consultants. As a result, the responses show a significant degree of agreement regarding the ranking of the factors. The responses tend to show strong correlations coefficient for all of groups of cost overruns for contractor, owner and consultant.

6.6.10 Ranking by all three types of respondent of the factors causing cost overruns in Libyan construction projects

The ranking by all respondents of all the factors causing cost overruns in Libyan projects that have been investigated in this research is shown in Table 6.33.

Table 6-33: The ranking by all respondents of all the factors causing cost overruns

Factors	Importance Index (I.I)	Rank	Group
Political instability	72.92	1	Legal changes
Poor management and supervision on site	72.00	2	Construction
Lack of proper financial appraisal of the project	70.77	3	Funding
Delays in decision-making by government	70.62	4	Legal changes
Inaccurate estimates	70.31	5	Construction
Poor quality materials	70.00	6	Materials
Deficiencies in coordination between parties (clients, consultants and contractors)	69.69	7	Construction
Lack of experience and performance of project management team	69.54	8	Construction
Market shortages of construction materials	69.38	9	Materials
Delays in material deliveries to site	69.23	10	Materials
Lack of design team experience	69.08	11	Design changes
Inappropriate types of contract used	68.62	12	Contractual procedures
Poor communication and misunderstanding	68.31	13	Construction
Changes in prices of materials	68.00	14	Materials
Difficulties in obtaining construction materials at official current prices	68.00	14	Materials
Poor contract management	67.23	16	Contractual procedures
Poor judgment in estimating time and resources	67.08	17	Construction
Strikes and border closures	66.77	18	Legal changes
Lack of timely decisions and corrective actions	66.62	19	Construction

Table 6-33: The ranking by all respondents of all the factors causing cost overruns (cont.)

Factors	Importance Index (I.I)	Rank	Group
Lack of new technology or new construction methods	66.62	19	Construction
Unpredictable weather conditions	66.15	21	Weather and natural calamities
Inadequate contractor experience	66.15	21	Contractual procedures
Errors and omissions in the bills of quantities	66.00	23	Construction
Rework of bad quality performance	65.38	24	Construction
Damage of materials in storage	65.08	25	Materials
High quality of work required	64.77	26	Construction
Shortage of site workers	64.46	27	Construction
Improvements to standard drawings during the construction stage	64.31	28	Construction
Inappropriate construction methods	63.54	29	Construction
Inadequate construction planning	63.08	30	Construction
Low labour productivity	62.92	31	Construction
Shortages of tools and equipment on site	62.77	32	Equipment
Lack of technically skilled staff	62.62	33	Construction
Level of uncertainty of soil conditions	62.62	33	Weather and calamities
Lack of communication from donors to compensate for uncertainties resulting from poor political situation	62.46	35	Legal changes
Lack of equipment maintenance	62.15	36	Equipment
Poor quality of subcontractor's skills and performance	62.00	37	Construction
Indecision by the supervising team in dealing with the contractor's queries	61.85	38	Construction
Equipment allocation problems	61.38	39	Equipment
Changing government policies and regulations	61.08	40	Legal changes
Complexity of design	60.62	41	Design changes
Absence of consultant's site staff	60.15	42	Construction
Delay in payments to contractors of completing work	59.54	43	Funding
Lack of commitment to consultants' instructions	59.08	44	Construction
Mistakes during construction	58.77	45	Construction
Unrealistic contract expiry dates imposed by owner	58.31	46	Construction
Wrong choice of site	57.85	47	Construction
Lack of cost reports during construction stage	57.85	47	funding
Slow payment for completed work	57.69	49	Funding
Slowness in giving instruction	56.62	50	Construction

Table 6-33: The ranking by all respondents of all the factors causing cost overruns (cont.)

Factors	Importance Index (I.I)	Rank	Group
Unethical contractor behaviour in order to achieve the highest possible level of profit	55.69	51	Contractual procedures
Lack of co-ordination between design team and contractor	55.54	52	Design changes
Shortages of craftsmen	55.23	53	Construction
Lack of a strong organizational culture	55.08	54	Construction
Lack of job security for the consultancy team	54.92	55	Construction
Storms and heavy dusty winds	54.46	56	Weather and natural calamities
Centralized consultants' decision making processes	53.85	57	Construction
Different political affiliation of workers	53.85	57	Legal changes
Lack of detailed information	53.38	59	Construction
Requirements for external work	53.23	60	Construction
Lack of regular sessions to address work problems	52.15	61	Construction
Difficulties in obtaining construction licences	51.08	62	Legal changes
Delay in subcontractors' work	48.00	63	Construction

The respondents' ranking of factors causing cost overruns in Libyan construction projects is shown in Table 6.33. They rated "political instability" as the leading factor because of the extraordinary political situation at the time the study was conducted. Poor management and supervision on site was ranked second, while they viewed Lack of proper financial appraisal of the project as being the third greatest contributor. The major factors influencing cost overruns in Libyan projects have already been discussed in this chapter.

6.6.11 A comparison of rankings of influencing time control and influencing cost control factors

The results show that there is a large degree of consensus between contractors, clients and consultants regarding the ranking of the major factors affecting time and cost overruns. They all rated "lack of experience and performance of project management team" as the leading cause of delays, but only ranked it eighth in relation cost overruns. This result comes as no surprise because lack of experience will certainly have a negative effect on schedules, which will consequently increase projects' costs. Another example of consensus is the factor "inaccurate estimates" which was ranked fourth as regards delays, but fifth for cost control. This is also to be expected, because in Libyan organisations it is mostly project consultants, managers and experts who give cost and time estimates, the accuracy of which depends on their level of experience in project planning, as well as on the estimation process itself. Therefore, the accurate estimation of unit costs for all activities and the requisite resources is very important for the consistent completion of the required tasks within the planned time frame.

Tables (6.22) and (6.33) also reveal a consensus regarding the weighting given the factors affecting time and cost overruns. For example, Lack of proper financial appraisal of the project was ranked as sixth for delays but third for cost overruns. This should be expected because any interruption of regular progress payments to contractors, or failure to manage financial resources and plan cash flow by utilising progress payments and managing the contingency budget to cover expenses resulting from climate factors and high market prices, will result in cost and time overruns.

There was also consensus on the lowest as well as the highest-ranking factors, examples being the lack of regular sessions to address work problems, delays in subcontractors' work and lack of detailed information. Some differences did emerge, however. The explanation for these is that the nature of construction work varies between parties, each of whom regards themselves as sparing no effort to avoid time and cost overruns.

6.7 Categorisation of time and cost overrun factors based on the party responsible

This section reviews another part of the results of Survey Questionnaire I. It presents the respondents' perceptions on the responsibility of the parties involved in construction projects regarding the above factors. Based on the existing literature and findings from pilot studies, delays and cost overruns causes of construction projects can be divided into four categories:

(1) contractor- related causes
(2) consultant- related causes
(3) client- related causes
(4) external party- related causes

The respondents were asked to categorize the party responsible for each cost and time overrun factor; the frequency and percentage for each of these is illustrated in Table 6.34.

Table 6-34: the party responsible for cost and time overruns factors

Factors causing cost and time overruns	No	% (Contractors)	No	% (Consultants)	No	% (Clients)	No	% (External parties)	Rating of dominate party			
Lack of experience and performance of project management team	91	70	13	10	14	10.8	12	9.5	1	3	2	4
Poor management and supervision on site	62	47.7	43	33.1	11	8.5	14	10.8	1	2	4	3
Mistakes during construction	80	61.5	36	27.4	3	2.3	11	8.5	1	2	4	3
Lack of timely decisions and corrective actions	19	14.6	72	55.4	24	18.5	15	11.5	2	3	1	4
Lack of detailed information	15	11.5	52	40.0	49	37.7	14	10.8	2	3	1	4
Inappropriate construction methods	86	66.2	20	15.4	8	6.2	16	12.3	1	2	4	3
Poor communication and misunderstanding	13	10.0	63	48.5	37	28.5	17	13.1	2	3	4	1
Slowness in giving instructions	25	19.2	55	42.3	35	26.9	15	11.5	2	3	1	4
Lack of regular sessions to address work problems	61	46.9	40	30.8	15	11.5	14	10.8	1	2	3	4
Lack of technically skilled staff	81	62.3	9	6.9	29	22.3	11	8.5	1	3	4	2
High quality of work required	38	29.2	53	40.8	27	20.8	12	9.2	1	2	3	4
Poor judgment in estimating time and resources	61	46.9	32	24.6	23	17.7	14	10.8	1	2	3	4
Lack of a strong organizational culture	76	58.5	28	21.5	19	14.6	7	5.4	1	2	3	4
High quality of work required	74	56.9	18	13.8	29	22.3	9	6.9	1	3	2	4
Lack of new technology or new construction methods	72	55.4	15	11.5	32	24.6	11	8.5	1	3	2	4
Shortage of site workers	83	63.8	9	6.9	29	22.3	9	6.9	1	3	2	4
Rework of bad quality performance	69	53.1	36	27.7	18	13.8	7	5.4	1	2	3	4
Inaccurate estimates	38	29.2	46	35.4	36	27.7	10	7.7	2	1	3	4
Indecision by the supervising team in dealing with the contractor's queries	24	18.5	64	49.2	37	28.5	5	3.8	2	3	1	4
Deficiencies in coordination between parties (clients, consultants and contractors)	47	36.2	34	26.2	41	31.5	8	6.2	1	3	2	4
Improvements to standard drawings during the construction stage	15	11.5	52	40.0	50	38.5	13	10	2	3	1	4
Wrong choice of site	15	11.5	36	27.7	45	34.6	34	26.2	3	2	4	1
Errors and omissions in the bills of quantities	52	40.0	34	26.2	37	28.5	7	5.4	1	3	2	4
Delay in subcontractors' work	50	38.5	36	27.7	37	28.5	7	5.4	1	3	2	4
Unrealistic contract expiry dates imposed by owner	62	47.7	21	16.2	36	27.7	11	8.5	1	3	2	4
Lack of commitment to consultants' instructions	68	52.3	37	28.5	15	11.5	10	7.7	1	2	3	4
Poor standard of subcontractor's skills and performance	61	46.9	18	13.8	41	31.5	10	7.7	1	3	2	4

Table 6-34: The party responsible for cost and time overruns factors (cont.)

Factors causing cost and time overruns	No	% (Contractors)	No	% (Consultants)	No	% (Clients)	No	% (External parties)	Rating of dominate party			
Low labour productivity	18	13.8	29	22.3	78	60.0	5	3.8	3	2	1	4
Absence of consultant's site staff	24	18.5	66	50.8	29	22.3	11	8.5	2	3	1	4
Lack of job security for the consultancy team	22	16.9	72	55.4	26	20.0	10	7.7	2	3	1	4
Centralized consultants' decision-making processes	16	12.3	84	64.6	22	16.9	8	6.2	2	3	1	4
Requirements for external work	18	13.8	35	26.9	31	23.8	46	35.4	4	2	3	1
Inadequate construction planning	21	16.2	50	38.5	48	36.9	11	8.5	2	3	1	4
Unpredictable weather conditions	43	33.1	21	16.2	9	6.9	57	43.8	4	1	2	3
Level of uncertainty of soil conditions	16	12.3	33	25.4	31	23.8	50	38.5	4	2	3	1
Storms and heavy dusty winds	9	6.9	2	1.5	1	0.8	118	90.8	4	1	2	3
Equipment allocation problems	75	57.7	23	17.7	22	16.9	10	7.7	1	2	3	4
Shortages of tools and equipment on site	65	50.0	31	23.8	23	17.7	11	8.5	1	2	3	4
Lack of equipment maintenance	64	49.2	24	18.5	28	21.5	14	10.8	1	3	2	4
Market shortages of construction materials	33	25.4	14	10.8	16	12.3	67	51.5	4	1	3	2
Changes in prices of materials	24	18.5	19	14.6	49	30.0	48	36.9	4	3	1	2
Damage of materials in storage	67	51.5	12	9.2	41	31.5	10	7.7	1	3	2	4
Delays in material deliveries to site	50	38.5	13	10.0	42	32.3	25	19.2	1	3	4	2
Poor quality materials	61	46.9	19	14.6	18	13.8	32	24.6	1	4	2	3
Difficulties in obtaining construction materials at official current prices	29	22.3	18	13.8	22	16.9	61	46.9	4	1	3	2
Inappropriate types of contract used	32	24.6	34	26.2	57	43.8	7	5.4	3	2	1	4
Unethical contractor behaviour in order to achieve the highest possible level of profit	71	54.6	16	12.3	33	25.4	10	7.7	1	3	2	4
Inadequate contractor experience	61	46.9	32	24.6	17	13.1	20	15.4	1	2	4	3
Poor contract management	40	30.8	62	47.7	22	16.9	6	4.6	2	1	3	4
Lack of design team experience	16	12.3	35	26.9	45	34.6	34	26.2	3	2	4	1
Lack of co-ordination between design team and contractor	29	22.3	73	56.2	18	13.8	10	7.7	2	1	3	4
Complexity of design	33	25.4	56	43.1	15	11.5	26	20.0	2	1	4	3
Lack of proper financial appraisal of the project	25	19.2	13	10.0	80	61.5	12	9.2	3	1	2	4
Delay in payments to contractors of completing work	64	49.2	14	10.8	37	28.5	15	11.5	1	3	4	2

Table 6-34: The party responsible for cost and time overruns factors (cont.)

Factors causing cost and time overruns	No	% (Contractors)	No	% (Consultants)	No	% (Clients)	No	% (External parties)	Rating of dominate party			
Slow payment of completed works	52	40.0	19	14.6	44	33.8	15	11.5	1	3	2	4
Lack of cost reports during construction stage	97	74.6	5	3.8	23	17.7	5	3.8	1	3	2	4
Different political affiliation of workers	55	42.3	7	5.4	47	36.2	21	16.2	1	3	4	2
Lack of communication from donors to compensate for uncertainties resulting from poor political situation	6	4.6	11	8.5	3	2.3	110	84.6	4	2	1	3
Delays in decision making by government	8	6.2	4	3.1	4	3.1	114	87.7	4	1	2	3
Political instability	4	3.1	2	1.5	1	0.8	123	94.6	4	1	2	3
Strikes and border closures	8	6.2	1	0.8	8	6.2	113	86.9	4	1	3	2
Changing government policies and regulations	7	5.4	3	2.3	12	9.2	108	83.1	4	3	1	2
Difficulties in obtaining construction licences	9	6.9	7	5.4	23	17.7	91	70	4	3	1	2

Table 6.34 presents the frequency and percentage for each factor. The results show that the parties responsible for most of the factors affecting delay and cost overrun were as follows:

- 30 contractor-related factors
- 15 consultant-related factors
- 5 client-related factor
- 13 external party (ies)-related factors

Research by Ogunlana et al. (1996) and Rohani (2008) agree with this result: most of the factors contributing to delays and cost overruns lie with the contractors.

The details of percentage distribution among the respondents for each factor are shown in Table 6.35.

Table 6-35: The percentage for risk factors

Factors causing cost and time overruns	Contractors				Clients				Consultants			
	Contractors	Consultants	Clients	External parties	Contractors	Consultants	Clients	External parties	Contractors	Consultants	Clients	External parties
Lack of experience and performance of project management team	63.9	13.9	22.2	-	72.1	9.3	2.3	16.3	74.5	7.8	9.8	7.8
Poor management and supervision on site	41.17	41.17	5.6	11.1	46.5	32.6	7.0	14.0	52.9	27.5	11.8	7.8
Mistakes during construction	58.3	33.3	-	8.3	55.8	34.9	2.3	7.0	68.6	17.6	3.9	9.8
Lack of timely decisions and corrective actions	16.7	50.0	25.0	8.3	11.6	53.5	18.6	16.3	15.7	60.8	13.7	9.8
Lack of detailed information	5.6	47.2	41.7	5.6	11.6	46.5	30.2	11.6	15.7	29.4	41.2	13.7
Inappropriate construction methods	69.4	16.7	5.6	8.3	69.8	14.0	7.0	9.3	60.8	15.7	5.9	17.6
Poor communications and misunderstanding	11.1	44.4	30.6	13.9	14.0	53.5	23.3	9.3	5.9	47.1	31.4	15.7
Slowness in giving instructions	16.7	33.3	33.3	16.7	23.3	44.2	25.6	7.0	17.6	47.1	23.5	11.8
Little regular sessions to address work problems	55.6	27.8	8.3	8.3	32.6	37.2	16.3	14.0	52.9	27.5	9.8	9.8
Lack of technically skilled staff	52.8	5.6	36.1	5.6	53.5	14.0	18.6	14.0	76.5	2.0	15.7	5.9
High quality of work required	19.4	44.4	25.0	11.1	32.6	39.5	18.6	9.3	33.3	39.2	19.6	7.8
Poor judgment in estimating time and resources	50.0	5.6	25.0	19.4	44.2	30.2	18.6	7.0	47.1	33.3	11.8	7.8
Lack of a strong organizational culture	66.7	16.7	8.3	8.3	51.2	25.6	18.6	4.7	58.8	21.6	15.7	3.9
Shortages of craftsmen	58.3	5.6	25.0	11.1	53.5	20.9	23.3	2.3	58.8	13.7	19.6	7.8
Lack of new technology or new construction methods	50.0	5.6	30.6	13.9	51.12	11.6	32.6	4.7	62.7	15.7	13.7	7.8
Shortage of site workers	47.2	8.3	33.3	11.1	62.8	7.0	25.6	4.7	76.5	5.9	11.8	5.9
Rework of bad quality performance	50.0	33.3	13.9	2.8	44.2	27.9	16.3	11.6	62.7	23.5	11.8	2.0
Inaccurate estimates	27.8	27.8	36.1	8.3	20.9	44.2	25.6	9.3	37.3	33.3	23.5	5.9
Indecision by the supervising team in dealing with the contractor's queries	11.1	50.0	33.3	5.6	11.6	53.5	30.2	4.7	29.4	45.1	23.5	2.0
Deficiencies in coordination between parties (clients, consultants and contractors)	33.3	22.2	38.9	5.6	25.6	32.6	37.2	4.7	47.1	23.5	21.6	7.8

Table 6-35: The percentage for risk factors (cont.)

Factors causing cost and time overruns	Contractors				Clients				Consultants			
	Contractors	Consultants	Clients	External partjies	Contractors	Consultants	Clients	External parties	Contractors	Consultants	Clients	External parties
Wrong choice of site	5.6	27.8	38.9	27.8	9.3	27.9	41.9	20.9	17.6	27.5	25.5	29.4
Errors and omissions in the bills of quantities	33.3	25.0	36.1	5.6	39.5	32.6	20.9	7.0	45.1	21.6	29.4	3.9
Delay in subcontractors' work	27.8	27.8	41.7	2.8	39.5	23.3	27.9	9.3	45.1	31.4	19.6	3.9
Unrealistic contract expiry dates imposed by owners	47.2	16.7	25.0	11.1	39.5	20.9	32.6	7.0	54.9	11.8	25.5	7.8
Lack of commitment to consultants' instructions	41.7	27.8	19.4	11.1	51.2	27.9	14.0	7.0	60.8	29.4	3.9	5.9
Poor standard of subcontractor's skills and performance	41.7	8.3	38.9	11.1	51.12	14.0	25.6	9.3	47.1	17.6	31.4	3.9
Low labour productivity	11.1	22.2	52.8	13.9	11.6	20.9	67.4	-	17.6	23.5	58.8	-
Absence of consultant's site staff	22.2	41.7	19.4	16.7	16.3	53.5	23.3	7.0	17.6	54.9	23.5	3.9
Lack of job security for the consultancy team	16.7	58.3	19.4	5.6	16.3	53.2	23.3	7.0	17.6	54.9	17.6	9.8
Centralized consultants' decision-making processes	16.7	58.3	16.7	8.3	4.7	76.7	16.3	2.3	15.7	58.8	17.6	7.8
Requirements for external work	13.9	27.8	27.8	30.6	16.3	20.9	23.3	39.5	11.8	31.4	21.6	35.3
Inadequate construction planning	16.7	38.9	33.3	11.1	9.3	46.5	37.2	7.0	21.6	31.4	39.2	7.8
Unpredictable weather conditions	30.6	11.1	5.6	52.8	34.9	18.6	4.7	41.9	33.3	17.6	9.8	39.2
Level of uncertainty of soil conditions	13.9	25.0	25.0	63.1	14.0	27.9	23.3	34.9	9.8	23.5	23.5	43.1
Storms and heavy dusty winds	2.8	-	2.8	94.4	4.7	4.7	-	90.7	11.8	-	-	88.2
Equipment allocation problems	50.0	19.4	13.9	16.7	67.4	14.0	14.0	4.7	54.9	19.6	21.6	3.9
Shortages of tools and equipment on site	44.4	33.3	11.1	11.1	51.2	23.3	18.6	7.0	52.9	17.6	21.6	7.8
Lack of equipment maintenance	47.2	27.8	13.9	11.1	46.5	20.9	23.3	9.3	52.9	9.8	25.5	11.8
Market shortages of construction materials	25.0	22.2	11.1	41.7	20.9	7.0	11.6	60.5	29.4	5.9	13.7	51.0
Changes in prices of materials	16.7	19.4	38.9	25.0	11.6	18.6	25.6	44.2	25.5	7.8	27.5	39.2
Damage of materials in storage	44.4	11.1	33.3	11.1	53.5	9.3	30.2	7.0	54.9	7.8	31.4	5.9
Delays in material deliveries to site	30.6	8.3	38.9	22.2	41.9	11.6	30.2	16.3	41.2	9.8	29.4	19.6
Poor quality materials	41.7	13.9	8.3	63.1	48.8	20.9	18.6	11.6	49.0	9.8	13.7	27.5

Table 6-35: The percentage for risk factors (cont.)

Factors causing cost and time overruns	Contractors				Clients				Consultants			
	Contractors	Consultants	Clients	External partjies	Contractors	Consultants	Clients	External parties	Contractors	Consultants	Clients	External parties
Inappropriate types of contract used	27.8	19.4	47.2	5.6	16.3	32.6	46.5	4.7	29.4	25.5	39.2	5.9
Unethical contractor behaviour in order to achieve the highest possible level of profit	58.3	16.7	19.4	5.6	55.8	9.3	27.9	7.0	51.0	11.8	27.5	9.8
Inadequate contractor experience	41.7	36.1	8.3	13.9	41.9	20.9	23.3	14.0	54.9	19.6	7.8	17.8
Poor contract management	36.1	52.8	5.6	5.6	20.9	44.2	30.2	4.7	35.3	47.1	13.7	3.9
Lack of design team experience	13.9	30.6	30.6	25.0	11.6	25.6	41.9	20.9	11.8	25.5	31.4	31.4
Lack of co-ordination between design team and contractor	33.3	50.0	8.3	8.3	20.9	58.1	14.0	7.0	15.7	58.8	17.6	7.8
Complexity of design	25.0	44.4	8.3	22.2	16.3	51.2	11.6	20.9	33.3	35.3	13.7	17.6
Lack of proper financial appraisal of the project	22.2	11.1	55.6	11.1	11.6	11.6	69.8	7.0	23.5	7.8	58.8	9.8
Delay in payments to contractors of completing work	63.9	5.6	22.2	8.3	37.2	14.0	34.9	14.0	49.0	11.8	27.5	11.8
Slow payment for completed work	47.2	11.1	30.6	11.1	34.9	11.6	39.5	14.0	39.2	19.6	31.4	9.8
Lack of cost reports during construction stage	83.3	5.6	8.3	2.8	79.1	2.3	16.3	2.3	64.7	3.9	25.5	5.9
Different political affiliation of workers	38.9	-	38.9	22.2	37.2	11.6	44.2	7.0	49.0	3.9	27.5	19.6
Lack of communication from donors to compensate for uncertainties resulting from poor political situation	8.3	11.1	-	80.6	4.7	7.0	2.3	86.0	2.0	7.8	3.9	86.3
Delays in decision-making by government	11.1	-	5.6	83.3	7.0	4.7	4.7	83.7	2.0	3.9	-	94.1
Political instability	2.8	-	-	97.2	2.3	4.7	2.3	90.7	3.9	-	-	96.1
Strikes and border closures	2.8		5.6	91.7	2.3	-	11.6	86.0	11.8	2.0	2.0	84.3
Changing government policies and regulations	8.3	2.8	8.3	80.6	2.3	-	14.0	83.7	5.9	3.9	5.9	84.3
Difficulties in obtaining construction licences	2.8	2.8	33.3	61.1	7.0	7.0	16.3	69.8	9.8	5.9	7.8	76.5

6.8 Summary

This chapter has presented the analysis and findings of the survey questionnaire (I). It has provided information regarding time and cost overruns and the importance of cost and time control in Libyan construction projects on the part of Libyan construction professionals, information that helps determine the factors influencing those overruns. The results of the survey questionnaire analysis also reveal the frequency with which Libyan organisations encounter problems relating to time and cost overruns, as well as the methods used to determine the times and costs of the activities involved in Libyan construction projects.

The rankings of all the relevant factors that have been investigated in this study of contractors', clients' and consultants' views were based on importance index values. The respondents' ranking of factors causing time and cost overruns in Libyan construction projects has been discussed in this chapter. They ranked "lack of experience and performance of project management team" first, while the "low labour productivity" came second major factors causing time overruns. All respondents saw "lack of timely decisions and corrective actions" as the third factor causing time overruns. Meanwhile, the respondents ranked "political instability" first for cost overrun, no doubt due to the extraordinary political situation at the time the study was conducted. Poor management and supervision on site was ranked second for cost overruns, and "Lack of proper financial appraisal of the project" came third.

There is consensus, then, between contractors, clients and consultants regarding the importance of some of the factors affecting time and cost overruns. However, the data also reveals some differences of opinion. Each party's priorities and perceptions will inevitably be different – poor weather, for example, will mean more to contractors actually doing the job than it will to clients or consultants.

Finally, the perceptions of who is responsible for each cost and time overrun factor have been identified, as have been those factors' percentages, in order to suggest measures to help mitigate and control cost and time overruns in Libyan construction projects.

Chapter 7 Qualitative Study (Semi-Structured Interviews)

7.1 Introduction

This chapter describes the process of data collection and data analysis adopted during the qualitative stage of this study. Semi-structured interviews with professionals from Libyan organisations were used as a qualitative research method in order to cover topics not easily investigated by questionnaire I. The interviews were essential to determine the tools and techniques used by practitioners in Libyan construction projects to maintain time and cost control; they were also used to investigate the views of professionals in the LCI regarding the importance of time and cost control in construction projects, and to explore processes that could improve project control in the country. The chapter begins by giving the main reasons for selecting the semi-structured interview method of data collection, and proceeds to describe the process by which the interviewee sample was selected and the interviews themselves conducted. The findings of the analysis of the data obtained from those interviews are finally discussed.

7.2 Semi-Structured Interviews

The semi-structured interviews as a qualitative research method were used to discover the views held by professionals (contractors, consultants and owners) involved in the LCI as to the importance of project control. This method was also used to investigate the efficiency of time and cost control processes, tools and methods in construction projects in order to develop a framework by which Libyan construction projects can effectively establish control of both cost and time. The interviews therefore covered the following aspects:

- the perceptions of professionals in the LCI as to the importance of time and cost control in construction projects
- the extent to which the processes of cost and time control were applied in practice
- the procedures and processes used to control time and cost
- identification of the most commonly used techniques for cost and time control in the LCI
- the barriers encountered in the course of exercising cost and time control
- the skills and abilities available to address risk
- identification of the parties responsible for the project control process

- identification of the means by which the processes and activities of professionals can be improved in order to positively affect the performance of time and cost control

7.2.1 Justification of the selection of the semi-structured interview method of data collection

The third phase of the research study qualitatively explores how the costs and times of construction projects are controlled by professionals, with a view to determining the common processes, problems, best practices and expectations relative to cost and time control tools, techniques, methods and processes. Rouse and Dick (1994) state that qualitative methods are important to the investigation of any management practice, and are essential to the discovery of holistic, practical answers to real-world problems in a way that is not possible using quantitative methods. In this study, the main reasons for selecting semi-structured interviews are:

- triangulation of data
- to fulfil the need to adequately understand the situation and the problem being studied, and to meet the need to clarify some of the questions posed in the questionnaire I; the qualitative research method was adopted to help propose a solution that can be used to tackle the problem on the ground in Libya
- to cover topics not easily investigated by the questionnaire (I)
- to obtain greater knowledge of project control, in order to use the analysis of the interviews feedback to gain an insight into the matters raised by participants, as well as helping answer research questions three, four, five and six.
- to allow the researcher the flexibility to obtain a richer and more varied dataset than would be possible using quantitative methods
- to help the participants outline not only on their professional practice but also their opinions, based on their practices and experiences
- to allow more extensive and exhaustive discussion of areas of interest, and thereby to give the researcher the opportunity to improve the understanding of the participants' opinions by asking additional questions related to the participants' professions

7.2.2 The interview sample composition

The same sample of the population was used for the interviews as for the questionnaire I. Some of respondents who had participated in questionnaire I, including senior project managers, project directors, and construction directors expressed their willingness to participate further in this research. In order to stimulate the interviewees' interest, the researcher explained the objectives of conducting the interviews. At the initial stage of the preparation for the interviews, 14 participants with great experience in construction projects and project management from who were willing to be interviewed were selected.

The selection of interviewees was based on the positions they occupied in their organisations and their experience in the construction field. At the actual stage of the interview, however, some of the potential interviewees withdrew because of other commitments. The details of the participants in the interviews are given in Table 7.1. The total time taken by the interviews was 617 minutes; the average time for a single interview was 62 minutes. Between them, the interviewees had amassed 256 years' experience; the average interviewee had 26.

Interviews' number	Position of interviewees	Years' experience	Type of company	Size of company	Duration of interview
1	Senior Project Manager	31 years	Client	Large	1hr 17m
2	Supervisor Engineer	24 years	Consultant	Medium	1hr 9m
3	Site Manager Quantity Surveyor	22 years	Contractor	Medium	1hr 2m
4	Planning Engineer	29 years	Contractor	Large	49m
5	Project Manager	27 years	Main Contractor and Project Consultant	Medium	57m
6	Executive Manager	26 years	Client	Large	59m
7	Senior Site Engineer	19 years	Contractor	Small	41m
8	Senior Quantity Surveyor	33 years	Main Contractor	Medium	1hr 2m
9	Associate Director	31 years	Consultant	Medium	1hr 20m
10	Project Manager	14 years	Contractor	Small	51m

Table 7-1 Information regarding the participants in the interviews

7.2.3 The interview process

To ensure that the interviews covered subjects as fully as possible, the interview structure was piloted by conducting two interviews with professionals in Libyan organisations. These pilots helped the researcher to check for ambiguities in the questions and to get an idea of the times involved. As a result, it enhanced the subsequent interviews to obtain clearer, more specific and more reliable responses.

The researcher prepared a simplified version of the interview guide to present to the respondents. It consisted of an explanation of the interview's importance and the reasons why it was being conducted, a summary of the questions and an account of what the researcher aimed to do with the responses. The researcher confirmed that the responses would be used purely for academic purposes, and explained the confidentiality and anonymity involved.

It was initially intended that all interviews be digitally recorded on a dictation machine. However, some participants agreed to participate only on the condition that their interviews not be recorded. The researcher therefore had to prepare a question-response template on which to take notes during those interviews. This method of data collection actually helped in the subsequent analysis. All the interviewees' responses were for the most part gracious and patient. The interview process was conducted by asking questions sequentially, resort being made to supplementary questions as the need for additional clarification or detailed explanation arose.

7.2.4 Steps in qualitative data analysis

- **Transcription:** The first step was to transcribe all the interviews. This was an important step in attempting to represent the respondents' words as accurately as possible; it was carried out by listening to the audio version and reading the text in order to understand the data.

- **Familiarisation:** The process of familiarisation with the data followed transcription. It was performed by listening to the recordings several times and reading and re-reading the data, making notes and then summaries. All of this preceded the formal analysis.

- **Organising the data:** The third step was to organise the responses question by question to allow the researcher to go through each topic to pick out common themes, categories and patterns in the data.

- **Indexing:** The researcher began to see the themes, patterns and relationships emerging from the responses. The researcher looked for similarities and differences in phraseology, and noticed the different ideas and concepts within a category.

- **Combination the data**: After the researcher indexed the themes and concepts, it was essential to summarise the responses to a more controllable level in order to extract the embodiment of fact that derived so far for presentation. This phase of combination of the original data allowed the researcher for the summarizing presentation of the data revealed from the analysis of interviews manuscripts.

- **Categorising the information:** This involved classifying the information into categories, which helped to identify other themes that served as subcategories. In this step the researcher combined two approaches to data categorisation, using preset categories and emergent categories. The researcher started with a list of categories and searched for data that matched them. The researcher also categorised the data using predetermined themes, by discovering the topics that recurred in the data. Continuous reading of the data helped the researcher categorise the data correctly.

- **Interpreting the data:** In order to explain the findings, the researcher developed a list of key points that were determined as a result of data categorisation. The final step was the development of a diagram to present the findings of interviews in order to illustrate all the data points and to make the concepts easily comprehensible (see table.7.2).

7.3 The qualitative study output

The output of the qualitative research including themes and patterns are presented in this section. The key points that were determined as a result of data categorisation were:

- the practical application of the processes of cost and time control
- the extent of such application
- the procedures and processes involved
- the identification of barriers encountered
- the definition of the available skills and abilities to address risk
- the definition of the responsibility for the project control process
- the development of the process of project time control
- the development of the process of project cost control
- the identification of the means by which the processes and activities of professionals can be improved in order to positively affect the performance of time and cost control

The output of the interviews is illustrated in Table 7.2

The practical application of the processes of cost and time control

- understanding the concept of project control in the industry
- identifying the basics and the variables needed to exercise control
- identifying the disparities in the application of project control between organisations
- identifying the state's role in supporting project control
- identifying the stage at which time and cost will be at risk
- determining how the control of time and cost in a company affects its reputation
- determining the effect of the Civil War
- drawing up project control policies
- identifying the differences between concepts of project control in developing and developed countries
- identifying the processes that are often used in project management
- determining whether the process of time and cost control is separate or integrated

The extent of such application

- differences between the mechanisms clients use to apply control
- determining the effect of the project's size on the application of project

control

- determining the general attitude of organisations towards project control
- gauging the degree of professional satisfaction with the current procedures
- deciding how to initiate the process of control

Procedures and processes involved

- the process of project time and cost control taken into account
- identifying procedures at the planning stage
- identifying procedures at the takeoff and design interface phase
- identifying procedures at the construction stage
- identifying procedures and processes, including tools and techniques, used to guarantee that projects do not overrun time and budget
- the use of S-curves
- the use of bar charts
- the use of Gantt Chart tools
- the use of Primavera Version 6
- the use of the Earned Value System
- deciding when to initiate the process of time and cost control (the process begins when the tender is won)
- discovering the effect of the recent unexpected events on time control
- exploring the evolution of time and cost control processes
- investigating the serious attempts by the state to apply all measures necessary to manage the procurement process and create a regulatory environment for the LCI
- exploring the cooperation between the project team as regards project control
- daily, monthly and annual reports
- exploring the role of project manager
- identifying means of overcoming negligence at all stages
- determining how the project's budget is allocated
- determining how control processes can be improved
- developing the will, the determination and the appropriate plans
- the application of new tools and techniques and systems
- recognising good skills
- taking the effect of recent events into account
- the motivation of the project team members
- developing a systematic plan
- application of local companies the processes of project time and cost control
- monitoring the processes of time and cost control during procurement, design construction and start-up phases
- examining the role of the contractor
- examining the software used
- exploring the role of the consultant
- conducting regular meetings to help to control time and cost
- estimating the length of time necessary to complete the job
- the responsibilities of staffing
- adoption of a proper plan

- keeping client requirements in mind
- ensuring good communication
- estimating the materials and bills of quantity during the takeoff and design interface stages

Identifying the barriers encountered in the process of cost and time control.

- lack of specialist staff
- no uniform set of procedures or actions by which to practice risk management
- lack of meaningful documentation to support these processes
- the difficulty of putting risk plans into action and ensuring that the project plans are still valid
- inability to use project control tools
- changes in the weather
- the inability of contractors to supply onsite materials and storage
- lack of capacity to meet national construction demands
- the client's failure to allocate funding resources to contractors for the job
- lack of detailed planning
- disruption to timetables through unforeseen circumstances such as sick leave
- material costs exceeding the original estimate
- the nature of the legal system
- centralisation
- inflexibility of work practices
- corruption
- complex company procedures
- delays in the approval of detailed designs by the client
- high degree of bureaucracy
- lack of a good monitoring and control system throughout the project's lifetime
- improper planning
- unexpected events
- lack of commitment
- prevalence of the profit motive
- unrealistic estimates
- weak foundations
- ignorance on the part of the executives about the process or strategy of risk management
- the lack of a proper delay analysis system
- malfunctions, weather, absence of workers, power cuts

Defining the available skills and capabilities with which to address risk

- lack of in-house expertise
- need for systematically intensive training systems
- need for workforce knowledge regarding project management skills
- need for skilled labour and training courses

Defining the responsibility for the project control process

- lack of specialists in project control
- overlap of responsibility between all participants in the project
- defining the project manager's responsibility
- defining the quantity surveyor's and planner's responsibility

- defining the responsibility of all three categories (contractors, clients and consultants)
- recognition that process is an integrated one involving all parties in the project
- the absence of risk managers
- sharing of responsibilities for managing project work

Investigating the development of the process of time control

- no procedures for project control
- adoption of old measures
- identification of the project plan and the resources needed
- the need to schedule project work in series using the Gantt chart, Primavera Systems, time and milestone schedules and the S curve and critical path
- conducting meetings, including internal and kick-off
- reporting on progress daily, monthly and annually
- taking the effects of various types of contract into account
- instituting a recovery plan
- ensuring access to information
- carrying out the work as designated and in accordance with the standards.
- introducing decisions with a set of suggestions

Investigating the development of process of cost control

- recognising that the process starts from the very first project cost plan
- tracking the project's cost performance against the baseline budget using Project Cost-Value Reconciliation and Earned Value Analysis
- bills of quantity
- using Primavera planning software
- using the Work Breakdown Structure (WBS) recall tool
- adhering to the price as agreed in the contract
- providing the cost estimators
- allowing for unexpected events
- conducting daily, monthly and annual reports

Exploring how professional processes and activities can be improved in order to positively affect the performance of time and cost control

- recognising the need to update the plan frequently
- the scheduled work should be in parallel
- taking advantage of resource availability
- involving a risk consultant in every organisation
- resolving problems and conflicts
- acknowledging the necessity for the board to notice changes in a company's risk management practice
- making annual improvements
- the site administrative and technical staff should be assigned as soon as the contract is awarded
- the coordination and management of labour forces
- effective, constant communication with the suppliers and the subcontractors
- professionals should implement recording measures and a series of reviews
- a risk management department must be created within the company

- if a solution has already been found, it should be reused rather than wasting resources redeveloping it
- developing a uniform set of procedures and meaningful documents for practicing the risk management process
- developing measures for evaluating the effectiveness of actions, mechanisms and techniques
- use of computerised systems, software and programs
- small to midsized projects call for some form of matrix organization
- the government must take all necessary measures to combat corruption
- timetable follow up and progress monitoring must be continuous
- implementation of effective monitoring and control systems
- regular review meetings
- weekly cost status figures
- daily visits to the project's financial program
- production of end-of-month cost reports
- inclusion of a clause in the contract allowing for price adjustment in the event that prices of materials increase
- re-examination of follow up strategy

Table 7-2 Interviews output

7.4 Discussion of the qualitative study findings

7.4.1 Participants' understanding of the concept of project control in the industry

The purpose of the interview's first question was to elicit interviewees' perceptions of the concept and application of control in Libyan construction projects. Many authors state that project control requires a firm understanding of the project's activities: how long each activity should take, how much each element should cost, who is responsible for each one, and how they interrelate. It can be concluded that project cost and time control means to provide plans for time and cost so as to allow portions of the project work to be organized, sequenced and monitored for the purpose of completing the whole project in an efficient and organized manner. Most participants' definitions of project control focus on the general aspects of cost and time that several writers and researchers suggest should be managed for the purpose of reducing the problems consequent on overruns, so that the entire project could be completed on time and within budget. Most answers were similar to the following:

Actually, in construction projects control can be involved in many parts of the construction process: control for material management, construction *management, time control and cost control. We have some measures and a set of tools available, particularly in Libyan public companies, but to be honest with you, most of these companies need to improve on their current performance*

This finding agrees with many authors' definitions of project control, including Peeters & Madauss (2008) and Harpum (2010).

7.4.1.1 *Identification of the most important variables needed to exercise control based on professionals' perceptions*

As mentioned above, the most important factors needed to maintain control in construction projects are cost, time, safety, materials and quality:

> *Project control in the construction industry involves time and cost and materials quality and safety.....but that doesn't mean that there's no connection between them. I mean, there are many basics that everybody working in the construction industry must follow.*

The professionals involved in interviews focused on the variables of cost and time overruns needed for control in Libyan projects:

> *Let me be honest with you: risk in the construction field is not handled adequately, and many construction projects are faced with scheduling problems that cause them to overrun their due dates, increased costs and time delays that all result in really poor performance. In my opinion there's an urgent need to improve the processes of project management in the LCI.*

Anthony Walker (2002) concurs: construction project management is the process of control, coordination and planning from start to finish in terms of quality, time and cost. However, Zielinski (2005) comes to a different conclusion from that of the present author. He states that the process of project control should focuses on soft skills:

If you had asked project-management gurus five years ago to name the most important competencies project managers should have, most would have said technical skills. Today they'd be more inclined to place communications or negotiations acumen at the top of their lists.

Before looking at project control performance, it is necessary to understand the precise meaning of project management. The Project Management Institute (1996) defines project management as "the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project".

7.4.1.2 *The extent of the practical application of the process of cost and time control*

The findings of the interview analysis shows that most interviewees were of the opinion that Libyan companies in general do not greatly interest themselves in the field of project control in the construction industry:

As I've said, Libyan companies until now are still practicing out-of-date management policies in terms of cost, time, people, and information and so on. In fact, we have an authoritative management style for construction projects, but unfortunately the executive's approach is to continue to operate the same old system. We really need to improve the approach of management to such things as giving orders, and we need to impose those changes and expect them to happen without involving supervisors, managers and employees. Truly, I believe that we are out of date, so we really need to be aware in project management and apply modern management tools and techniques to stop killing our organisations.

Most professional interviewees also repeatedly confirmed inconsistent attitudes on the part of organisations to the application of project control in construction projects. One senior manager commented that:

In big private companies and public organisations and large-scale projects I would say "yes". I've just said that they use some techniques and tools to control the costs *and timings of construction projects. Even then there are some differences in the mechanism of applying them from organisation to organisation.*

Zacharakis et al. (1999) identify some of the reasons why SMEs fail. These include lack of risk management planning, poor management, failure to adopt a risk limit threshold, government policies, natural disasters, civil strife, vulnerability resulting from small size, competition from larger businesses and general economic downturns. Zacharakis et al. add overconfidence as a factor that can often drive workers in SMEs to devalue the importance of fundamental risk assessment, thus ultimately causing their firms' failures.

7.4.1.3 *The importance of the application of project control*

This was also reiterated by almost all participants. Any project's execution is inherently risky, and the lack of an appropriate approach to control these risks will result in undesirable effects on project execution:

I have to say that the LCI has a poor image in the construction market in general due to its low performance over the past few decades. However, many Libyan organisations try to develop their performance as regards control and management of projects. In my opinion, the processes of project control used by Libyan organisations are still weak and need improvement to be consistent with the control and management processes adopt by developed countries.

The participants explained their views on the motives and the reasons behind the importance of project cost and time control from their perspective. These can be summarized as follows:

- **Stop reinventing the wheel**

Some participants pointed out that one of the reasons why the application of control is so important is that every company tries to invent ad hoc project control systems, whereas specific techniques are generally available. As one interviewee put it:

We have to stop the habit of reinventing the wheel. Let me explain that: most developing countries don't follow the best practice techniques that are used particularly in developed countries to implement construction projects and finish them on time and to cost.

Wulke and Cool (2009) agree that the most significant benefits of standard processes and solutions are the time/cost savings that avoid unnecessary inefficiencies and mistakes in construction projects. Managers should therefore refrain from creating processes anew.

- **Provide information on the current status of the project**

The analysis of the interviews showed also that another reason for the importance of project control is to obtain information about the current status of the work to identify what stage the work is at, what resources are available, what the payments and profits are, and any other matters that may arise:

In terms of time and cost, at every stage of the project we have to know exactly where we are in every respect.

- **To effectively manage projects**

Project control also helps identify risk factors and enables pre-emptive planning. One interviewee argued that

Putting the project control framework into practice will enable local contractors and international companies to systematically identify and assess the risk factors affecting Libyan construction projects. This will help companies better understand the major risks associated with this kind of project, and consequently plan and undertake effective risk alleviation measures to eliminate those risks before they happen.

- **Get a good reputation**

Some of the participants explained the need to improve their approach to project control to get a good reputation in order to improve stakeholder satisfaction, support innovation and increase control of insurance costs:

> *We realise that reputation is very important and that we can't afford to lose it. A good reputation makes stakeholders more satisfied, supports innovation and gives greater control of insurance costs. As an engineer I know that to preserve the company's reputation the workforce has to try as hard as possible to finish and deliver projects on time and within the specified cost.*

- **To obtain client satisfaction**

Some participants believed that project control improved client satisfaction, which would consequently increase the company's chances of obtaining contracts in the future:

> *We all know as company employees that if we can manage cost and time effectively through all the phases of a project, we will show clients that we are competent and they will realise our capacity.*

Research by Naoum & Mustapha (1995), Kumaraswamy & Dissanayaka (1998) and Cheng & Proverbs (2006) agrees that client satisfaction in the construction industry is a major determinant of project success.

7.4.1.4 *When the process of project control begins*

The participants stated that in public organisations and large-scale projects the starting point for the process of project control was as following:

> *The process of control begins when the projects' consultant prepares tender documents under the supervision of the Regional Executive Department. Thereafter these documents are sent to the General Planning Department for*

review and then issued for tendering. Tender bids are opened by representatives from the Regional Executive Department and the project's consultant.

Another participant reinforced this view:

> *The project's budget is identified at the pre-bidding stage – I mean that, after the General Project Office and Planning Department's reviews of any new projects and the status of current project budgets, a report is sent by the General Project Office to the Chairman of Regional Prime Ministers for approval and is used for initiating the new projects annual budget allocation.*

The process of project control in relation to the client's and consultant's role is explained by a participant in order to get good start of the work as following

> *The client starts by determining the resources and capabilities of the lowest bid before awarding the contract. The consultant's recommendations are forwarded to General Planning Department and the General Project Committee for review and then for approval by Regional General People's Committee so that the contract can be awarded. The award is often based on the tender that satisfies the contract's terms and conditions for the lowest cost.*

7.4.2 Practical procedures and processes used to control time

Wells (1986) maintains that project execution is inherently risky and that the lack of an appropriate approach to address these risks has resulted in many undesirable consequences in project execution, particularly in the LCI.

Analysis of the interviews showed that the process of time control in large private companies and public organisations, and in large-scale projects, was generally similar. The usual method of time control in Libyan construction projects is described below.

7.4.2.1 *Planning*

The planning (feasibility) phase is the first phase of most construction projects processes. It concerns their technical and financial viability. This phase constitutes the project's initial activity, and concerns the arrangement and preparation of actions required to direct the process of construction, project design and completion.

The planning process seems to be widely implemented in practice. There are several efforts and participation of almost participants in the construction process at this phase. However, each participant has a slightly different emphasis of the activities of the phase.

- Initially they usually prepare a time schedule for the whole project, and then a detailed work plan at the design stage that specifies activities' durations and the necessary resources:

> *At the early stages of project the designer and the planner at the organisational level set up its aims, strategies, techniques, and various other things. In this phase the risks should be taken into account concerning, for example, the movement of people onsite, the mechanism for receiving and handling materials and the forms and procedures that should be used, but unfortunately that does not always happen*

> *Firstly a baseline programme and schedule are prepared that includes the start and end dates and intermediate milestones, if there are any.*

- Another important issue in project control during the planning phase in practice is ensuring the availability of human resources in order to save time:

> *At the beginning of any project the contractor make sure that the site administrative and technical staffs are assigned as soon as the contract is awarded, which can help save time and deliver the project for the estimated cost.*

- ❖ The methods used to establish the time required to deliver the project are determined by the particpants themselves. Three interviewees' opinions are given below:

> *Often we estimate using expert judgment. Mostly we ask project consultants and project managers and experts to give cost and time estimates for the project. But the accuracy of this estimate depends on whether the project's experts have experience in project planning and the estimation process itself.*

> *We used some technical means to identify the project's activities and duration times, things like Graphical Evaluation and Review Technique and computerised systems such as Primavera.*

Ritz (1994) stated that planning is a bridge between the experience of the past and the proposed action that produces a favourable result in the future. It is the master plan for executing the field work, from bidding to completion and turnover to the owner. The planning time for a project is the itemized working plan for execution, which results in the detailed construction schedule. The workforce and professionals break the project scope down into a structure consisting of the major work activities. They then stipulate completion dates for each process. The detailed project finance is based on estimates of construction costs.

7.4.2.2 *Monitoring*

- ❖ Monitoring and reporting follows the planning phase to control projects:

> *Project control with respect to time is nothing but monitoring the ratio of the planned to the actual percentage completion. If this percentage is the same, then the project is running smoothly. If it's less than the planned percentage, it's necessary to increase resources according to the project's requirements.*

We often use the S-curve to monitor the programme in order to achieve key milestone dates. For example, we use this technique for the labour, cost and time expended. If we say that we should complete 80 per cent in a particular week, this means that we know what we have spent on labour, so if the actual figure is 60 per cent, it means that we're behind. In short, the S-curve tells us if we're working efficiently or not. The site managers monitor the programme regularly and have internal meetings where the workforce marks up the programme to show exactly where they are, and then they have onsite monthly progress meetings with the client to report on the progress of the project.

- A participant stated that project monitoring must continue throughout the project's life cycle. Unfortunately, however, the interview analysis shows that continuous monitoring does not always happen, which is one of the weaknesses of Libyan companies.

At the beginning of a project, project managers view risk as something they deal with by constructing some type of risk management plan and then filing it away so they can get on with the real work of the project.

It was thus obvious that the site manager intermittently monitors the project programme; there are internal meetings at which the project team members and quantity surveyors mark up the programme to show exactly what stage they have reached. They therefore cannot implement any solutions or processes to manage time before the regular meetings, which could be a month or more apart, which is a waste of time and a weakness in time management. It is thus necessary to apply more systematic processing methods, as recognised by participants:

If we don't have a good monitoring and control system in place throughout the life of the construction project, getting double-invoiced and over-charged is going to be a big contributor to project time and cost overruns.

- Organisations' control and monitoring practices differed according to the size of the company. In big projects, reports reviewing progress and providing basic information are prepare regularly as mentioned previously, whereas in SMEs only the project manager and project management team monitor the work. Two participants outlined this situation, the first one being from a large projects while the second was from SME :

> *The site managers monitor the programme regularly and have internal meetings where the workforce marks up the programme to show exactly where they are, and then they have onsite monthly progress meetings with the client to report on progress.*

> *I have found in over 22 years of practising project management that the project manager has to provide the project team with a road map on how to get the project done. He sets out how the project is to be managed through the phases of its life cycle.*

- The interview findings defined tools and techniques such as bar charts, gantt charts and checklists that guarantee projects' adherence to time:

> *Bar charts, Gantt charts and checklists are the usual methods used to display time for each activity or phase of the project. They're also used to identify the resources needed for construction.*

The anlysis also shows that monitoring generally occurs simply by releasing payments against consultants' fees and contractors' invoices. However, the process often suffers from many weaknesses because of a lack of project progress tracking, as an interviewee attests:

> *Monitoring the project must continue throughout its life, and that very important note must be maintained, but unfortunately that does not always happen, which is one of the weaknesses faced by the company. I*

mean that we should monitor during the procurement, design construction and startup phases to avoid any delays and cost increases.

- The analysis shows that the next step in practical project control is to assess progress at each fortnightly or monthly report issued after regular internal meetings at which the site management team can determine the current work status. Horner and Duff (2001) suggest that periodic meetings can create an effective environment for the participants to deal with any problems such as delays. A Libyan project manager described how they would then compile a monthly report:

> *Our monitoring for time and cost is weekly as well as monthly, and we assess the project at each report, which takes place every two weeks or monthly or whatever. Usually we present many types of reports to monitor time such as material delivery status reports and construction work reports and updated time schedule reports and also delay reports. Also, we arrange for meetings to include the site management team and the project planner. After that, we'll know if the project is running on time or not.*

- Some participants, however, stated that that time control and strategic management in their companies were not satisfactory:

> *the point of weakness in the report phase is poor communication between the project team members and board and between contractor and client and between consultant and client, and that leads to marked variations in the schedule, which in turn results in delays in the preparation of contractor document submissions.*

7.4.2.3 *Evaluation*

- A few participants explained that the lack of a proper delay analysis system caused project failure, with a consequent loss of time:

It's obvious that the lack of a proper delay analysis system in the LCI caused the failure of projects with a loss of time.

- It was concluded that existing delay analysis techniques lack the ability to integrate the influence of each delay factor with a quantification of that factor's impact on a construction project. This fact was mentioned by several interviewees.

  Risk analysis in the construction field is becoming the rule rather than exception in developed countries like the USA and the UK. Sometimes organisations have to present an initial financial analysis of the project before receiving approval to execute the detailed planning to make efficient decisions to formulate short- and long-term construction strategies and policies that aim to improve the industry's processes and operations. But unfortunately we couldn't implement this system because of bureaucracy in government agencies.

This finding coincides with those of Okpala, (1988) and Oglesby (1989), as bureaucracy impeded progress. Frimpong (2003) states that government bureaucracy constrains work progress by dilatory processing of official procedures.

- The importance of risk analysis in the construction industry in relation to defects in tracking monitoring process was also reiterated by almost all participants:

  it has become clear that there is a defect in management, and that there has to be a stronger system for the application of management.

  The construction industry might benefit from the simulation model, as it helps to quantify the possible delay and provide information on the impact of delay factors in advance, enabling the project manager to take preventive measures to reduce their impact.

Alkass and Harris (1991) point out that delay are the most common and costly problems encountered in a construction project's life, and that analysing construction delays has become an integral part of the project. Even with today's technology, and management understanding of project management techniques, construction projects continue to suffer delays and project completion dates still get pushed back. Therefore, the development of a delay analysis system is expected to provide a decision supporting tool with which to analyse and reduce the impact of delays in Libyan construction projects.

7.4.2.4 *Taking corrective action*

- ❖ The analysis shows the necessity of taking corrective action wherever and whenever necessary to bring the project back on schedule and within budget. For example, some participants stated that overcoming delays due to unexpected site conditions could be dealt with by providing more resources, different equipment and skilled manpower as corrective action steps. The interviewees reported that most corrective actions were reactive:

> *Schedules are the important thing to control time. They include all construction project activities, and we update them in the takeoff phase. Actually we have daily, weekly and monthly reports. Again, I'm talking about big projects. We assess the reports every month and then we compare what has been achieved with the time schedule. Based on the comparisons we can know if we are proceeding to plan or we need more time.*
>
> *All too often, risks are either ignored or dealt with in a completely arbitrary way.*
>
> *Mostly we react to risk events as they arise.*
>
> *Often – and especially in big projects – we develop a recovery plan for the completion of the project according to the approved schedule in case unexpected problems occur, so that by implementing a recovery plan the project team member can steer a project back on track.*

If there was a time delay we change the activities, or we do overtime, which is the most common way of making up time. I mean that we increase the number of workers or work two shifts, one during the day and the other in the evening.

Based on the above explanation of the process of time control in Libya construction projects in practice, the proposed framework for the time control process will be developed as seen in Fig (7.1).

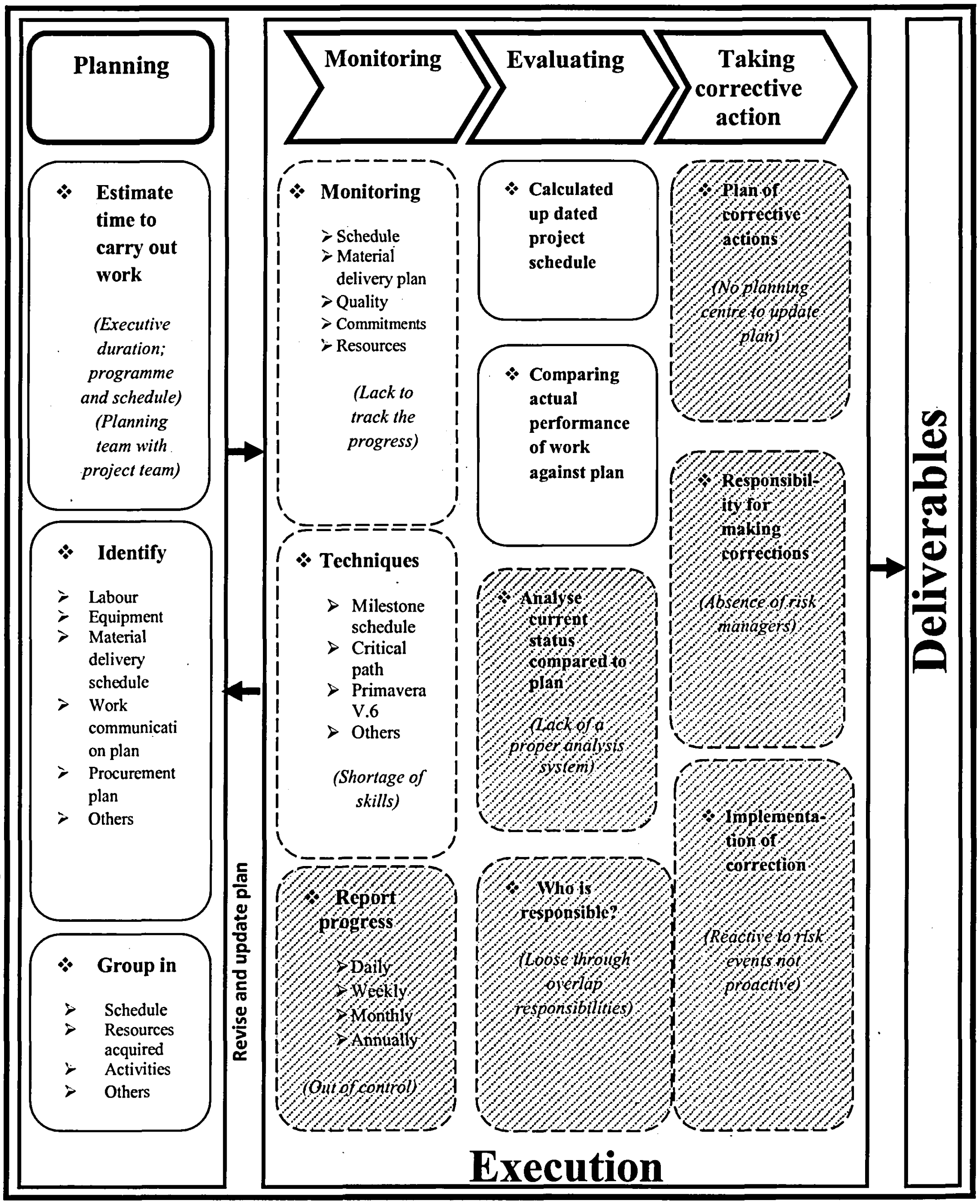
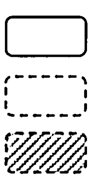


Figure 7-1: Framework of the time control process for Libyan construction projects in practice



Key:

The general process of time control in the construction industry

Prevalent process of time control in the Libyan construction projects in practice

The weakest parts of the process of time control in the Libyan construction projects in practice

7.4.2.5 *Tools used to guarantee that projects do not run over time*

- The analysis of the interviews shows that projects are usually planned using a variety of software tools such as Primavera, Milestone Schedule and Critical Path Technique to display time limits for each activity or phase of the project, and to identify the resources needed for construction:

> *In Libyan construction projects we use some technical means to identify the project activities and duration times – things like Graphical Evaluation and Review Technique and computerised systems such as Primavera version.6.*

Most participants also explained that the same tools and techniques are used to monitor and control project times.

> *In terms of time control, we mainly used Bar charts and Gantt charts, but because they're not very accurate we have recently started scheduling the work using Primavera Systems.*

- Another matter that emerges from the interviews is that the application of tools to the task of monitoring and controlling time differs from one organisation to another depending on the possibilities available and the skills available to the company. Some participants consequently saw tools such as Primavera as being more effective than more commonly used ones such as bar charts and Gantt charts. One Libyan senior manager made this point:

> *To monitor projects we use bar charts, S-curves and critical paths. I would say that you could refer to Primavera Version 6 as an alternative to all of those techniques. By using it we identify areas where we can compress project duration to reduce the total time taken by the project to meet the required date and avoid extending the project completion date beyond that one.*

Another interviewee added his personal experience:

> *Across the 33 years of my work in the housing building projects, I have seen project management based mostly on Gantt Charts to multi-disciplined tools, and processes to fit different types of situations.*

7.4.3 Practical procedures and processes used to control costs

The interview analysis revealed the most common processes used to control cost in Libyan construction projects.

7.4.3.1 *Estimating the project cost*

In infrastructure and development projects, the budget is identified at the pre-bidding stage. The projects' consultant prepares tender documents under the supervision of the Regional Executive Department. These documents are then sent to the General Planning Department for review, after which they are issued for tendering. Tender bids are opened by representatives from the Regional Executive Department and the project's consultant. An interviewee outlined this process:

> *I'm talking particularly about infrastructure and development projects that are carried out by the Executive Department. The owner starts by determining the resources and capabilities of the lowest contractor's bid before awarding the contract. The consultant's recommendations are forwarded to General Planning Department and the General Project Committee for review and then for approval by Regional General People's Committee so that the contract can be awarded. The award is often based on the lowest price tender that satisfies the contract terms and conditions.*

However, the participants said that the process of allocating or estimating the project cost differed slightly from company to company:

After that we need to establish the cost of the project, and the best way to determine that is to find projects that have been finished and are similar to the project we are starting, so we can use it as a reference to estimate the cost. That's what usually happens, but I suppose we must remember that every project is unique, and the estimate of costs will be slightly different in each case.

One professional maintained that

> *the common method for cost estimation is to list the resources we need for the construction project and then total the costs. These resources include everything from concrete for a building project to equipment, material, labour and services. As I just said, we can get costs for resources by consulting price lists. In the case of labour costs, we base the total costs on estimates from similar projects. Often we estimate using expert judgment. Mostly we ask project consultants and project managers and experts to give cost and time estimates for the project. But the accuracy of this estimate depends on whether the project's experts have experience in project planning and the estimation process itself.*

Another participant's firm implemented cost control processes from the very first cost plan. He explained their strategy to control costs:

> *Usually in Libyan construction projects, the ability of the client to influence the final cost is greatest at the beginning of project and diminishes as it continues. Let me explain why: at the beginning of project the rate of expenditure is low, then it increases around the middle and then drops rapidly as the work approaches completion. That means that at the beginning of the project the possibility of finishing it on time and at cost is lowest, so cost and time overruns are highest. The possibility of finishing the project on time and to cost generally increases as the project continues.*

- The analysis revealed that the planning stage suffers from weaknesses owing to inaccurate cost estimates. In practice, since an unstable economy leads to fluctuating material costs, the cost estimator has no control over the cost of materials, labour, equipment, the contractor's method of determining prices, or the competitive bidding or market conditions at the time of the bid. A revised estimate is therefore necessary, either because of unexpected cost overruns or savings. According to one participant:

> *This is evidenced by the recent case in Libya, when many projects were stopped due to the prices of steel doubling in 2011. These external factors also created clashes and disputes between the construction participants, which increased the project cost and duration.*

Improper planning has in many cases proven costly to the country. According to a report published by the General People's Committee PGC (2003), 97 per cent of construction projects associated with the public and private sectors between 1991 and 2003 suffered delays, with a high impact on cost. During this period, which was when Libya was being blockaded, the price of construction materials including steel was very high; so many projects were postponed in anticipation of a return to old price levels.

The factor of inflation and sudden price changes is one of major factor causing delay and cost overruns in a number of developing countries such as the UAE (El-Sayegh, 2008), Ghana (Frimpong et al., 2003) and Indonesia (Kaming et al., 1997; Andi, 2006). Chalabi and Camp (1984) state that, for most projects in developing countries, adequate planning at very early stages is important in minimising cost and time overruns. In practice, mostly construction in Libya is carried out without any formal planning technique, which results in a lack of databases that can be used to estimate such things as the resources required. This in turn leads to difficulties in reliably estimating the costs and resources needed to complete a given project.

7.4.3.2 *Monitoring the project's cost*

- The analysis shows that the process of cost monitoring and control starts at the commencement of a project, as affirmed by several interviewees:

We start cost control right from the very first project cost plan we do. We start looking at value opportunities. We manage the cost by following the price as agreed in the contract through a department called Contract Management that has the responsibility of monitoring the costs and comparing those after execution with those in the contract.

- Interview analysis shows that the process of monitoring the project's cost is carried out just by regular cost site review meetings with the quantity surveyors and the construction team, whose purpose is to determine the actual costs and values and estimate the final ones.

  we have regular cost site review meetings with the quantity surveyors and the construction team, and we monitor the cost every month and investigate the actual costs and the actual value, then estimate the final costs and the final value.

- The interviewees' responses lead to the conclusion that there is a lack of effective monitoring and control systems as specified in the project handbook. Such systems are designed to ensure that the input of the project team (contractors), design team and consultants meet the client's objectives in terms of time, cost, specifications and quality standards.

- However, the analysis shows that the process of cost control is largely based on the reporting mechanism. After the completion of the planning phase, the quantity surveyor immediately starts to prepare a report on the project cost. Interviewees outlined this process:

  To control costs we use bills of quantity, which are schedules for the overall process of construction. For example, if the price of a cubic metre of formwork is 300 Libyan dinars, the cost of a cubic metre in practice mustn't exceed 300 dinars including all the materials required and manpower, taxes and profits. Also, daily, weekly, monthly and quarterly reports are conducted. We also conduct meetings every month *and hold special meetings in emergencies. For example, if the price of steel rose suddenly we'd have to arrange a meeting with the client, the consultant and the contractor. In short, project monitoring is done only by reporting and comparing with bills of quantity.*

Our monitoring for cost is weekly as well as monthly, and we assess the project at each report, which takes place every two weeks or monthly or whatever. Also, we arrange for meetings to include the Project Manager, the Quantity Surveyor and the Project Planner as well. After that, we'll know if the project is running to cost or not.

Another participant said:

To monitor the project cost we usually present some types of reports such as financial, expenses, cash flow, variation and material cost reports.

Another participant stated that

The Planning and Finance Departments issue statistical reports of expenditures for each project for each Department every month. Also, they prepare a report reviewing the progress and provide basic information on each project every month. We as professionals and the project team are naturally optimistic, and unfortunately what that does is that it comes out in the report we get. Often that spells doom for the efforts that have been put into project's time and cost controls.

- Most participants stated that the quantity surveyor usually assumes full responsibility for the cost of the project:

The Quantity Surveyor must always monitor any changes to the contract that might affect costs, and then should create reports to show profitability.

7.4.3.3 *Evaluating the project's cost*

- The study also showed that, like the deficiencies in the time control process, the lack of a proper risk analysis system caused cost overruns. The participants stated that the need for a proper analysis system is increasing daily:

> *The processes of controlling costs are the same ones that I just mentioned for time control. It is difficult to separate them. Even so, we should take more care regarding risk analysis. It is true we often identify risks but in fact we don't care much about the analysis process, despite using bar charts and S-curves in most public and large organisations, but we lack standardisation. In my opinion that's the key to managing projects, including for small and medium enterprises in Libya.*

It can be concluded that the analysis step is just a description of the project's progress as measured against the plan. Many participants stated that this phase of construction project often relies on the project team's assessment of progress as time control is exercised; the project's status will therefore be ambiguous. Formal risk analysis techniques are rarely used in practice due to lack of knowledge and lack of skills people and to doubts on the suitability of these techniques for Libyan construction projects

For Jaskowski and Biruk (2011) the analysis model is required to integrate the influence of each risk factor independently and to more reliably identify or predict the duration of a particular activity by considering the risk factors influencing a project. There is therefore an urgent need to fill a gap in knowledge relating to the analysis of construction delays in the LCI in order to enable stakeholders to take the necessary actions to reduce the impact of delays and cost overruns factors associated with construction projects, to reschedule the project using the required resources and to reallocate the risks throughout the project's life cycle.

7.4.3.4 *Taking corrective action*

- Consequently, because of the lack of a proper analysis system to identify the causes and effects of risk factors, project managers cannot take corrective actions to eliminate the difference between planned and actual costs. In short, the ability to take preventive action is based on the capacity to decide what steps must be taken and to prioritize problem correction. The analysis shows that there is no systematic way to take such necessary preventive measures.

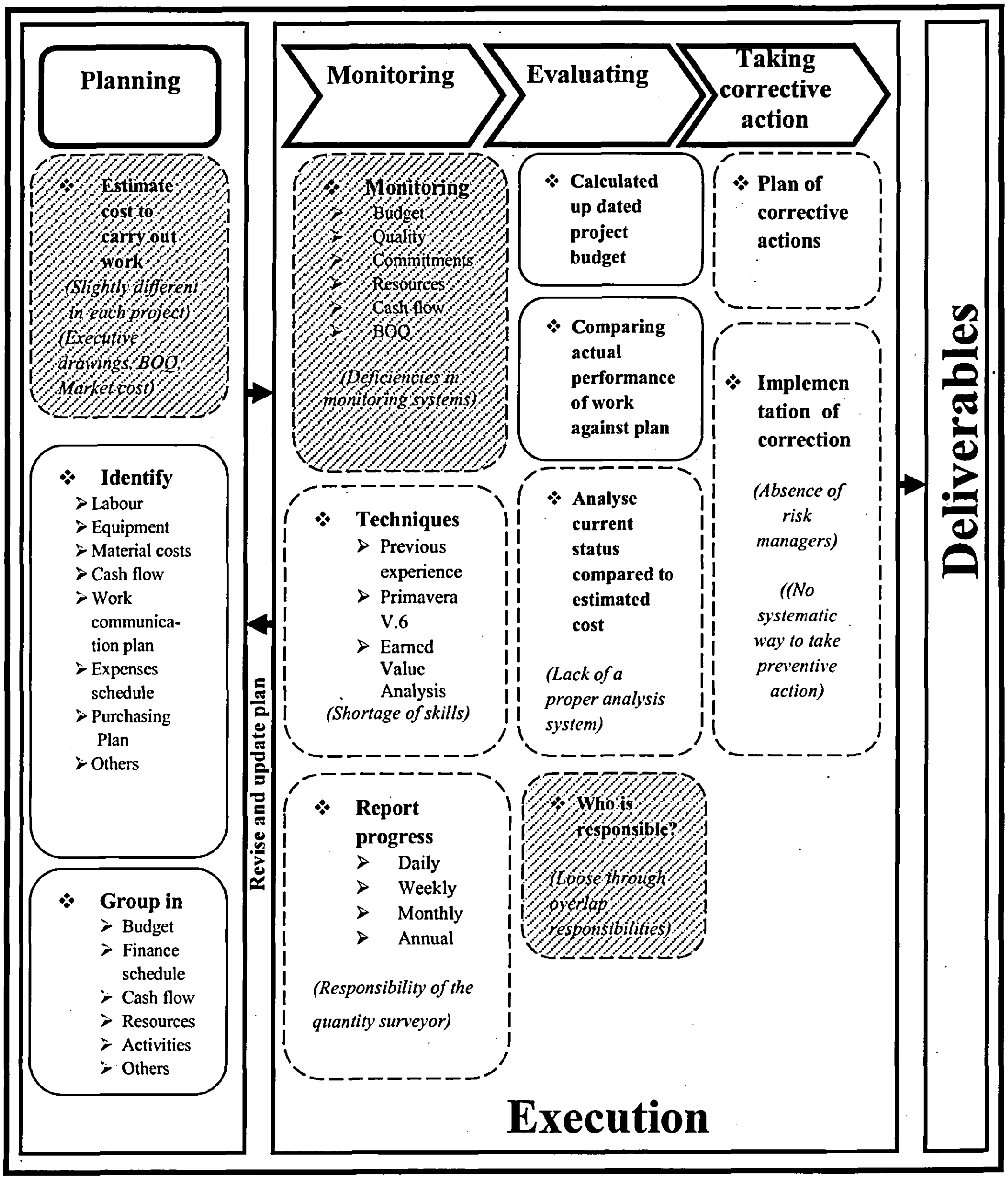
> *Sometimes we found that a particular cost of some activity in the construction project exceeded our original estimate. In this case we should look again at that particular activity for that particular subcontractor and re-think the strategy we follow, so that we can see where we are going to exceed our cost limit, and can look for somewhere else where we are going to under-spend, and re-allocate the pot accordingly.*

> *Let's say the excavation work of 18,000* m^3 *is to be done in 15 days, for which the contractor assigns two bulldozers whose productivity is 600* m^3*/day. Now, if the productivity rate falls from 600 to 400* m^3*/day, then to complete the same amount of work in the same time of 15 days there have to be three bulldozers, but unfortunately this kind of corrective action increases the cost.*

- However, the participants confirmed that the possibility of preventing problems in construction process mostly depended on taking the appropriate corrective action earlier:

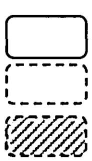
> *The earlier we can discover that we're facing a possible cost increase in our project, the more chance we'll have to correct it, and when something goes wrong on the construction project, the impact that it will have on cost and schedule is exponentially related to how fast you can apply corrective action. That means that every day that goes by without resolving the problem leads to increases in the project budget.*

From this explanation of the process of cost control in Libyan construction projects on, the proposed framework for project cost control process can be developed as follows:



Key:

Figure 7-2: Framework of the cost control process for Libyan construction projects in practice



The general process of cost control in the construction industry

Prevalent process of cost control in the Libyan construction projects in practice

The weakest parts of the process of cost control in the Libyan construction projects in practice

7.4.3.5 *Tools and techniques used to guarantee that projects do not exceed cost*

- The interview finding define the tools and techniques, such as previous experience and the Earned Value system, that guarantee that projects do not overrun their budgets. Various interviewees expanded on this:

> *For the cost, we used historical data and previous experience, if the construction project has the same activities. These projects can also have some engineers with backgrounds in cost accounting for building projects working on them.*

> *We always use Earned Value Analysis on construction. It isn't called Earned Value Analysis, but has another name. It's called Overall Profit and Loss Account, and it measures what we've done. For an Earned Value Analysis, the Project Manager tracks the project's cost performance against the baseline budget.*

> *Usually, so as to control and monitor the project budget, the project manager set up a cost control system to monitor cost performance so as to detect variations such as Project Cost-Value Reconciliation.*

> *Normally we use the overall profit and loss account to estimate actual progress and to establish a basis for the time required to deliver the project.*

> *It's no great secret that project cost control is the tool a project manager uses to get the project back on track and to keep its finances in check.*

7.4.4 The skills and abilities available in Libyan organisations to address risk factors

- ❖ The results show that there is a substantial agreement among participants that skills shortage preventing an ideal exercise of project control is a major obstacle they face:

> *We certainly need skilled labour and training courses to improve their capability. Management must not just have technical skills but play critical roles in order to make decisions. Believe me, having skills is very important to drive the project forward or maybe cause an obstacle to management.*

> *It's fairly clear to me that in the case of risk management processes we really suffer from the lack of any in-house expertise, and that means we start something new each time. We shouldn't have to reinvent the wheel each time.*

> *In my experience I've found that we don't expect the (senior) management to have good skills in terms of risk management, and we could overlook that, but not if we don't have skilled team members doing the work, because that means that there is no process of management at all.*

A review of previously published studies of project control reveals that shortages of skilled labour are ranked very highly in both developing and developed countries, including the UAE (Faridi & El-Sayegh, 2006; El-Sayegh, 2008), Saudi Arabia (Assaf et al., 1995; Al-Kalil & Al-Ghafly, 1999), the USA (Kangari, 1995), Kuwait (Nabil & Saied Kartam, 2001), Indonesia (Kaming et al., 1997) and Turkey (Arditi et al.,1985).

- ❖ All participants also agreed on the need for systematic intensive training systems to produce a generation of skilled workers for the processes of project control:

> *As a site manager I have to say that we need training courses to improve awareness of risk events. Construction projects are facing external*

problems, and with such training the management of these will become easier.

There is a need for continuous work-training programmes for industry personnel, so that they can update their knowledge and become familiar with project management skills.

Efforts to force change without individual training and giving the right support will not get the organisation any further in its efforts to improve quality

The systematic nature of training is what we're missing.

Ogunlana et al. (1996) likewise state that clients, contractors, suppliers, designers/consultants, financial backers, manufacturers, educational institutions and government should all cooperate to provide the necessary support for efficient management, and continuous work training programmes for personnel in the industry to update their knowledge and familiarize them with project management techniques and processes

7.4.5 Responsibility for project control processes

- The interviews revealed that participants disagreed somewhat on the responsibility for control processes. Few participants thought that all parties involved in a construction project are responsible for the control of the building process. The majority view was that the project team must share the responsibility for control, but some saw it as the project manager's resposibility. One stated:

  As a project team we must share the responsibilities of managing the project work. I mean that both the praise for the success of project work and blame for its failure should be equally shared by all project team, and that means that we should never hear of one of project team taking individual credit for the success of the project, and on the other hand no *project member blaming another for project failure, because they all shared equally in both. But that does not prevent or interfere with... in specific risk situations, we need – or I would say we have to delegate – responsibility to project professionals such the Project Director, the Site Manager and Project Planner.*

Another participant was more cautious:

In my experience of the construction project field, the situation was sometimes complex and we always requested a certain profile of experiences and skills in our team members, but often we couldn't meet them. Many people think that managing the work of the project is the job of the project manager, and also that managing the members of the project team is not the job of the project manager. That probably makes the situation more complicated. I think the process of risk management in the construction industry should be the project risk manager's responsibility.

And another's view differed yet again:

There's me, the Site Manager and the Quantity Surveyor responsible for project management, but again we can't say that we manage risk. I think that senior management should have an approach to managing risk in construction projects, and the company's project team members should just follow it.

- However, some interviewees maintained that failure to meet the project's objectives lies with the overlapping of responsibilities:

In fact, the responsibility for implementing the project control process in Libyan construction projects overlaps between all participants in the project, from the designer and planner at management level to the project manager, the procurement, and the construction site manager *and his staff at field level. As a result, they all face a big challenge in developing strategies to control projects.*

7.4.6 Absence of risk managers

- Another matter emerging from the interviews is that the absence of risk managers constitutes a weak point in the control process, one that leads to defects in monitoring cost and time. Griffin (2010) elaborates on this: the construction manager must go through each risk event and determine the probability of its occurrence and its impact on the project. If the risk event has both a high probability and high potential impact on cost or time, the construction manager should make the effort to analyze the relevant factors and attempt to arrive at some informed estimates. Some participants agreed:

> *I have found in over 22 years of practising project management that the project manager has to provide the project team with a road map on how to get the project done. He should sets out how the project is to be managed through the phases of its life cycle. We don't really have risk managers in the construction field in this country. We've had to try and fill these positions using project managers. Because, at the beginning of a project, project managers view risk as something they deal with by constructing some type of risk management plan and then filing it away so they can get on with the real work of the project.*

> *It's fairly clear that we don't have competent risk managers in the construction field, and that leads to overlapping responsibilities*

It is therefore noteworthy that the introduction of risk managers in the LCI has become an urgent requirement for project management analysis.

7.4.7 Identification of barriers encountered in the process of cost and time control

Interviewees saw the operations conducted by the LCI as apparently hampered by many obstacles. The major factors affecting cost and time control have already been identified in the previous chapter's quantitative study; the interviewees confirmed these as major inhibitory factors. They also discussed other barriers, which can be classified thus:

(5) contractor-related
(6) consultant-related
(7) client-related
(8) external party-related

<u>Contractor- related</u>

Like the results of the quantitative study, the interviews reveal the contractor to be the party responsible for most of the factors leading to delays and cost overruns. The main causes of these overruns were identified as:

- **Lack of commitment and interest**

Interviewees stated that a lack of commitment and interest in their companies led to excuses for consistent failures to complete required tasks on time. The participants pointed out that the ability of team members to keep to schedules was very important, and that project team members must be proactive in the performance of their responsibilities and duties without the project manager having to constantly remind them about schedules and deliverables. One professional said that:

> *Commitment and lack of interest are the biggest challenges we face in this company. Don't misunderstand me: the employees do their jobs, but sometimes they don't take into account the time that's necessary to complete particular activities. That might result in a divergence between boards and department heads.*

- **The lack of specialist staff in Libyan organisations**

The problem of skills shortages was reiterated. Almost all participants revealed that they had no staff trained in improving awareness of risk events working in project management. They pointed out the need for continuous work-training programmes for industry personnel so that they could update their knowledge and familiarize themselves with project management skills. Most of the sentiments expressed were similar to the following comment:

> *It's fairly clear to me that we haven't got trained staff working in risk management, which means that there are no official processes to manage the financial ones.*

- **The inability of contractors to supply onsite materials and storage**

Delays in payments or handling materials were another barrier faced in the process of project control. Many participants saw delays in supplies as affecting the project's timing. The contractor therefore has to insure permanent and temporary work and all equipment and materials brought to the site for their full replacement value against all loss or damage, fire, robbery and natural disasters. As one participant saw it:

> *For example, we faced this problem of poor material supply during my period as engineer. The project included the supply, installation and execution of all mechanical and electrical works and the building of the break-pressure reservoir. Most of the materials for this project were imported from overseas, and that was one of major barriers that led to delay on the work on the site, and increased the cost.*

Workers were rendered idle by this inability of contractors to supply onsite materials and provide storage at project sites, a situation exacerbated by the interdependence of the activities involved in construction projects. Iran Zakeri et al. (1996), Lim & Alum (1995) and Abdul Kadir (2005) point to this constellation of factors as causes of delays.

Consultant- related

- **Complexity of administrative procedures**

The analysis shows that the job culture in Libyan public departments is mostly driven by regulations and restrictive procedures. Moreover, most Libyan SMEs have no cost and time control procedures. It is only the project manager who monitors the work. A participant pointed out that the executives are totally unaware of either the process or the strategy of risk management. It is not so much this that is the obstacle; rather, it is their mistaken conviction that they do in fact know about this subject. Often they make suggestions and issue directives that unfortunately change established procedures and that are for the most part simply wrong. One participant expressed his frustration:

> *The set of administrative procedures used throughout the project is one of the barriers we face. For example, if one of our project team wants to handle the flow of project data between different departments, he will certainly find that difficult to do due to complex company procedures, and that lead to timewasting.*

- **Improper planning**

This is another of the many obstacles identified by the participants, who pointed out that they often do not even have a clear idea of what they are trying to accomplish, so the lack of clear priorities renders them much more vulnerable to unexpected events and interruptions. As a result, they often fail, fall behind schedule or miss deadlines:

> *It's simply that we don't have a proper plan. I'm not exaggerating when I say that some of the companies I worked for don't plan at all because some think it is too constricting and some think they understand how to plan but they really don't. Many honestly believe that they don't have enough time to plan, or that they don't need to plan, or that planning doesn't work for them; that's why we have difficulty in understanding what's necessary to finish a project successfully and how to prioritise our time properly.*

I would have to say the difficulty of putting risk plans into action and ensuring that the project plans are still valid are the greatest challenges we face during the process of project management.

- **Lack of standardisation**

Another barrier revealed by the interviews is the lack of a uniform set of procedures or actions by which to practice risk management, and a lack of meaningful documentation to support these processes. Some participants stated that the difficulty of putting risk plans into action and ensuring that the project plans are still valid are the greatest challenges they face during the process of project control.

- **Inability to use project control tools**

Some participants pointed out that projects are usually planned using a variety of software tools, and that it would therefore be desirable for construction project team members to have some familiarity with these tools and thus be able to leverage the technology to implement their project responsibilities. Such familiarity is unfortunately not often in evidence.

- **Difficulties obtaining reliable estimates**

Most of participants stated that they faced difficulties obtaining reliable percentages of work completed and estimated time to completion:

For example, most of the project team in our organisation pray five times a day, and then there are Friday prayers and the Ramadan fasting month – so all of these factors affecting the working hours should be taken into account to avoid any negative effects on work times.

I would have to say that the consequences of unrealistic estimation, such as the inability to deliver at the specified performance, in time and to cost, are much worse for small companies. All these factors lead to a *failure of our company's pricing strategy, since that strategy will have been based on weak foundations.*

Client- related causes

- **Centralized regulatory framework**

This is an important aspect of public construction projects in Libya; they may actually play a positive role in implementing policies and ensuring the outcomes that would satisfy policy goals. But on the other hand, one might argue that the shortcomings in satisfying public project goals at the construction level are rooted in this centralized governance and a sometimes despotic approach that may lead to time and cost overruns. This was certainly the view of one participant:

> *In the Libyan east we often do not take the jobs directly. Jobs are distributed to contractors from Misrata, Sirte and Tripoli, and we in the east take subcontractor contracts. In other words, things aren't perfect.*

- **Failure to allocate funding resources**

Another difficulty encountered during construction is the owner's failure to allocate funding resources to contractors for the job, which makes it difficult for contractors to manage projects and finish them on time and within cost. Frimpong et al. (2004) conclude that monthly payment difficulties are seen by contractors and consultants as being the most important delay and cost factor, a view echoed by the present interviewees:

> *For example, between 1991 and 2003 (which was when Libya was embargoed) almost all construction projects associated with the public and private sectors suffered delays, which had a great impact on project costs and times. The prices of construction materials including steel were very high and many projects were put on hold in anticipation of a return to old price levels, being the direct cause of delays. Contracting parties also created disputes between contractors and owners, which further increased projects' durations.*

> *In early 2011, Libya was mired in political conflict. Matters changed with the widespread popular protest against the Qadhafi government. Some companies lost hundreds of thousands of dollars in damaged and stolen property and many companies are currently trying to reap the financial benefits of keeping a low profile.*

The literature review of studies about project control revealed similar results for material price fluctuations for other countries including Nigeria (Okpala & Aniekwu, 1988; Elinwa & Buba, 1993; Mansfield, et al., 1994; Ayodeji & Odeyinka, 2006) and Ghana (Frimpong et al., 2003).

In addition to embargo and sudden politically motivated changes in government policies on the importation of special materials, another interpretation of the fluctuation of material prices in the LCI is the scarcity of some requisite materials such as steel bars because of artificial shortages created by "unlicensed" Libyan suppliers who sell such materials on the black market, forcing some contractors to wait for supplies, in turn negatively affecting work completion rates on construction projects.

- **Poor communication**

Interviewees adduced poor communication between managers and team members as leading to marked variations in schedules, resulting in cost and time overruns. Every project manager, planner and scheduler must therefore consider this issue:

> *I have found over 33 years of my work in the construction industry that the client always seems to expect more than project managers are prepared for. Time and again I've personally witnessed this expectation gap manifest itself. I believe that this is happening as the result of a failure to communicate more than anything else. This problem often starts at the beginning of the construction project and continues until we finish.*

This study's review of previous work on project control reveals similarly grave concerns in a number of countries such as the Lebanon (Mezher & Tawil, 1998), Hong Kong (Kumaraswamy & Chan, 1998) Kuwait (Nabil & Saied Kartam, 2000) and Thailand (Ogunlana et al., 1996). John (2000) states that their construction engineering experience has caused developed countries to evolve sophisticated methods such as advanced planning tools and information communication networks in order to reduce delays.

- **Level of detail**

Delays in approval of detailed designs by clients constitute another barrier faced by project teams. This usually happens when the clients change their minds or give instructions too slowly or too late when approving designs; delays in approval of work carried out cause delays in payment:

> *In my experience I can say the level of detail is the real issue that affects project control. Often the drawings presented for the building's uses don't have the level of detail we really need. Any delay caused by the Consultant Engineer in checking, reviewing and approving the design submissions prior to the construction phase could delay the project's progress.*

External party-related

- **Corruption and favoritism**

A few participants saw corruption in Libya as a relatively subtle disease requiring persistent treatment to eradicate, but unfortunately the prevailing attitude among many Libyans is that it is a habit rather than a morally or commercially reprehensible practice. One participant pointed out that contracts are the result of the tribal system and personal relationships, and that the government must apply all measures necessary to combat and overcome corruption in the construction sector so as to manage the procurement process and create a regulatory environment for the LCI:

> *The cultural factor gives structural power to the interests of higher-level operatives to adjust a project in such a way that it also becomes a source of jobs and influential positions for their extended family or clan in their known geographical boundaries.*

Another interviewee stated that influential parties can change the surrounding environment in terms of the laws, regulations and even the ethics of the construction industry in a way that ultimately affects all aspects of public projects and causes favoritism in implementing policies:

> *We live in a country with a particularistic culture, and instead of working with a clearly defined procedure to handle a certain type of project, we as a project team sometimes find ourselves having to see the person behind this role and adjusting our behavior to their personal characteristics.*

The literature review that corruption was identified as one of the major causes of cost overruns in Nigerian construction projects due to "fraudulent practices and kickbacks" (Okpala et al., 1988, and Elinwa & Buba, 1993). However, it is noteworthy that cultural and ethical differences between Nigeria and Libya would account for a disparity of the effect of this factor on work progress: despite this factor being considered as having a great impact on Libyan construction projects, it seems that international and local companies are more able to deal with this kind of risk in that country than in Nigeria.

- **Bureaucracy**

Bureaucracy was for the interviewees another barrier faced by project teams during the construction process. They pointed out that this factor frustrates employees and leads to delays and wasted time. For example, procedures should receive official feedback within days, but this actually takes months. This high degree of bureaucracy in Libya was and still is a major barrier to the initiation of any cultural change in the procurement of public construction projects. Participants also wondered how they could procure improvements in this bureaucratic environment. One interviewee expressed his frustration:

Obvious examples of centrally controlled bureaucratic organisations in Libya can be found in public departments concerned with authorisation of documents and activities in the construction process. Their procedure is long and inefficient. In these organisations it is quite normal to need formal authorisation, by means of official documents, to move a desk from one room to another. Furthermore, the members of these organisations have to write down every phone call they make, and before they can use a vehicle they need written permission from the director of the organisation. All of that is time consuming.

The issue of work permits in construction projects is a prolonged procedure because of the many government organisations involved, which maximizes the risk of conflicting decisions on the execution of work activities. This fact is also recognized by Al-Khalil, (1999) as being very important for public utility projects, while El-kmesh (2006) ranks "administrative routines" as one of the major factors causing delays and cost overruns, and Assaf et al. (2006) rates "excessive bureaucracy" as having the same effects on large building construction projects in Saudi Arabia.

- **Weather**

Some participants stated that weather is one obstacle to cost and time control, and that it should be taken into consideration when the contract is drawn up. One Libyan professional argued that

Maybe many people think that the weather factors don't need to be considered, because they don't influence the process of construction in a country like Libya, where the weather is stable most of the year, but in fact we do face weather difficulties such as unforeseen ground conditions and storms and heavy and dusty winds.

For example, the weather in the Green Mountain region is very important because it is in a mountainous area and therefore changeable, *whereas in Tripoli and Benghazi the weather is stable, and as a result it's of no interest to us as regards the delivery of materials.*

Zaneldin (2006) demonstrates the impact of weather changes on the cost of the Millennium Dome project in the UK: the project cost increased from an initial £339 million to £628 million, primarily due to the impact of the weather and changes of design.

- **Unexpected events**

Cost and time overruns were also seriously exacerbated by this factor, as one participant explained:

> *During the design of a road in the country, and despite the intensive study of the project, it emerged that a wet layer was not taken into account. The person who did the study dug a hole two metres deep, but in fact it had to be three metres. This kind of risk wasn't identified during the planning or takeoff phases, but the Project Manager identified it during the course of the work. We had to stop work and study the problem quickly to save time. I started researching another company that had faced same problem – it was the Korean Daewoo construction company that built the Sirte line. I went directly to the Korean company's site in order to find a solution to this problem, which was using rocks of various sizes. But that cost us time and money.*

> *For example, no one anticipated what happened in Libya. In early 2011, Libya was mired in political conflict. Matters changed with the widespread popular protest against the Qadhafi government. Some companies lost hundreds of thousands of dollars in damaged and stolen property and many companies are currently trying to reap the financial benefits of keeping a low profile.*

7.4.8 Participants' views of the specifications required for the project control framework

- **Optimum comprehensiveness**

Most participants emphasized that the framework must include all the elements of the activities required in the construction processes, as well as the tools and techniques used to control the projects, even though each organisation should be able to reorganise the framework to meet the requirements of its individual strategies. There was a consensus among the participants for the necessity to define the groups of activities that should be achieved, while the methods and procedures used to execute those tasks will help companies better understand the major risks associated with this kind of project, and consequently plan and implement effective risk alleviation measures to eliminate those risks before they happen:

> *First there must be a good understanding of those project activities that are needed to control projects. For example, how long each work activity should take to finish, and how much each element of the project should cost. The important point is who is responsible for each phase or activity.*

- **Logical sequence of project phases**

The participants were also unanimous in their opinion that the framework is a straightforward summary of the complete management process for projects. Therefore, it should be uncomplicated and simple to follow, in order to enable employees to understand the processes they should use to manage their projects. All participants emphasized that the framework should be characterised by the logical sequence of project phases to be applied flexibly:

> *Careful consideration must be given to the sequence of operations to see if it serves all the company's objectives. Also, it must take into account the type of project that we want to carry out, because the type of project greatly affects the sequence of operations. Some projects are interested in the planning and design phases and others in the construction itself.*

For example, in the construction of roads the design phase is not the important but the methods of application are very important.

All stages should depend on each other until the project is completed.

- **Continuous monitoring**

Participants emphasized that monitoring the project cannot be ignored at any stage of the project, and affirmed that this process must continue throughout the life of the construction project:

It must clarify the processes of project management depending on each – meaning, for example, monitoring the project cannot be ignored at any stage, even for example in the planning stage.

7.5 Summary

The semi-structured interviews helped this study to validate Questionnaire I and to investigate how the costs and times of construction projects are controlled so as to discover the reasons and related issues that affect the practical process of cost and time control in Libyan construction projects. The results presented in this chapter are relevant to the LCI, as they contribute to future measures that will help mitigate the causes of cost and time overruns in the LCI.

The participants explained the reasons for the importance of project cost and time controls from their perspective. These reasons included stopping the habit of reinventing the wheel, providing information on the current status of the project, effective project management, the maintenance of a good reputation, and client satisfaction.

In addition to the identification of factors causing time overruns in Libyan projects in the quantitative study, the analysis of the interviews detected some other barriers encountered the process of cost and time control. These are categorised as contractor-related, consultant-related, client-related and external party-related causes. Participants' also presented their views on the specifications required in the project control framework: comprehensiveness, the logical sequence of project phases, and continuity of monitoring through to project delivery.

The outcomes from Survey Questionnaire I and the semi-structured interviews will be used to develop the initial proposed framework to minimize cost and time overruns in Libyan construction projects that will be discussed in the following chapter.

Chapter 8 Development and Evaluation of the Project Cost and Time Control Framework

8.1 Introduction

This chapter reviews the development of the proposed framework for the control of cost and time in Libyan construction projects. The framework outlines a methodology by which practitioners (contractors, consultants, clients and external parties) directly involved in Libyan construction projects can minimize cost and time overruns. The methodology is based on a synthesis of the findings and results of the research, which has involved a comprehensive literature review, a quantitative study and a qualitative study in chapters 2, 3, 4, 5, 6 and 7.

As mentioned in Chapter 5, the design of the initial proposed project control framework was based on documentary analysis of previous studies and monographs. This chapter presents the stages of the development of the proposed framework. Firstly, it compares the theoretical framework with the current practice of contractors, consultants and clients in Libyan construction projects. Finally, it brings together the best practices as revealed in the literature review and the findings of the quantitative and qualitative studies. Because a variety of factors determines what cost and time overruns occur in construction projects, it is anticipated that the use of the project control framework presented in this study will make the various remedial activities in the control of time and cost in the construction industry considered in this work effective, and would contribute to minimizing those overruns, thereby improving client satisfaction. In addition, this chapter validates the mitigating measures incorporated in the framework, and evaluates it in terms of the completeness of the factors responsible for project control.

8.2 The stages of the development of the project control framework

As mentioned in Chapter 7, building companies in Libya generally utilize past experience as a basis for managing the process of construction projects so as to minimize problems during execution. In fact, in the LCI many companies have managed their projects according to the same processes that produced the previous Libyan government. However, some of these processes are not always executed effectively or efficiently. The framework for project control design initially proposed in the present work is based on previous studies; other practices regarding project cost and time control are derived from the findings in the literature, as shown in Fig.5.5. The attempts that have been conducted for the developments of the framework are presented in the following subsections.

8.2.1 A comparison between the initial proposed framework and current practice of project control by Libyan construction companies

In addition to the findings of the literature review, the results of semi-structured interviews as supported by those of Survey Questionnaire I would also contribute to the development of the initial proposed framework. Survey Questionnaire I was conducted to identify the major risk factors causing time and cost overruns in Libyan projects. Semi-structured interviews with professionals of Libyan organizations as a qualitative research method were also used to investigate how costs and times of construction projects are controlled in practice, and to investigate the issues that affect how that control is exercised.

The first attempt at developing a cost and time control framework for the LCI is based on comparing current practice to the initial proposed framework in order to discover the differences between the two.

The analysis of the interviews shows that the perceptions of professionals in Libyan construction projects regarding the processes of project control are generally similar to the processes involved in the initial proposed framework. However, several processes are not carried out effectively in practice. Figs 7.1 and 7.2 show those activities that are not implemented in a very comprehensive manner in construction projects in Libya. The importance of project control was nonetheless reiterated by almost all participants, because project execution is inherently risky and the lack of an appropriate approach to controlling these risks results in undesirable effects on a project's execution.

The analysis of the interviews shows that time control in Libyan construction projects often suffers from a lack of both progress tracking and proper delay analysis systems, which causes the projects to fail, or at least to run over-time. In addition, those corrective actions that are taken are mostly reactions to rather than anticipations of risk events that occur.

The interview analysis also shows that the process of cost control in practice lacks quantitative estimation methods and effective monitoring systems. Cost control is based largely on the reporting mechanism: after the completion of the planning phase, the quantity surveyor immediately begins to prepare a report on the project's cost. The analysis showed that there is no a systematic way to take preventive actions when they are required. The process of cost and time control in practice is illustrated in Table 8.1

8.2.2 Integration of the process of cost and time control

The author has studied how construction projects in Libya are controlled. In this chapter the initial proposed framework will be developed in order to help improve the work done in this field by trying to fill the gaps and highlight the weaknesses peculiar to Libya. The development of the initial proposed project control framework began by analysing interviews with project professionals. The framework is designed according to these analyses and observations, as compared to the initial proposed framework. It begins by considering construction professionals' perspectives on current cost and time control practices as described in the preceding chapter, then proceeds to integrate the process of cost and time control by amalgamating the practical processes of control, in order to design an alternative solution regarding remedial activities in the form of a unifying cost and time control framework which is then reviewed and refined through an iterative process summarized in the following sections and depicted graphically in Figs 8.1 and 8.2 (see pages 271 & 273). The integration of process of cost and time control is shown in Table 8.1

Process of project cost and time control in practice	
Planning phase	
Cost	**Time**
❖ Estimation of cost is the weakest part of the process of cost control because it is not based on quantitative methods but on the lowest price tender that satisfies the contract terms and conditions. ❖ The weakness of the estimation has deeper roots in the country's political instability. ❖ Find similar projects and use them as a reference to estimate the cost. ❖ Under the supervision of regional departments, the project consultant prepares tender documents for the infrastructure and development projects in order to allocate the budget. ❖ In general, difficulties in reliably estimating the cost and resources needed to complete the work.	❖ The project's duration is determined through the project programme and schedule. ❖ The activities in this phase are carried out using experts' judgment. However, the accuracy of their judgments is based on their experience of making estimates. ❖ Government organisations and large companies depend on a combination of experience and calculation. ❖ Use of software such as bar charts, Gantt charts and critical path analysis. ❖ The responsibility for this phase lies with the project planner together with the project office team. ❖ In general, the majority of planners undertaking post-project reviews, but small projects were sometimes missing out.
Monitoring phase	
❖ The process of monitoring the cost is carried out by regular site review meetings with the quantity surveyor, who has full responsibility for cost control. ❖ The monitoring step seems to be very loose, and does not adopt systematic or computer systems. ❖ Following process monitoring, the reporting step take place. It seems more robust than the monitoring process because it is the quantity surveyor's responsibility. Therefore, the author recognizes that identification of responsibilities is the important element that leads to the success of the project. ❖ Reporting seems not to be robust – indeed, it often does not exist as a step to control time. The author finds that this is due to overlapping responsibilities between the site management team	❖ The monitoring process often relies on checking work performance by comparing what has actually been achieved (after breaking down the schedule into its component parts) with the planned programme. This comparison is carried out by regular progress reports to identify progress and delays. ❖ The project programme is usually monitored on the critical path using the S-curve in order to reach milestones on time. ❖ Internal meetings are regularly conducted; they include the project office and site teams, and are intended to track work progress and to consider the main reporting structure. This means that continuous monitoring often fails to occur, because any solution to any risk cannot be implemented before the meeting. ❖ However, to monitor the work in small and medium organisations,

during this step.	the project manager provides the project team with a road map on how to complete the project. ❖ In general, it seems that there is no dedicated mechanism to monitor work progress; not only is the reporting step during time control ambiguous, but it is often neglected.
Evaluation phase	
❖ Formal risk analysis techniques are rarely used in practice due to lack of knowledge and lack of skilled people and to doubts on the suitability of these techniques for Libyan construction projects. ❖ A few professionals alluded to the use of tools such as earned values under the name of "overall profit and loss account" to show the causes of overspend.	❖ Depends on performance checking by comparing actual with planned progress ❖ Lack of proper analysis system ❖ Lack of skilled staff ❖ The way time control is analysed in practice makes it difficult to identify the factors causing delays, which makes it difficult to control these factors. Therefore, the finding or the analysis of the project status will be ambiguous. ❖ This step is considered the weakest part of the process of time control.
Taking of corrective actions phase	
❖ No systematic manner of taking corrective action. ❖ Actions are taken in practice by reacting to circumstances as they arise, rather than in a planned or systematic – i.e. proactive manner such as "shuffling of cost" ❖ Therefore, the author finds it is important to incorporate the mitigation measures for major risk factors that have been identified with the developed project control framework.	❖ Often actions are taken after the delay has occurred, reacting to events as they arise. ❖ Taking action without study the consequences ❖ The actions taken in practice are unplanned, or are taken without consultation with other relevant parties such as changing the subcontractor, introducing different workers.

Table 8-1: Integration of processes of cost and time control in practice

8.2.3 An initial improvement of the proposed framework for project control

Based on the literature review and the results of Survey Questionnaire I and the semi-structured interviews, the initial proposed framework must be developed to commensurate with the situation of the construction sector in Libya in order to control a project throughout its life cycle, from planning, through execution until delivery, in order to minimize cost and time overruns.

The analysis of Survey Questionnaire I (Chapter 6) presents the major factors causing time and cost overruns in Libyan construction projects as they are perceived by all the parties involved in the Libyan construction industry. Furthermore, the analysis reveals a consensus between contractors, clients and consultants regarding the importance of certain factors affecting overruns. However, the analysis also demonstrates some perceptual differences, which can be explained by the fact that the work varies in nature between parties, who all see themselves as exerting their utmost efforts to avoid time and cost overruns. Moreover, the results of the semi-structured interviews reinforce those of Survey Questionnaire I. They investigate how the costs and times of construction projects are actually controlled, thereby disclosing the issues affecting the practice of cost and time control in Libyan construction projects.

Most participants involved in interviews emphasized the importance of the application of a project control framework, even though each organization found it desirable to reorganize the framework to meet its strategic demands. The analysis indicates that risk control should has three aspects: constant surveillance of the trigger events associated with each risk register; regular review of risks in order to identify new ones and re-evaluate the items identified on risk register; and periodic review of contingency plans, schedule reserves and budgets so as to determine if changes are needed. It can therefore be concluded that the project control framework should provide plans for time and cost that allow portions of the project work to be organized, sequenced and controlled so that the whole project can be completed in an efficient and organized manner.

The initial proposed framework for minimizing cost and time overruns was developed first according to the results of the survey questionnaire I and the semi-structured interviews. Findings from Questionnaire I as discussed in Chapter 6 have been taken forward into the development of the proposed framework for effective implementation of cost and time control in Libyan construction projects. In addition, data has been collected through semi-structured interviews to ascertain construction industry professionals' perceptions of the importance of construction time and cost. Findings from semi-structured interviews as discussed in Chapter 7 is used as a reference for the development of the proposed framework as an alternative solution for remedial activities in order to minimize cost and time overruns. The initial improvement of that initial proposed framework is presented in Fig.8.1.

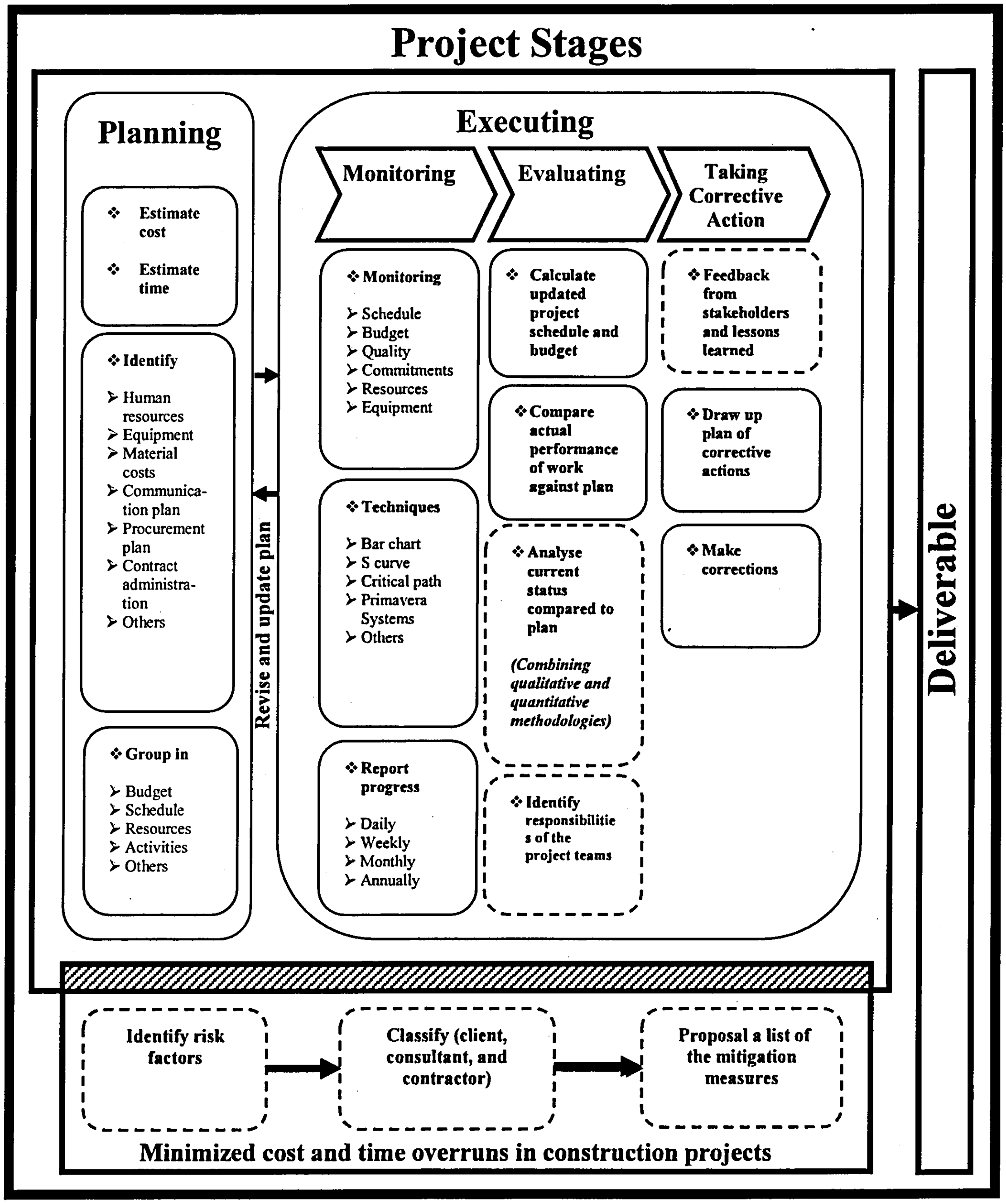


Figure 8-1: An initial improvement of the proposed framework for project control

<u>Key:</u>

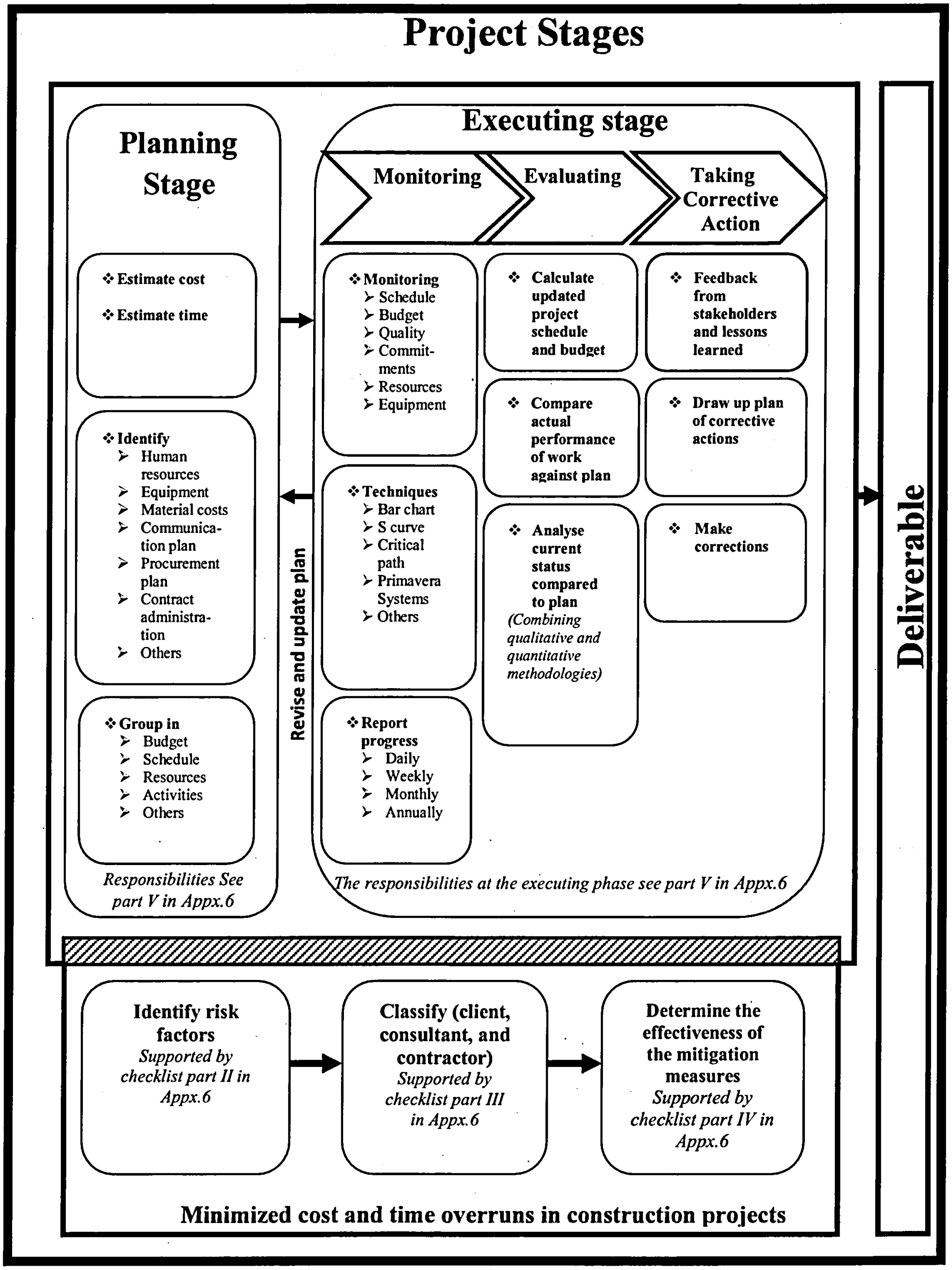
Alternative solutions for remedying control cost and time overruns problems in Libyan construction projects

Interface of the Project Control Stages with Minimized Cost and Time Overruns Stage

8.2.4 Final developed framework for project cost and time control

Project control requires a comprehensive understanding of the project's activities: how long each activity should take to complete, how much each element should cost, who is responsible for each and how they interrelate. The proposed project control framework is essentially a set of processes that work together to reach the project's objectives. The process of project control interacts with other parts of the project control process. Planning, monitoring, evaluating, taking corrective action and re-planning are all included in the control cycle of the proposed framework as shown in Fig.5.5. The initial improvement of the proposed framework constitutes a suitable approach to providing an overview of existing practices in Libyan construction procedures, especially in terms of cost and time overruns and problems based on frameworks for project control as described above, because it presents all the steps involved in project control and describes the methodology by which performance procedures and processes in general are carried out in the LCI.

The study was carried out in order to identify each participant's approach to execution and to determine their perspectives on the project control phases so as to control its processes by using the initial developed framework. The development stages of the proposed project control framework are discussed in Section. 8.3. The final developed proposed framework for project control is shown in Fig.8.2



Key:

Interface of the Project Control Stages with Minimized Cost and Time Overruns Stage

Figure 8-2: Final developed framework for project cost and time control

8.3 Discussion of the development stages of the proposed project cost and time control framework

The project control framework shown in Fig.8.2 is the document that guides construction projects and is used to determine whether or not they are managed successfully. The framework suggests that the process of project control starts with the planning phase, which is composed of a number of items including construction schedules, communication plan, human resources, purchasing, contract administration and project baselines in addition to cost estimates as well as the time needed to complete the work. However, there are local peculiarities and conditions that must be contextualised for Libya. The majority of Libyan construction project practitioners build up their programmes from individual activities and then compare actual with planned performance, but some reverse this process, starting with overall cost and time and then breaking these down into individual activities. The techniques generally used in practice include bar charts and the Critical Path Method.

The project control framework moves from the planning to the construction or execution stage, in which the plan is implemented. Particular attention is paid to control cost and time during the execution phase due to the complexity and risky processes involved. Because execution relies heavily on the project plan, it is important to ensure that the planned activities are carried out efficiently and effectively. The process of execution consists of the monitoring, evaluating and corrective action phases. The execution process is not a one-time fix, but rather a continuous cycle of goal-setting, evaluation, correction, improvement and re-evaluation. It is worth mentioning that the project control framework referenced to that during the execution phase, the project plan must be revised and updated as necessary.

In fact, there is a lack of databases that can be used in Libyan construction to estimate such factors as the resources required to complete a particular activity. This in turn leads to difficulties in reliably estimating the project's time and cost and the requisite resources. The project control framework corrects this deficiency by stipulating that the project plans should be updated frequently, to keep an update historical database of construction project, including the programme, cost estimate, prices of materials, equipment, and unit price for work packages. Moreover, the project control framework stipulates that the responsibilities inherent in the project's initial activities should be integrated, and those required preparing and directing the construction process, project design and completion during the planning phase should be identified.

The project plan is then put into effect in the construction / execution phase in order to complete the project within the specified time and budget. The process of execution begins with the monitoring phase. However, the process of monitoring in practice suffers from many weaknesses due to the absence of a tracking mechanism for the progress of construction projects and a lack of effective monitoring and control systems as specified in the project handbook. Although the process of project control in construction projects is largely based on the reporting mechanism, the prevailing situation in Libya is that the quantity surveyor assumes full responsibility for the project's cost. Meanwhile, the site manager monitors the project programme from time to time, and there is an internal meeting where the project team members and quantity surveyors mark up the programme and show exactly where they are. Since monitoring constitutes a key method of keeping risks within an acceptable level, the developed framework seeks to remedy this flaw by identifying the parties' responsibilities in this phase in order to assign project objectives and to document and provide ongoing and consistent evaluation of risk factors and resolution strategies.

After monitioring comes reporting. In practice it was revealed that the process of cost control is largely based on the reporting mechanism: after the planning phase, the quantity surveyor immediately starts to prepare a report on the project cost. The size of the company plays a role in the mechanism involved in the control process. In big projects, reports reviewing progress and providing basic information on the project are regularly prepared as mentioned previously, whereas in small and medium firms it is only the project manager and project management team that monitor the work. In order to remedy this weakness in the reporting phase, and to inform the project team and executive management and stakeholders about progress and the activities required to complete the project, the developed framework proposes a more systematic approach through the identification of the parties' responsibilities regarding a number of issues such as detailing activities, accomplishments, milestones and problems. This system will help indicate such things as the destination of reports, the reporting templates and the reporting cycle, and will ensure that reports will be thoroughly organized and systematic.

The next step in the project control framework is the analysis phase. Although this phase has become an integral part of projects, the present study shows in practice it amounts to no more than a description of the project's status in terms of progress against the plan. It often relies on the project team's assessment of progress, and consequently the project's current status will be ambiguous. In addition, existing analysis techniques cannot integrate the influence of each delay factor with a quantification of the delay's impact on a construction project. The developed framework therefore demands the use and application of techniques with which to analyse and quantify in advance the impact of risk factors associated with construction projects. That will assist construction managers to take measures to reduce the impact of risk factors in projects before they occur. The framework also stipulates the use of an analysis system by which to examine the threats posed by potential delays, thereby helping decision-makers in public departments take proactive measures to combat them.

The framework then moves to the action phase. The interview findings reveal no systematic way of integrating the results of the analysis step in Libyan construction projects; what actually happens is that discussion meetings are held as the best way of tracking work progress.

The interview analyses also show that the framework specifies dedicated feedback actions. However, this step is often not applied in many project cost and time control frameworks; it is also found to be wanting in prevailing Libyan project control practice. The author suggests that communicating the analysis of the project's status to stakeholders and project teams is very important in order to enable corrective actions. If this is not done, the effort put into planning, monitoring, reporting and analysis of the project data will be wasted.

The study reveals that, as a result of the lack of a proper analysis system to identify the causes and effects of risk factors, project managers cannot take corrective action to eliminate cost overruns and delays. In addition it is also apparent that there is no systematic way to take preventive actions when required. The development of the project control framework states that the possibility of preventing problems in the construction process is based mostly on taking corrective action as early as possible. The framework also requires that such actions should be systematic and should carefully consider the responsibilities of the parties involved, because some actions may be counterproductive and can cause delays or cost overruns.

The proposed framework therefore notably indicates that project plans should be reviewed frequently, even if there are no changes, to ensure that the project work progresses as planned. This step has been tagged to the planning phase, as shown in Fig.5.5. Revised and updated project plans are important to mitigate the effect of inevitable in work activities. The establishment of a programme reflecting the planning process in relation to real time forms the core element of planning. The evolving planning documents also might include increasing levels of detail about the procedures to be used when executing the project. The project plans should therefore be updated frequently, even if there are no changes in scope.

Rad and Anantatmula (2005) stress that changes in project plans might also become necessary because of expanded or modified client requirements, environmental changes and changes in design philosophy. In view of this, the framework demands revision of the plan by breaking baseline scheduled work activities down into tasks in order to describe the sequence of events more precisely. Other proposals include modifying the durations of planned activities and adjusting the plan to absorb these, as well as additional manpower or man-hours to compensate for any delays. The revised proposal stipulates that all parties involved in the construction project must participate in any changes in order to ensure successful completion of the project.

8.3.1 Inclusion of feedback from stakeholders on the project control framework

The conception of "feedback" refers to the measures taken to make correction either to the project plan or to the activity; and performance should continuously evaluated. Frequent feedback from project teams, clients, suppliers and management, all of which can offer lessons, is important in the project control process because it helps reveal the complete solution, and thereby the success of the project. The construction project is complete at this phase; the process of organizational control will start somewhere else but with more knowledge and experience and with more lessons having been learned. The project control framework therefore crucially involves soliciting comments from people who will use it, which will help identify project successes and failures.

In this approach, not only project managers, but also all project management staff is involved in monitoring and evaluation phases. Staff's workings at field level have a particularly important role to play in providing their observations regarding the activities being implemented and their suggestions of how to improve them. Lessons that are developed by management staff can help project managers make better decisions about how to adjust the construction work strategy and budget.

8.3.2 Inclusion of the major factors causing delay and cost overruns in the project control framework

The literature review of project control shows that the control process aims to manage the potential risks by identifying, analysing and addressing them in order to help reduce the likelihood of risks being actualized, and mitigate the negative impact when they are. According to Eskesen et al. (2004) the use of risk management from the early stages of a project, where major decisions such as choice of alignment and selection of construction methods can be influenced, is essential. As stated by Hillson (2004), the proper management of risks requires that they be identified and allocated in a well-defined manner. In view of this, the proposed framework requires inclusion of the major factors causing delay and cost overruns.

Every project is unique in that it is not a routine process but a set of actions taken by the project manager in an effort to reduce the level of potential risk in LCI organizations. Since cost and time overruns are also a major problem in the LCI, the framework incorporates a phase called 'Minimized cost and time overruns in construction projects'; this phase first identifies the major factors and then classifies and analyses them before determining a response.

The study identifies 63 factors involved in delay and cost overruns; these factors are further classified into eight categories and a number of sub-categories according to their origin. The respondents were asked to identify each factor's degree of influence using a five-point scale, while the party responsible for each factor has been identified and its frequency and percentage determined. This phase uses the major factors from Survey Questionnaire I after determining the party responsible for each factor.

From the viewpoint of Carbone and Tippett (2004) the identification and mitigation of project risks are crucial steps in managing successful projects. Therefore, it should be mentioned that all relevant measures found in the literature review and from the results of Questionnaire I and the interviews were considered in order to produce the best means of mitigation for each category. If such measures prove ineffective, however, they should be revised by the parties concerned in order to ensure that an effective solution is achieved and cost and time overruns thereby minimized.

8.3.3 Inclusion of a list of core responsibilities in the project control framework

Baguley (2008) stresses that control is part of project management and can be defined as an implicit part of managing. It is applied to all sorts of things, people, costs, schedules, deliveries, etc. Thompson and Perry (1992) stated that the success or failure of a construction project depends on how the parties deal with all the factors related to it. This can only be achieved if contracting parties comprehend their risk responsibilities, risk event conditions, and risk handling capabilities.

To control the risk efficiently and effectively, the participants of construction process must understand risk event conditions, risk responsibilities, and project control capabilities in construction projects and, as such, it would be helpful to specify roles for project participants. The analysis of Questionnaire I and the interviews reveals that the processes of project control are common throughout the world, but the failure of Libyan construction projects to meet objectives lies in overlapping responsibilities and a lack of commitment. The major problem faced by the professionals in the Libyan construction industry was in developing a consensus about participants' responsibilities in the construction process. In order for the controlling processes to take place, responsibilities of project team must be defined so that job descriptions can be developed, not just for doing the work, but also for controlling and managing it.

A review of previously published studies of project control reveals that the need to identify responsibilities in construction projects is essential and there are many documents that already achieved this to varying extents (Chartered Institute of Building 1982, Royal Institution of British Architects 1992, 1995, 1997). The current study seeks to identify the participants' responsibilities in a way that is acceptable to all parties.

The framework therefore includes the identification of responsibilities in its evaluation phase in order to:

- Recognition and elimination of delays, cost increases and disagreements.
- Predisposition of the gray-area responsibilities which, if left unassigned, can cause disputes.
- Identification of project management requirements and unify these requirements.
- Establishment of lines of communication within project team.

However, Questionnaire III was designed to use participants' feedback to evaluate the framework's elements; one participant's criticism of the framework in Questionnaire III has led to a reconsideration of this step, as shown in Fig.8.2. He stated that the interests of all parties involved in the construction projects processes are well served by each being fully aware of its roles and responsibilities. He concluded that group working in a country like Libya results in time wastage, to which a failure to define clear responsibilities is a major contributory factor. The author therefore argues for the great importance of accompanying project control with a list of planned and clearly defined responsibilities for all parties at every stage of the project, from the planning or design stage through to the completion of construction, in order to facilitate achievement of the project's goals. The responsibilities are presented in Table 8.2.

Table 8-2: Responsibilities of parties (contractor, consultant, and client) in construction project

Project parties' responsibilities in the Planning phase			
No.	**Responsibility**	**Phase**	**Responsible**
R1	Assessing tenders	Planning	Consultant
R2	Preparing cost and time plans, estimates and cash flow projections	Planning	Consultant
R3	Preparing tender pricing documents	Planning	Consultant
R4	plan effectively for the delivery of materials and equipment in time	Planning	Contractor
R5	Submitting a comprehensive plan of action and stipulate how each item will be executed	Planning	Contractor
R6	Verifying the resources and capabilities of the lowest-bidding contractors before awarding the contract	Planning	Client
R7	Collating and issuing tender documentation	Planning	Consultant
R8	Preparing bills of quantities	Planning	Consultant
R9	Preparing a time schedule that clarifies the needs for equipment on site	Planning	Contractor
R10	Allocating the required amount of manpower to the construction site	Planning	Contractor
R11	Determining a realistic duration for the project	Planning	Client
R12	Facilitating the emergence of licenses needed to begin project work	Planning	Client
R13	Obtaining approval after delivering the risk management plan	Planning	Consultant
R14	Arranging and attending pre-construction meetings	Planning	Consultant
R15	Ensuring familiarity with work sites and all documents and plans prior to bidding	Planning	Contractor
R16	Defining requirements as a prerequisite for planning	Planning	Client
R17	Hiring qualified technical staff to manage the project competently	planning	Consultant
R18	Ensuring that project personnel are qualified and properly trained	planning	Contractor
R19	Attending pre-construction meetings and ensuring that appropriate personnel, including the project superintendent attend	Planning	Contractor
R20	Facilitating the laboratory testing of construction materials and products	planning	Consultant
R21	Approving design documents, shop drawings, and the payments of contractor	planning	Consultant

Table 8-2: Responsibilities of parties (contractor, consultant, and client) in construction project (cont.)

Project parties' responsibilities in the Execution phase			
No.	**Responsibility**	**Phase**	**Responsible**
R22	Preparing regular reports including work progress, expenditures, progress estimates and estimated final expenditures	Execution	Consultant
R23	Reviewing the contractors' monthly payment certificates	Execution	Consultant
R24	Focusing on reviewing and approving design documents	Execution	Consultant
R25	Ensuring permanent and temporary work and all equipment and materials brought to the site	Execution	Contractor
R26	Ensuring that site administrative and technical staff are assigned as soon as the contract is awarded	Execution	Contractor
R27	Paying progress payments regularly to contractors	Execution	Client
R28	Minimizing changes in orders during construction	Execution	Client
R29	Revising bid documents such as technical specifications, drawings, bills of quantities and the project design	Execution	Client
R30	Conducting interviews in cases of disputes between contractors and consultants to prevent such problems affecting the project's quality and completion	Execution	Client
R31	Attending meetings and making sure that contractors follow the plan that has been drawn up	Execution	Consultant
R32	Monitoring contractors for compliance with the construction contract and taking appropriate action when the standards or specifications are not being met	Execution	Consultant
R33	Discussing any problems with the project team and seeking approval/ direction/ agreement	Execution	Consultant

Table 8-2: Responsibilities of parties (contractor, consultant, and client) in construction project (cont.)

Project parties' responsibilities in the Execution phase			
No.	**Responsibility**	**Phase**	**Responsible**
R34	Focusing on planning and scheduling tasks during the construction process by matching the available resources and time	Execution	Contractor
R35	Improving communication and coordination between the local construction and international funding agencies to solve the material financial issues	Execution	Client
R36	Meeting with contractors monthly to review progress payments	Execution	Consultant
R37	Managing work undertaken by sub-consultants	Execution	Consultant
R38	Notifying the project sponsor of all claims in a timely manner	Execution	Consultant
R39	Arranging continuous work training programs for industry personnel	Execution	Contractor
R40	Meeting monthly with consultants to review progress payment estimates	Execution	Contractor
R41	Inspecting mistakes and discrepancies in design documents.	Execution	Consultant
R42	Ensuring proper communication and coordination among project stakeholders	Execution	Consultant
R43	Reviewing and approving the design documents within the agreed schedule	Execution	Client
R44	Confirming that contractors have the necessary materials and assessing their financial ability to implement the project	Execution	Client
R45	Providing technical staff who are able to manage the different stages of the project and to follow the performance percentages, and who can also compare actual with planned performance	Execution	Client

Table 8-2: Responsibilities of parties (contractor, consultant, and client) in construction project (cont.)

Project parties' responsibilities in the Execution phase			
No.	**Responsibility**	**Phase**	**Responsible**
R46	Notifying the client of any potential scope changes that may affect the fees payable in a timely manner, before any additional work is done	Execution	Consultant
R47	Completing a self-evaluation and submitting it with final details to the project sponsor	Execution	Consultant
R48	Managing financial resources and planning cash flow by utilizing progress payments and managing the contingency budget	Execution	Contractor
R49	Taking full responsibility for the adequacy, stability and safety of all site operations, labour and construction methods	Execution	Contractor
R50	Checking the action steps, discovering obstacles and seeking alternatives and solutions	Execution	Consultant
R51	Providing solutions to the client's problems and negotiating those solutions with project team members	Execution	Consultant
R52	Motivating workers to improve their skills and awarding pay rises	Execution	Contractor
R53	Informing the consultant and project sponsor in writing regarding any problems that are not being resolved on site	Execution	Contractor
R45	Notifying the consultant and project sponsor of any other problems such as those concerning landowner issues, utility movements and public traffic	Execution	Contractor
R55	Correcting all deficiencies and carrying out all necessary repairs in a timely manner	Execution	Contractor

8.4 Description of the framework

The proposed framework offers a methodology for minimizing cost and time overruns in Libyan construction projects. The framework is designed to be simple and user-friendly so as to encourage consistent use of this guidance in the LCI. Every set of core processes is represented in a list of the common project control processes and comprised an amalgam of proven project control practice worldwide as shown in the proposed project control framework that has been designed by the author in order to be employed to minimize time and cost overruns in the Libyan construction industry projects. The author suggests that the proposed guidance in this study is not intended to be prescriptive. However, it provides a project control structure and a selection of proven project control tools and techniques that would provide for effective project control. Specific activities within the control system approach to risk have been addressed for each of the project phases: planning, monitoring, evaluating and making corrections to fit with the process of project control in the LCI.

Following the questionnaire and interview analyses, each phase's core processes have been reformulated in accordance with the current situation regarding Libyan project control. This framework step is intended to cover project control practice in the LCI throughout all lifecycle phases from planning to project completion. It specifically addresses cost and time control as shown in Figs 7.1, 7.2, 8.1 and 8.2.

As a result, the framework first suggests that, irrespective of the results of the interview analyses, feedback from stakeholders and project teams – indeed, from all those capturing lessons for future projects – is crucial for helping identify project successes and failures. The use of feedback reports from project teams sent to site teams, decision makers and senior managers should therefore constitute one of the processes of project control; this will motivate site teams and reassure them that the project data is transmitted efficiently and quickly and are not left on the desk until obsolescence renders them superfluous.

The developed framework also incorporates a phase called 'Minimized cost and time overruns', as explained in Section 8.3.2; this phase begins by identifying the major factors, then classifies them according to the party responsible for each one, after which it analyses and responds to them. Firstly, the major risk factors have been identified to raise awareness when dealing with the factors contributing to time and cost overruns. Analysis of Survey Questionnaire I results in the identification of the major factors causing time and cost overruns as perceived by all the parties involved in Libyan construction projects, as illustrated in Chapter 6. It is worth noting that most of these factors were also recognised by the interviewees, as discussed in Chapter 7. The latter also pointed to other barriers such as 'corruption' that were encountered in the process of cost and time control. The agreement between questionnaire respondents and interviewees proves the importance played by certain factors in delays and cost overruns. The next step is to classify these factors according to four groups: consultants, clients, contractors and external parties. The classification of these factors is based on the party responsible for each factor, and their frequency and percentage are identified in the second phase, which is concerned with minimizing cost and time overruns.

The author argues that the development of the project control framework involves not only the organization of processes into phases, but also the inclusion of some more widely used practices in order to make the framework more realistic and applicable to the country that is the subject of this study. It therefore contains guidelines for measures to help control cost and time overruns in construction projects.

Hence, a total of ten participants from Libyan construction projects were interviewed, their selection having been based on their organizational positions and their experience in construction. The total time taken by the interviewees was 617 minutes, the average interview lasting 62 minutes. The interviewees had 256 years' experience between them, the average being 26. The interviews began by determining how the costs and times of construction projects are controlled in the LCI and proceeded to investigate the reasons and related issues affecting this process. This led to discussions regarding the practical process of cost and time control. Among other things, the results of the interview analyses explored measures that will mitigate cost and time overruns and promotes project control.

The list of mitigation measures has been developed through such techniques as transcription, familiarisation with the data and its organization, categorisation of the information, indexing and the construction of diagrams to present the interview findings in order to illustrate every point implied by the data and to render the resulting concepts easily comprehensible. In the end, a total of 48 mitigation measures are proposed for all the categories of risk factor based on the literature review's critical investigation from the project success factors and Survey Questionnaires I and interviews, taking into consideration the need to develop the final list of risk response measures for the factors causing delays and cost overruns. Participants were asked to rate the effectiveness of these measures in the Questionnaire II, and their views are incorporated into the project control framework as shown in Fig.8.2.

According to Thompson and Perry (1992), the success or failure of any construction project depends on how the parties deal with all the factors related to it. In view of this, the following step is intended to provide the relevant parties with processes by which they can take appropriate corrective action to minimize the effects of the risk factors; it also proposes a guideline comprising a set of all parties' responsibilities that is intended to minimize and control cost and time overruns in Libyan construction projects. These responsibilities were derived from the relevant literature reviews and recommendations made by the participants during the interviews, and are incorporated into the final project control framework as shown in Fig.8.2.

The control framework will supply the lack of a published set of processes for project control relevant to Libyan construction projects by proposing mitigation measures and identifying the responsibilities of all parties involved in construction projects, in order to minimize cost and time overruns.

8.5 Validation of mitigation measures and evaluation of the framework

The framework is developed as a guide for project control in the Libyan construction sector; with the view to increasing the potential for a project's success. This section aims to present the evaluation process of the framework. Badri et al. (1997) state that the evaluation process aims to reconcile the framework and its related activities with end users' problem resolution mechanisms and intentions. Therefore, the initial phase of the evaluation process was conducted to evaluate a part of the framework through the validation of the proposed mitigation measures. The second step of the evaluation process was designed to use experts' feedback to evaluate the entire framework's elements.

8.5.1 Objectives of evaluation processes

The objectives of evaluation processes include:

- To obtain Libyan experts' evaluation of the framework in order to ensure the efficiency and effectiveness of work activities of construction projects
- To assess the adequacy and applicability and capability of the project control framework proposals in addressing the problem of cost and time overruns in the LCI
- To examine the understanding of Libyan construction industry experts of the components of the project control framework
- To explore the perception of Libyan professionals (contractors, consultants and owners) regarding the relevance of the framework to development in the LCI
- To identify areas for required modifications to make framework more practical and efficient in addressing the need of development of project control process in the LCI
- To assess the possible benefits of the project control framework in the enhancement of the development in the LCI sector

8.5.2 The evaluation processes

The participants in Questionnaire I and the interviews were involved in developing the proposed project control framework. The questionnaire respondents first identified the major factors that cause cost and time overruns and affects the process of control. The interviewees then revealed the extent of the project control process in Libyan construction projects, and explored ways in which the processes and activities of professionals could be improved in order to positively affect the performance of time and cost control.

Case, Andrews, and Werner (1988) provide a definition of evaluation process: "*to make an explicit judgement about the worth of all or part of a program by collecting evidence to determine if acceptable standards have been met*". Hence, the initial phase of the evaluation processes of the framework was conducted to evaluate a part of the framework through the validation of the proposed mitigation measures. This was achieved using the perceptions of experts in Libya construction projects about the effectiveness of each mitigation measure. It should be noted that since the process of project control at each phase of the framework have been evaluated during the interview analyses, it was decided to validate the proposed mitigation measures and determine how applicable the final version of the framework was to Libyan construction projects. Meanwhile, the author argues that the validation of responsibilities that have been identified for all parties involved in the construction projects would have been too onerous for the participants of the validation process and may discourage them from completing the questionnaire II. The author therefore was content to list the project team's responsibilities and included it in the framework under the heading 'Identify responsibilities'. The author states that the list is not exhaustive, nor does it supersede any other obligations or responsibilities contained in contracts or other relevant documents.

The second phase of the evaluation processes was designed to use experts' feedback to evaluate the entire framework's elements. The following sections will discuss this evaluation processes.

8.5.3 The Evaluation Methods

In order to evaluate research effectively and efficiently, it requires consideration of which methods are most appropriate for a specific evaluation context. Methods of evaluation tend to fall into two main categories of software system:

- Formative evaluation
- Summative evaluation

According to Best (2012), with formative evaluation, evaluators collect information about a programme in order to help bring about improvement. The evaluators draw attention to what things went wrong, and how better results can be achieved next time. A formative evaluation, also known as process or implementation evaluation is performed to examine various aspects of an ongoing program in order to make changes/improvements as the program is being implemented. Best states that summative evaluation is often used to determine how effective a programme is at achieving its objectives. The results of this kind of evaluation might point to changes that should be made in a program in order to improve it in subsequent implementations.

Summative and formative evaluation can co-exist, but in many cases it is the need for greater accountability that is most important. However, when professional growth is included in the evaluation system, evaluation is more effective in meeting the needs of employees and the organisation in general.

8.5.4 The Evaluation Approach

In this study, formative evaluation was an integral part of the evaluation methodology, throughout the development of the project control framework. The summative evaluation approach was used to assess the framework elements. The main aim of the summative evaluation was to evaluate the framework in terms of the completeness of the factors responsible for project control.

It is worth noting that there is a different perspective on validity when viewed within the context of qualitative and quantitative research (Then, 1996). Qualitative research identifies the presence or absence of a given feature in a given problem or situation, as opposed to quantitative research which measures the degree of presence of the feature itself. Many researchers argue that combining qualitative and quantitative methods in one evaluation effort can offset perceived biases and complement strengths of different methods. Multiple methods are appropriate for:

- Allowing greater plurality of viewpoints.
- Generating deeper and broader insights.

The evaluation processes of this study are based on combining quantitative and qualitative methods. The researcher first adopted a quantitative approach using Questionnaire II to define participants' responses regarding their perspectives on mitigation measures regarding cost and time control, which serve as reference points in the development of the proposed framework and consequently of the developed project control framework. Another questionnaire, however, is designed for open-ended question in Questionnaire III to reveal qualitative information about the project control framework to use the feedback of participants of Questionnaire III to re-validate the developed framework elements.

8.5.4.1 *Parameters for mitigation measures validation*

According to Fox et al (2003), validation will not be effective unless it comprises an appropriate balance of all necessary expert knowledge. Hence, the author has to choose purposeful (non-probability) samples to use for the selection of participants in the validation process. A purposeful sample does not rely on random selection of participants. It has been chosen to ensure a number of critical characteristics of participants are selected. In view of this, the participants of validation process had to:

- Have a good knowledge of the Libyan construction sector;
- Have a good experience in professional practice within the LCI
- Be highly experienced with the construction management process
- Have vast and knowledgeable in the management process of the construction projects within the Libyan Construction sector
- Be involved at different levels of construction project

As a first step towards validation, the non-random (snowball) sampling method was employed to derive a sample of (consultants, contractors and clients) since it is the best way to locate participants with certain attributes and characteristics (Berg, 2004). This type of sampling relies on previously identified qualified members of a group to identify other members of the population. As newly identified members name others, the sample snowballs. Fellows & Liu (2008) argue that the snowball method is one of the research methods that may be used for construction; in this method the researcher may identify a very small number of respondents and, after collecting data from each one, requests those respondents identify further respondents thereby progressively building a sufficient sample. Stakeholders were selected based on their specialized skills and their experience. The validity of the questionnaire response data can consequently be reasonably inferred.

The proposed mitigation measures were validated by employing the effectiveness approach used to measure the performance or achievement of an action or activity. Since the validation of the mitigation measures for cost and time overrun factors is clouded by risk and uncertainty, the effectiveness approach is utilized for each mitigation measure as perceived by a panel of Libyan professionals (effectiveness being part of the framework's evaluation). This effectiveness approach is based on Wang et al's (2004) view that it is one of the important measures by which the implementation of mitigation measures can be prioritized.

Five main categories of risk mitigation measure were listed and 40 questionnaires sent to the selected project teams; these included government and private clients, contractors and consultants. Only 24 questionnaires were completed. Participants were asked to rank the effectiveness level of risk mitigation measures, a ranking that will act as a guide to project teams using the framework.

For Nguyen (1987), validation is intended to ensure that the system developed is one that users want and need – that is, that the domain knowledge is correctly represented and simulated by that of the system, and is acceptable to users. Hence, the author argues that evaluation is not a one-time event. Evaluation is a continuous activity that should be an integral and integrated part of the study process. Well designed, thoughtful and carefully executed evaluation processes can point the researcher toward areas where improvements may be needed. In view of this, responses to the Questionnaire II were analysed and the developed framework posted back to certain participants for reconsideration.

8.5.4.2 *Parameters for project control framework evaluation*

It was also deemed imperative to evaluate the developed framework and to use participant feedback to improve it. Each of the selected evaluators were provided with a copy of the project control framework and requested to provide candid comments:

- in terms of its comprehensiveness, completeness, clarity, ease of understanding and ease of using
- its applicability in tackling cost and time overruns in Libyan construction projects
- on any omissions of the entire framework's elements that could enhance process of project control in the LCI
- or suggestions for modification and improvement to develop the framework

The author was careful in the selection of participants to evaluate the final version of the framework. In order to ensure that the evaluation process will be sufficiently strong, the participants of Questionnaire III had to:

- Have a good knowledge of the Libyan construction sector
- Be professionally qualified in construction management
- Be highly experienced and have worked for a long period in the LCI

The mixture of the different categories of the Libyan construction stakeholders in validation and evaluation processes ensures an appropriate balance of expert opinions as suggested by Fox et al. (2003). He states that validation assessment will not be effective unless it comprises an appropriate balance of all necessary expert knowledge.

Hence the author used a combination of positional and reputational criteria. The author began by using positional criteria to identify an initial subset of respondents based on their known relevance to the research topic. The author then conducted a chain-referral process to select independent respondents according to positional criteria as well as reputational criteria whereby these initial respondents are then asked to recommend names of organisations that have a good reputation in terms of project management in the LCI; these procedures have been done in order to identify independent experts who did not get involved in the development of the framework for the purpose of participation in the evaluation process of the framework.

In short, using the previous listed criteria as a pedestal, the experts who participated in Questionnaire III were purposely selected for evaluation process as follows:

- Some of the participants in the earlier interviews must play a role in the evaluation process in order to ensure continuity of the process. They also have vast experience in the project management and have a background of the research. This step is necessary because the data collected through semi-structured interviews are used as reference in the development of the initial proposed framework.

- Because of the author's believe that the use of independent participants assures that the evaluation will be more "objective". Therefore independent experts who are highly experienced with the project control process and involved at different levels of construction projects and neither participated in the surveys or the interviews must play a role in the evaluation process in order to increase the validity of the framework.

Hence, the 10 experts who had participated in the interviews were contacted explaining the aim of evaluation session. Of these ten, only four gave approval to participate in evaluation process. The rest of experts were unable to participate in the evaluation process due to unforeseen circumstances and internal constraints in their organisations.

In addition, another four independent experts who had good experience and were nominated and put forward for evaluation process by their organisations, which were selected on the basis of the amount of contracts they gave and the success of those organisations in finishing projects on time and to cost.

The details of the experts who participated in Questionnaire III are given in Table 8.3. This table shows each expert's years of experience and their position. The total experience was 214 years, the average being 27. The experts were a mix of clients, consultants and contractors, which provided the variety by which the validity of the survey questionnaire III response data can reasonably be inferred.

Respondents to Questionnaire III were first required to rate the developed framework in terms of the completeness of the factors responsible for project control (i.e. whether the framework covered all the important aspects of project control), the ease with which the framework could be understood, and its applicability to both simple and complex projects. Participants were required to rank each question on a five-point Likert scale where 1 represented 'strongly disagree' and 5 'strongly agree'. This stage was titled're-validation'.

Participants in Questionnaire III were also asked to elaborate on these views and to suggest how they thought the framework could be improved. In the last part of this questionnaire a space was provided for the experts to make comments that could inform further framework development.

Evaluators	Position of participants in their companies	Type of company	Details of participants experience (yrs), professional status, educational qualification and involvement in the study
Evaluator 1	Site manager / Quantity surveyor	Contractor	❖ Currently engaged in professional practice in Building Construction and Civil Engineering ❖ A member of Libyan Engineers Association ❖ Has over 22 years of working experience in the Libyan construction industry ❖ Possess university degree in civil engineering ❖ Participated in the interviews
Evaluator 2	Director	Consultant	❖ Currently engaged in professional practice in Building Construction, infrastructure and Civil engineering infrastructure ❖ Has over 24 years working experience in the construction industry ❖ Possess an MSc in construction management ❖ A registered engineer with the Association of Registered Engineers of Libya ❖ Did not participate in the interview or questionnaire survey
Evaluator 3	Planning engineer	Contractor	❖ Currently engaged in professional practice in the public works company for the implementation of housing projects. ❖ Work as a Director of civil engineering department of Brak Al-chatee Faculty of Engineering in Libya ❖ Has over 29 years working experience in the Libyan construction industry ❖ Possess a PhD in urban planning ❖ Participated in the interview
Evaluator 4	Senior quantity surveyor	Main contractor	❖ Currently engaged quantity surveying in professional practice in social housing/ regeneration ❖ Has over 32 years working experience in the construction industry ❖ Possess a PhD degree in construction management ❖ A registered quantity surveyor with the Estate Surveyors Registration Board of Libya

			❖ Did not participated in the questionnaire survey or interview
Evaluator 5	Project manager	project consultant	❖ Currently engaged in professional practice in transport infrastructure, building and civil engineering ❖ Has about 27 years working experience in the Libyan construction industry ❖ Possess a PhD in road management and engineering ❖ A member of the Libyan Society of Engineers ❖ Participated in the interview
Evaluator 6	Executive manager	Client	❖ Currently engaged in working in the field of managing the responsibilities of The General Housing Corporation ❖ Has an MSc in project management ❖ Has about 26 years working experience in the construction industry ❖ Participated in the interview
Evaluator 7	Associate director	Consultant	❖ Currently engaged in professional practice in Building Construction and Civil Engineering ❖ A member of Libyan institute of building ❖ Has over 23 years working experience in the construction industry ❖ Possess an MSc in safety and risk management ❖ Did not participated in the questionnaire survey or interview
Evaluator 8	Project manager	Contractor	❖ Currently engaged in professional practice in the construction, civil engineering ❖ A registered engineer with the Association of Registered Engineers of Libya ❖ Has over 31 years working experience in the construction industry ❖ Possess a PhD in construction management ❖ A member of architectural and planning department in Tripoli University, Libya ❖ Did not participated in the questionnaire survey or interview

Table 8-3: Questionnaire III participants

The following sections will present the results of Questionnaire II, which relate to the effectiveness of the proposed risk mitigation measures as rated by the panel of professionals. This ranking can be used as a guide to practitioners in the LCI, along with the results of Questionnaire III regarding evaluation of the framework's elements.

8.5.4.3 *Justification for validation and evaluation methods*

As mentioned, in the methodology chapter, many researchers stated that one survey method is not better than another. However, one method may be more suitable than others depending upon the situation. In this study, the researcher endeavoured to choose methods that best suits the study's topic, time line, respondent' characteristics and experience availability. The researcher also carefully selected the warranted and appropriate method for validation and evaluation processes. Some possible approaches of validation or evaluation processes could be considered such as organising a workshop and inviting experts of Libyan construction industry for discussion and to give their feedback and suggestions on the developed framework. This approach of evaluation was however viewed to be costly in terms of time and cost. It is difficult to persuade people to give up their time and to find a time suitable for all participants in view of their individual work schedules and other engagements. Therefore, the researcher first realized that internet technologies (Email surveys) offer significant benefits to collect data for the validation process.

Taylor et al (2000) point out that mail surveys are most appropriate when the researcher is working under the following conditions:

- The people the researcher are surveying have some interest in the survey topic and are likely to respond
- The research targeted respondents with adequate skills
- The researcher wants to give participants time to consider their answers or other information when completing the survey
- The researcher wants to give participants privacy when completing the survey

In the present study, the following factors have been considered simultaneously as the researcher selected internet technologies (Email surveys) for the validation process:

- Geographical factor: Libya is a large country in terms of area; it comprises desert and semi desert lands. Most of the Libyan cities are separated from each other by a few hundred miles as on the coast, and more than this distance in the desert. Because of the Libyan construction industry operates in a highly restrictive geographical environment, the researcher argue that considering the problem of geographical dispersion to collect data in limited time is essential, it is suggested that email survey is geographically flexible and should be applied to overcome the problems of geographical dispersion and to make the study efficiently in Libya's geographical context through reach targeted individuals across geographical borders with an obvious reduction of time and costs.

- Cost and Time factors: This study was sponsored by the Libyan government, and finance and time were critical factors. Hay-Gibson (2009) points out that the time taken to set up the internet technologies was considerably less than the travel time usually taken to reach the small and medium-sized companies' location. Owing to the limited time and financial available that influences the scope and the depth of analysis in a study, it was decided to use (Email surveys) more suitable to collect data for validation process.

- Track of participants: Because many roads, streets and buildings are not named or numbered in the majority of Libyan' cities, the researcher failed to contact many Libyan professionals involved earlier in the study to encourage them to supply missing answers or to explain unclear answers. Therefore to overcome the limitation of ambiguities in the participants' addresses that faced the research earlier, the researcher employed email survey for validation process. In addition, the flexibility resulting from email usages; researchers can make changes and adaptations for a new version of a survey and then send it again in the case of having sent a survey which is not satisfactory.

- Privacy and convenience: Respondents of internet technologies are able to complete the survey in the privacy of their own homes, which may make them feel more comfortable giving truthful answers. Also, the participant can answer the survey questions at their best time without being controlled by face-to-face contacts like interviews, or having to go to a post office to send the reply as in postal surveys.

- Researcher bias: using an email survey method removes the possibility that the researcher's manner of asking a question may influence the participant's answer. In addition, email enables "non-coercive dialogues" in which some participants tend to respond in a candid and open atmosphere without necessarily facing their partners.

In view of the earlier listed constraints of the research study in terms of limited time, coupled with the limited financial resources, this method of this for validation of this study was considered to be most appropriate and feasible to yield the best outcomes in the validation process.

In addition, the validation methods that has been adopted in this research was also deemed appropriate because it could help circumvent any bias which might be possible if a face to face interview enquiry approach was conducted for the validation process. Thus, the mitigation measures were first e-mailed to the participants as an attachment and they were required to e-mail their individual responses.

Following the validation of the mitigation measures, the researcher had to use hand to hand questionnaire method for the evaluation process in order to receive the feedback from Libyan experts about the project cost and time control framework. This method also is taken into consideration to give the selected experts an opportunity to give their responses and write their comments on the framework in full freedom and at their own convenience times. Moreover, they would consult with other professionals in project management in the process of reviewing the framework to give the proper valuation.

8.5.5 The results of questionnaire II - validation

As mentioned previously, the aim of Questionnaire II is to validate the identified mitigation measures in order to discover how the experts think they will aid time and cost control efforts and to see if some level of agreement could be reached on the effectiveness of each of the measures.

Questionnaire II was sent with a covering letter explaining the aim and objective of this stage of the study. As mentioned, in the first part of the questionnaire, participants were asked to rank the effectiveness of the risk mitigation measures identified from the literature and from Survey Questionnaire I and semi-structured interviews with contractors, consultants and clients. The data were analysed using a statistical approach to responses by consultants, contractors and clients individually, and by all respondents combined, that ranked the mitigation measures. This ranking will constitute a guide to practitioners when using the framework.

The mean values were used to calculate the value for each mitigation measure according to their effectiveness as rated by the panel of experts. The result is shown in Table 8.4. The higher-value mitigation measures, which are perceived to be more effective, should be implemented more urgently than the less effective ones.

Table 8-4: Respondents' perceptions of the effectiveness of risk mitigation measures for construction work

Effectiveness of mitigation measures influencing cost and time of construction work						
No.	**Factors**	**Standard deviation**	**Mean**	**Importance index**	**Coefficient of variation**	**Group Ranking**
	Mitigation measures for construction					
A1.1	Ensure good design report for the project and examine by consultant and client before its commences	0.88	3.92	78.33	0.22	3
A1.2	Arrange preconstruction meetings for explanation procedures in the course of carrying out construction work	0.92	3.83	76.67	0.24	6
A1.3	Conduct visits to the construction site and check materials	0.92	3.67	73.33	0.25	10
A1.4	Adopt good supervision and proper quality control procedures	0.74	3.88	77.50	0.19	5
A1.5	Monitor and control construction process activities properly	0.93	4.08	81.67	0.23	1
A1.6	Determine of quantities properly during the bidding phase	1.00	3.83	76.67	0.26	6
A1.7	Develop appropriate plans, and control costs and schedules	0.75	4.04	80.83	0.19	2
A1.8	Adopt proper management systems and safety programs	0.91	3.71	74.17	0.24	9
A1.9	Adopt as much as possible local employers to save cost	0.97	3.42	68.33	0.29	11
A1.10	Provide regular updating of the construction work plans and regular reports on project progress	1.02	3.92	78.33	0.26	3
A1.11	Utilize modern programmed planning techniques	0.90	3.75	75.00	0.25	7
	Mitigation measures for materials					
B1.1	Conduct visits and check materials at the factory	1.06	3.42	68.33	0.31	8
B1.2	Use as much as possible local materials to save cost	0.98	3.46	69.17	0.28	7
B1.3	Attempt to obtain materials directly from suppliers	1.06	3.54	70.83	0.30	6
B1.4	keeping an inventory at optimum level to guarantee availability of materials during construction phase	0.90	3.71	74.17	0.24	

Table 8-4: Respondents' perceptions of the effectiveness of risk mitigation measures for construction work (cont.)

No.	Factors	Standard deviation	Mean	Importance index	Coefficient of variation	Group Ranking
B1.5	Prepare detailed material planning to use along with project engineering and planning	0.97	3.63	72.5	0.27	5
B1.6	Selecting vendors not on lowest cost criteria basis but for critical items	0.99	3.75	75	0.26	3
B1.7	Schedule construction activities along with materials delivery	0.98	4.00	80	0.24	1
B1.8	Provide incentives and effective training for plant operators	0.96	3.83	76.666	0.25	2
Mitigation measures for contractual procedures						
C1.1	Arrange preconstruction meetings for explanation of contract requirement in the course of carrying out construction work	1.02	3.50	70	0.29	9
C1.2	Provide clauses for extra payment in contract, which happen due to change in law or new rules	0.88	3.92	78.33	0.22	1
C1.3	Include clauses on extra payments if caused by any party	1.06	3.54	70.83	0.30	8
C1.4	Seek incorporation delay clauses in contract	0.97	3.63	72.5	0.27	6
C1.5	Have clear contractual terms; define clear responsibility and authority in contract; agree on one accounting standard	1.02	3.50	70	0.29	9
C1.6	Provide comprehensive terms of default in contract	0.88	3.63	72.5	0.24	6
C1.7	Incorporate escalation clauses for delays and inflation rates in contract	0.93	3.79	75.83	0.25	2
C1.8	Pay careful awareness to contract interpretation	0.95	3.71	74.17	0.26	4
C1.9	Provide construction extension clauses in contract	0.99	3.75	75	0.263	3
C1.10	Identify compensation clauses in contract for payment	0.96	3.67	73.33	0.26	5
C1.11	Employ a good legal advisor who is familiar with the industry in drafting the contract	1.06	3.46	69.17	0.31	11

Table 8-4: Respondents' perceptions of the effectiveness of risk mitigation measures for construction work (cont.)

No.	Factors	Standard deviation	Mean	Importance index	Coefficient of variation	Group Ranking
	Mitigation measures for design change					
D1.1	Undertake investigation and exploration to construction site before design phase	1.00	4.04	80.83	0.25	2
D1.2	Provide and submit all required design information on time	1.02	3.58	71.67	0.28	10
D1.3	Undertake pre-project planning to reduce errors during the design phase	0.93	3.79	75.83	0.25	8
D1.4	Organize for vetting and appraisal of design criteria by at least one independent architect or engineer	0.88	3.79	75.83	0.23	8
D1.5	Standardized designs should be updated as per necessity to minimize errors and save time	0.90	4.13	82.50	0.22	1
D1.6	Adopt design strategy during initial stages of planning	0.93	4.00	80.00	0.23	3
D1.7	Prepare the work specification taking work breakdown structure, implementation methodology and the output of risk analysis study into account	0.85	3.88	77.50	0.22	4
D1.8	Provide adequate computer software in order to improve correctness in design	0.99	3.88	77.50	0.26	4
D1.9	Determine the cost and time implication of a design change	1.02	3.50	70.00	0.29	11
D1.10	Determine the cost and time implication of any given design change	0.90	3.88	77.50	0.23	4
D.11	Notification of all the parties involving in the project of how they will be impacted and the cost and schedule implication of a design change before going ahead with the change	0.99	3.88	77.50	0.26	4

Table 8-4: Respondents' perceptions of the effectiveness of risk mitigation measures for construction work (cont.)

No.	Factors	Standard deviation	Mean	Importance index	Coefficient of variation	Group Ranking
	Mitigation measures for funds					
E1.1	Create a book for recording payments	1.12	3.13	62.50	0.36	7
E1.2	Supervise present financial status of organisation	0.97	3.63	72.50	0.27	6
E1.3	All parties involved in construction project should agree on one accounting standard and hire one independent accountant	1.19	3.75	75.00	0.32	4
E1.4	Contractor should secure standby cash flow in advance	1.00	3.96	79.17	0.25	1
E1.5	Review the differential taxation and find reasonable measures to reduce taxes	1.06	3.91	78.33	0.27	2
E1.6	Obtain payment and performance bonds from international and local banks	0.96	3.67	73.33	0.26	5
E1.7	Consult a financial consultant to conduct the verifying the financial report of the project	1.15	3.88	77.50	0.30	3

The study revealed the most important risk mitigation measures that might be used as alternative solutions for remedying control cost and time overruns in Libyan construction projects. The measures were listed and ranked according to all respondents' views of their effectiveness, as shown in Table 8.4.

The result of the analysis of Questionnaire II ranks the most potentially effective construction-related, material-related, contractual procedures-related, design change-related and funds related risk mitigation measures. The most significant mitigation measures related to the construction group were the proper monitoring and control of construction activities, the development of appropriate plans and the control of costs and schedules, the regular updating of work plans and regular reporting on project progress, the ensuring of good project design reports, the examination by consultants and clients before commencement, and the adoption of good supervision and proper quality control procedures. It is obvious that participants stated that monitoring the project cannot be ignored at any stage of the project, and affirmed that this process must continue throughout the life of the construction project. The experts involved in QII emphasized that project monitoring must continue throughout the project's life cycle to prevent cost and time overruns by adopting such measures to formulate effective management teams. For all respondents, the proper monitoring and control of construction activities deemed likely to have high effectiveness in this category as embodied in the overall ranking. In general, experts in the public and private sectors in the Libyan construction industry had similar opinion as overall where; control and monitoring from start to finish fell under 'very important' measures in order to check whether the project is or isn't working to original plan or budget. Young (2006) claimed that monitoring the process of construction needed for each activity in a construction project in order to identify and resolve the issues that arise; track the project that is, comparing with the actual plan and updating the records.

Material risk mitigation measures are associated with schedule construction activities along with materials delivery, and the provision of incentives and effective training for plant operators. In practice, since an unstable economy leads to fluctuating material costs, the cost estimator has no control over the cost of materials, labour, equipment, the contractor's method of determining prices, or the competitive bidding or market conditions at the time of the bid. A revised estimate is therefore necessary, either because of unexpected cost overruns or savings. Hellman (1996) maintains that materials are a key resource for the construction industry. Construction and installation materials account for more than half of the total cost of construction products. Material management must therefore be established by adopting appropriate measures.

The single most highly rated mitigation measure for contractual procedures concerns the provision of clauses for extra payments and delays in contracts, which occur due to legal and regulatory changes. The lack of attention to contractual procedures by experts in the LCI was obvious. This can be attributed to the way projects are awarded in Libya, which is to the lowest bidder. The findings of Questionnaire I and the interview analysis also show that contractual documents in the LCI lack practicality. It is therefore further recommended that measures devoted to improving the efficiency of the pre-contracting and design processes be devised.

Design change risk mitigation measures are among those ranked most important. These measures are associated with the necessity for standardised designs to be updated as necessary to minimize errors and save time, the investigation and exploration of construction sites before the design phase, the adoption of a design strategy during the initial stages of planning, the preparation of work specifications taking work breakdown structure into account, the implementation of a new methodology, the conducting of a risk analysis study, the provision of adequate computer software to reduce design flaws, the determination of the cost and time implications of design changes, and the notification to all parties of how they will be impacted and the cost and schedule implications of design changes before going ahead with them. Okpala (1988) states that design changes during construction projects are an important systematic variable responsible for delays and cost overruns that prevent the development of construction projects. Ferry and Brandon (1980) show that over 80 per cent of construction costs are incurred at the sketch design stage, leaving only 20 per cent for the cost control of the design team. Measures must therefore be devised to establish design change management.

Another difficulty encountered during construction in Libya is the owner's failure to allocate funding resources to contractors for the job, which makes it difficult for contractors to manage projects and finish them on time and within cost. Three fund risk mitigation measures are among the most highly rated: secure standby cash flow in advance by the contractor, review of differential taxation and the employment of reasonable measures to reduce taxes, and the use of financial consultants to verify the project's financial report. Mansfield (1994) states that a lack of project funds as the work progresses can have a severe effect on the project's cost and time, and measures must be instituted to counteract this.

8.5.6 The results of Questionnaire III - evaluation of the Framework

The second step of the evaluation processes, Questionnaire III, was designed to use participants' feedback to evaluate the framework's elements.

Table 8.5 shows how the framework is rated by the panel of experts in terms of thirteen factors. The percentages shown in this table were calculated using Microsoft Excel. The response scores are presented in five grades: 'strongly disagree', 'disagree', 'neutral', 'agree' and 'strongly agree'.

Elements of the framework	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Overall result
Appropriate identification of framework phases	-	-	25	50	25	Agree
Appropriate identification of the planning stage	-	-	25	62.5	12.5	Agree
Appropriate identification of the monitoring stage	-	-	12.5	75	12.5	Agree
Appropriate identification of the project evaluation stage	-	-	25	62.5	12.5	Agree
Appropriate identification of the phase of the actions required by the organizations	-	-	12.5	62.5	25	Agree
Appropriate identification of the minimized risk factors stage to be provided	-	-	12.5	50	37.5	Agree
Appropriate identification of responsibilities of project parties	-	-	25	50	25	Agree
Completeness	-	-	25	50	25	Agree

Comprehensibility	-	-	25	37.5	37.5	Agree
Ease of use	-	-	37.5	50	12.5	Agree
Providing systematic stages for successful implementation of time and cost control	-	-	12.5	37.5	50	Strongly Agree
Applicability to prospective time and cost control organizations	-	-	37.5	50	12.5	Agree
Applicability to complex projects	-	-	25	50	25	Agree

Table 8-5: The framework evaluation rating by the panel of experts

The analysis of the responses indicates that all the experts were satisfied with the identification of the systematic stages, as shown in Table 8.5: 75 per cent considered that the framework identifies phases of project control appropriately (50 per cent 'agreed' and 25 per cent 'strongly agreed'). There was a 62.5 per cent 'agree' response rate for the appropriate identification of the planning stage, 75 per cent 'agreed' on the appropriateness of the monitoring stage and 62.5 per cent 'agreed' likewise for the evaluation of the project control stage.

A majority of the experts rated the remaining nine assessment factors as 'agree': identification of the actions required by the organizations (62.5 per cent), identification of the minimized risk factors stage to be provided (50 per cent), identification of project parties' responsibilities (50 per cent), completeness of the project control framework (50 per cent), comprehensibility of the framework (37.5 per cent), ease of use (50 per cent), applicability to prospective time and cost control organizations (50 per cent), applicability to complex projects (50 per cent) and positive support from the experts on the provision of a systematic stage of successful implementation of time and cost control (50 per cent 'strongly agreed'). This suggests that the project control framework as regards the identification of critical success factors is important for the LCI.

More specifically, the high percentages for the 'agree' rating regarding the appropriate identification of the monitoring (75 per cent), evaluation of project control (62.5 per cent) and planning (62.5 per cent) stages, as well as the appropriate identification of the actions required by the organizations (62.5 per cent), the provision of systematic stages of successful time and cost control implementation (87.5 per cent for 'agree' and 'strongly agree' combined) suggest that the framework is potentially highly appropriate for projects in Libya. Positive comments by some experts reflect their support for a framework by which to minimize time and cost overruns in Libyan construction projects; these were used to improve the final framework produced.

The following section presents comments by the panel of experts on the framework, as well as their opinions of the potential difficulties that may face by the implementation of this framework in the LCI.

8.5.7 Comments on the project control framework

By adopting the Fox et al (2003) techniques, the feedback received from the evaluation survey could be accepted as opinion of the appropriate 'experts' and the knowledge provided considered as sufficient for recommendations. Questionnaire III seeks the opinion of experts on the final version of the control framework. A space was provided at the end for the experts to provide other general comments or recommendations that could be used to improve the framework. This feedback was very positive: they all thought it suited the LCI and would help project control process, and they said they would recommend it to the LCI. They also commented on possible improvements, which were used to develop the framework.

The framework has been developed for general construction projects, with an emphasis on Libyan ones. The major factors causing cost and time overruns have been identified pursuant to a study conducted in Libya and incorporated into the framework, which has also benefited from the additional feedback on its applicability provided by the panel of expert respondents to Questionnaire III. The experts explained that implementation of the framework might encounter difficulties, and provided comments that were used to improve the final version. The comments have been used to improve the framework.

The first comment from an executive manager suggests that despite the framework being adequate, comprehensive and appropriate to control cost and time overruns, it should also address project quality, just as it deals with cost and time, because the quality of major activities has to be shown in the project time schedule and the owner must be informed about these in advance. However, this study focuses on cost and time performance in construction projects. Quality is vital, but a more extensive study should be conducted to analyse this component.

Another comment from an associate director is that the framework is a very good effort towards managing construction projects and the proposals under each phase of the framework are well detailed. However, the mitigation measures were a good idea, but he added that the adoption of the framework would demand serious commitment from project team members from planning to execution phases, and in particular from client organizations. He argues that cultural factors will be a major impediment to the framework's adoption because it requires professionals to work together. The LCI's culture, however, is one in which cost and time professionals work separately. Seeking to implement projects as a group would require dedicated administrative effort and possibly some organizational readjustments; the difficulty of achieving this may be seen as outweighing the perceived advantages of the proposed control framework.

This barrier is tackled firstly by making the framework's processes separate but interdependent, as explained previously. Secondly, the framework supports project control by eliminating duplication of effort and by proposing a guideline set of all parties' responsibilities. Project team members must therefore be proactive in the performance of those responsibilities without the project manager having to constantly remind them about schedules and deliverables. Adoption of the framework might consequently be difficult at the outset, but the advantages would soon become noticeable.

A project manager agrees that Libyan construction projects require systematic methods by which to successfully implement time and cost control; he views the framework as ideal, and sees its adoption as possibly reducing the amount of variation in work practices and uncertainty, minimizing risk factors, and helping complete the project on time and to specified cost. He did, however, stress the importance taking risk factors such as malfunctions, worker absenteeism, power cuts and other unexpected events into account during the scheduled work, emphasising that *'we are suffering a lot from such* *factors*'. He also argues that the implementation of the framework largely depends on purchasing management in a country like Libya, where a significant proportion of construction resources are imported, particularly construction materials and equipment, and in light of the high level skills required for construction. Economic instability and difficulties in obtaining import licenses, unexpected increases in the costs of materials and shortages in imported construction materials and equipment also affect progress. All this leads the author to regard the application of this framework in practice in such an unstable and risky environment as requiring a longer time and greater awareness.

To help adopt this framework in construction projects, the author sees management's instilling of the need for systematic methods by which to successfully implement time and cost control into project teams as a crucial factor in realising the framework's full benefits and allowing it to stand the test of time.

A further comment on the framework by the planning engineer is that the framework is a straightforward idea that could be implemented with strong support from government departments and organizations, because the Libyan Government has been and will continue to be a major client of construction projects; in fact, it funds the majority of building projects. Without such support, the framework will be difficult to adopt because only the government can provide training for the workforce with the most current technologies in the construction industry, as well as controlling the prices of construction materials and inflation. He argues that the framework's control procedures for defining the functions and responsibilities of all parties involved in construction projects are too comprehensive, but it is good for government organizations to be aware of such important matters when involved in project control.

A senior site engineer agrees that the framework could enhance the project team's capability for project control. On the other hand he maintains that, irrespective of the fact that the elements indicated are too comprehensive, feedback from stakeholders and project teams, and from all those involved who can offer lessons for future projects, is crucial in helping identify project successes and failures. He says that the lack of agreement regarding responsibilities for implementing project control in the LCI results in those responsibilities overlapping between the participants, from designer and planner at management level to project manager, procurement and construction site manager and staff at field level. This identification of responsibilities is actually a quite unique feature of the framework. He adds that:

> *the work as a group leads to a waste of time, and thus defining the responsibilities of the project team will affect the success of project control and will serve as a magic wand by which to bring about success.*

It would, however, be preferable to identify the responsibilities of the project team for all phases of the project, not only for the evaluation stage. This recommendation has been taken into consideration in the final version of the framework.

The quantity surveyor agrees that the framework is applicable – indeed, that almost of its processes are in fact applied in practice, but not with this structure and in this sequence. He also mentions that effective communications are needed to control these processes so as to break down barriers between companies' departments; that would provide a basis for project control, often needed to satisfy requirements, and help avoid cost overruns and schedule delays. But he queries the perceived cost of the framework's application, because it is clear that this would require training in the use of different techniques in order to achieve the desired goal. It is true that the framework advocates the same techniques used in the past, but this raises the question of the possibility in the present circumstances of providing management support for professional training in the use of such tools and techniques as Primavera and Earned Value Analysis.

A less encouraging comment on the framework was by a site manager to the effect that:

> *Even though the framework looks theoretically impressive, it is still doubtful if it could be adopted in the development of construction projects in Libya unless the entire construction industry is conversant, efficient, knowledgeable and committed.*

This gives the impression that the LCI is still not ready to use the framework. Nevertheless, Grifa (2006) states that the future of the LCI and its capability to cope with challenges, changes and threats will be determined by certain planning processes, including the application of new tools and techniques, in the construction industry and in project management. Indeed, many local companies in the country have recently started to receive significant education in project control. The American AECOM Corporation was selected by the Libyan Housing and Infrastructure Board as its main advisor and to oversee construction of new housing and infrastructure systems for all major Libyan cities throughout the country. The job of AECOM includes reviewing the planning and design of housing and building boards, evaluating ongoing construction projects, preparing detailed plans for roads, water systems and bridges and applying control systems for all these projects for most large cities. The organization provides a guide for all the methods that must be used, and explains how to manage construction projects in meticulous detail. This answers the site manager's scepticism.

A project manager's comment is very similar to that of the associate director. They agree that the proposed measures to mitigate the causes of cost and time overruns in Libyan construction projects were a very good idea. He states that re-estimation is a very important step: it is a kind of risk mitigation, because there may be other risk factors that might not be discerned in the planning phase, such as the period between the request for materials and their arrival onsite.

Since the framework should encourage the development of a proactive approach to preventing cost and time overruns in Libyan organizations, mitigation measures for risk factors in construction projects are intended to minimize or altogether avoid the adverse consequences of delay and cost overruns that could affect the project's success. It noteworthy that, although these elements of the control system are typically applied sequentially, they could also be applied concurrently – for example, known risk factors should be monitored in parallel with new ones as the latter are identified and assessed.

In conclusion, the experts' comments and feedback in relation to the applicability of the project control framework suggest that it could be used for future project control in Libya, and their critical comments as to the framework have been used to develop the final draft of the framework. However, some feedback has not affected the final version of the framework, because it has already been incorporated in the previous version, or it simply consisted of commentary on the framework's applicability.

8.6 Summary

This study has led to the development of a comprehensive framework for minimising cost and time overruns on the basis of international standards of project control strategy. The present chapter has presented the framework and described its development.

Firstly, the core processes and procedures for each phase of the construction project were described, a step that has been incorporated into the initial proposed framework.

Secondly, the developed framework takes into account the most important factors that lead to overruns and defines the most important mitigation measures based on practitioners' knowledge, supported by literature reviews, to help to deal with these factors. The major causes of cost and time overruns in Libyan construction projects have been identified in Chapter 6, and suggested mitigation measures have been evaluated in Chapter 8. Hence, these steps have been incorporated into the final developed framework.

Thirdly, each party's responsibilities have been delineated for each step, thus filling a gap and making practitioners' efforts more effective. The responsibilities outlined in Appendix (6) are presented in order to clarify working relationships with contractors, clients and consultants. The list is not exhaustive, nor does it supersede any other obligations or responsibilities contained in contracts or other relevant documents. Furthermore, the contractors, consultants and clients who participated in the study commented very positively on the framework.

To sum up, this study has combined theory and practice through a literature review and the involvement of practitioners in an attempt to develop a framework for minimizing cost and time overruns in Libyan construction projects. It is envisaged that the framework will bring future changes in such projects, because it enables practitioners to be more systematic in dealing with the factors that lead to cost and time overruns and support the improvement of current practice to deliver construction projects with better quality, client satisfaction and the minimum cost and time overruns.

Chapter 9 Conclusions and Recommendations

9.1 Introduction

Previous chapters have included a literature review, and have discussed the research methodology, the design of the conceptual framework for project cost and time control, and the development and evaluation of this framework. This chapter concludes the thesis by presenting the main conclusions drawn from the chapters, as these helped the researcher examine the major causes of project underperformance. In addition, it led to the suggestion of several remedial actions that the respective parties could carry out in order to manage unfavourable risk events before they occur. Finally, this chapter suggests recommendations practitioners can use to further develop their control of time and cost objectives of their projects.

9.2 Conclusions of the study

The study's conclusions and main findings are presented in this section. To reduce the biases inherent in the research strategy and to make the study a more rigorous piece of work, a methodological triangulation was conducted. The research objectives set up for this study are based on a synthesis of the five data sets. The first set was based on extensive literature review, the second on Survey Questionnaire I, the third on the semi-structured interviews, the fourth on Questionnaire II and the fifth on Questionnaire III. The achievement of the research objectives is summarised below:

Objective 1: to examine the current situation regarding time and cost overruns in Libya construction projects

The initial research pilot study was carried out on a number of random selected professional including architects, engineers, managers and directors of construction and consultancy firms and clients of Libyan construction projects. While visiting construction sites throughout the country, some interviews were conducted with members of the construction industry. They were asked about the processes by which the costs and timings of construction projects were controlled and managed, the most important and frequent problems they have faced, and the people they would turn to when seeking help.

Three pilot studies were conducted at different stages for different purposes. These pilot studies enable the researcher to obtain the principal information about the strategy by which project target times and costs in the LCI is controlled, as well as to critically analyse the list of causes for delays and cost overruns in Libyan construction projects that have been collected from the literature review.

Moreover, the study examined the current situation regarding Libyan construction projects using qualitative and quantitative studies. The quantitative data analysis revealed that more participants "often" encountered such problems (39.23 per cent), with 24.62 per cent "sometimes" doing so. 21.54 per cent of respondents "always" and 14.62 per cent "rarely". The result also indicated that 38 per cent used experience to determine the times and costs of activities involved in construction projects, 33.85 per cent made calculations, 6.92 per cent used other techniques and 13.85 per cent did not use any specific method.

The quantitative analysis of data gathered from the research revealed that despite the fact that Libyan construction projects are jeopardized by cost and time overruns, and that poor performance has always been the result, no clear trend emerged regarding the importance of cost and time control in Libyan construction projects: the distribution seemed to be fairly uniformly distributed. 27.69 per cent of respondents ranked their projects as highly important, 26.15 per cent as important and 23.08 per cent each slightly important and unimportant.

Qualitative and quantitative analysis of the questionnaire I and semi-structured interviews revealed that the nature of construction projects and the size of the organisations involved do affect time and cost overruns in Libyan construction projects. The results, however, suggest that small and medium projects suffer high risk levels, which might be seen as translating into high time and cost overruns. In this particular study, the time and cost control of large projects performed better than their small and medium counterparts.

Both the public and the private sectors do suffer from delays in the completion of projects, delays that affect all aspects of projects and all parties involved. The negative effects of delays are reflected in the cost of developments, the revenue from projects and the quality of those projects. The more time taken to complete the job, the higher the cost of construction, because delays mean more members of staff, more hours worked, more equipment, plant, direct and indirect overheads, as well as potential claims between owners and contractors and more interest paid to funding institutions.

Objective 2: to identify the major risk factors causing time and cost overruns in Libyan projects

A survey of the LCI was conducted (Survey Questionnaire I), with 130 responses being collected from clients, consultants and contractors, in order to analyse the views of the parties involved. An importance index was calculated to rank the listed delay and cost overrun factors, which helps achieve the second objective of the study. The Importance Index II method was also used to rank the responsible parties in construction projects.

As discussed in Chapter 6, the rankings of all the relevant factors that have been investigated in this study of contractors', clients' and consultants' views is based on importance index values. They rated "lack of experience and performance of project management team" as the first and "low labour productivity" as the second major factors causing time overruns. All respondents saw "lack of timely decisions and corrective actions" as the third. For cost overruns, respondents ranked "political instability" first (no doubt due to the extraordinary political situation at the time the study was conducted), "poor management and supervision on site" second and "lack of proper financial appraisal of the project" third.

The study showed that there was consensus between contractors, clients and consultants regarding the importance of some of the factors affecting time and cost overruns. However, the data also reveals some differences of opinion. Each party's priorities and perceptions will inevitably be different – poor weather, for example, will mean more to contractors actually doing the job than it will to clients or consultants.

Moreover, the parties responsible for each cost and time overrun factor have been identified, as have been those factors' percentages, in order to suggest the responsibilities are intended to clarify working relationships between contractors, consultants and clients and measures to help mitigate and control cost and time overruns in Libyan construction projects.

In addition to the identification of factors causing time and cost overruns in Libyan projects in the quantitative study, the analysis of the interviews detected some other barriers encountered by the process of cost and time control. These have been categorised as contractor-related, consultant-related, client-related and external party-related.

Objective 3: to determine the current procedures of cost and time control tools and techniques adopted by practitioners in the Libyan construction projects

The analysis of the data collected from Survey Questionnaire I provided useful information on issues relating to the frequency with which Libyan organisations encounter problems of time and cost overruns. The study also revealed the methods used to determine the times and costs of the activities involved in Libyan construction projects.

The quantitative analysis of data gathered from the research revealed that 45.38 per cent used experience, 33.85 per cent made calculations, 6.92 per cent used other techniques and 13.85 per cent did not use any specific method.

In addition, Qualitative analysis of the semi-structured interviews helped this study to validate Questionnaire I and to investigate how the costs and times of construction projects are controlled so as to discover the reasons and related issues that affect the practical process of cost and time control in Libyan construction projects.

Objective 4: to explore the perception of professionals (contractors, consultants and owners) involved in the LCI regarding the important processes of cost and time control

The interview participants explained the reasons for the importance of project cost and time controls from their points of view. The main reasons for embarking on project control in practice included; stopping the habit of reinventing the wheel, providing information on the current status of the project, effective project management, the maintenance of a good reputation, and client satisfaction.

Participants also presented their views on the specifications required in the important processes of project control framework: comprehensiveness, the logical sequence of project phases, and continuity of monitoring through to project delivery.

Objective 5: to establish measures that will assist to mitigate the causes of cost and time overruns in Libyan construction projects

To develop the project control framework, the researcher took into account the most important factors that lead to overruns and defined the most important mitigation measures based on practitioners' knowledge, supported by literature reviews, to help to deal with these factors. The major causes of cost and time overruns in Libyan construction projects have been identified in Chapter 6, and suggested mitigation measures have been evaluated in Chapter 8. Hence, these steps have been incorporated into the final developed framework.

Objective 6: to develop and validate a project cost and time control framework

Finally the research study used information from and implications of LR and Survey Questionnaire I and the semi-structured interviews to develop the proposed framework to minimize cost and time overruns in Libyan construction projects, while Questionnaires II and III were used to validate mitigation measures incorporated into the framework, as well as to evaluate the developed project control framework in terms of the completeness of the list of factors responsible for project control

The developed project control framework takes into consideration the most important factors that lead to overruns and the most important mitigation measures based on practitioners' practical knowledge as supported by literature reviews to help deal with these factors. In addition, the developed project control framework seeks to fill the gap in knowledge by identifying the responsibilities of (contractor, consultant, and client) parties involved in the construction projects so as to help practitioners become more effective. The responsibilities outlined in Appendix (6) are offered to clarify working relationships with contractors, clients and consultants.

The final developed project control framework went through two evaluation stages; 'Formative Evaluation' and 'Summative Evaluation': the initial phase of the evaluation process was conducted to evaluate a part of the framework through the validation of the proposed mitigation measures. The second step of the evaluation process was designed to use experts' feedback to evaluate the entire framework's elements.

The evaluation processes of this study are based on combining quantitative and qualitative methods. The researcher first adopted a quantitative approach using Questionnaire II to define participants' responses regarding their perspectives on mitigation measures regarding cost and time control, which serve as reference points in the development of the proposed framework and consequently of the developed project control framework. Another questionnaire, however, is designed for open-ended question in Questionnaire III to reveal qualitative information about the project control framework to use the feedback of participants of Questionnaire III to re-validate the developed framework elements. The participants (contractors, consultants and clients) commented very positively on the developed project control framework.

9.3 Research contribution to knowledge and practice /significance

This study can serve as a basis for research and practice. The research has added to academic knowledge in the areas of project cost and time control. The study has also provided Libya based study that has helped identify issues most relevant to the contemporary practice in the country.

9.3.1 Contribution to knowledge

The most obvious contributions of the present research to the body of knowledge on the subject include the following:

- in order to reveal factors that can potentially inhibit effective cost and time and consequently impact the project performance, the study presents a broad vision and understanding of risk concept in the construction industry, and reviews the causes of time and cost overruns in the construction industry in different countries worldwide, as revealed by various studies. The factors causing time and cost overruns were also classified. These factors were classified into categories extracted from literature review as well as review of existing studies that revealed a lot of issues in construction project time and cost overruns. This classification process is used due to the nature establishment relationship between those identified factors and their main group.

  Moreover, to find out which of the identified factors from previous studies are deemed by practitioners as greatest inhibitors that potentially impact the cost and time objectives of projects, the study identifies the most frequent delay and cost overruns factors in different countries, especially in developing countries' construction projects.

  The prime finding from the conducted literature review was the identification of the most important causes of delays and cost overruns in different countries by analysing the many previous surveys. The present author has collated these studies and investigated the 15 most frequent delay and cost overruns factors in those countries' construction projects. The outcomes are shown in Table 2.4

- Many Libyan construction projects were found to have been completed at a much higher cost and conducted over a longer period than was originally anticipated and planned for (General People's Committee, 2006). The present study provided an up-to-date investigation of project cost and time overruns in Libyan construction projects, reflecting developments in recent years, previous studies in this area having become somewhat outdated. The systematic procedure of the design and implementation of the questionnaires survey used to obtain the required statistical data and information for the current research study is a contribution to the knowledge as questionnaire surveys may be an easy and simple process in countries like the (UK), but in third-world, developing countries it is not an easy task to implement successfully.

- This study is also concerned with looking at the practices based on previous studies in controlling the construction project process that could help to minimize the time and cost overrun problems by reviews' standard processes for project control of several researchers in several countries such as, USA, UK, Japan and Malaysia. They all provide a suitable approach to providing an overview of the existing practices in construction procedures, especially in terms of cost and time overruns and highlighted process and procedure of good time and cost management practices.

- The documentary studies from journals and books have been reviewed together with synthesizing the works of several writers and researchers regarding project cost and time control framework for project management practices. This work was used to propose a theoretical project control framework for project control practices like the one as seen at Figure 5.5 on page 126. Every set of core processes is represented in a list of the common project control processes and comprised an amalgam of proven project control practice worldwide. This is shown in the proposed project control framework that has been designed by the author to promote the minimization of time and cost overruns in the Libyan construction industry projects.

9.3.2 Contribution to practice

This study also can serve as a basis for practice in order to prevent project overrun. It reveals surrounding issues, prevalent practices and the requirements of practitioners in relation to cost and time control. The study provides a number of key attributes of contribution to practice; the most obvious contributions to practice include the following:

- The many studies examining the causes of delays and cost overruns in various global regions have rarely discussed such causes as they pertain to construction projects. Unlike previous studies, the present one presents the problems associated with project costing and schedules in addition to the identification of the factors that make difficulties to control construction projects in practice. This study has supplemented the literature by determining the most important causes of delays and cost overruns in Libyan construction projects, and followed by disclosing of reasons and related issues that inhibit effective cost and time control of construction projects in the LCI.

- It is clear that a special and unique process to achieve the goal of the study has been taken through the research methods used. This did not come coincidental, but is a result of the researcher's belief of the need to adopt the distinctive and reliable strategy in achieving the research goal. Design of the research methods was based primarily on the views of practitioners for construction operations in Libya in order to establish a realistic and practical framework for the management of LCI projects. For example, the researcher has involved practitioners in recognizing current situation related to time and cost overruns in Libyan construction projects facilitating identification of the factors influencing project overruns. Practitioners in the LCI were also consulted to recognize the obstacles which affect the process of cost and time control in order to bring some practicality into any developed solution that will promote the successful adoption of project control on Libyan construction projects. In addition, the solutions that have been developed were also evaluated by the practitioners. The researcher attempted to reach these solutions by the contributions of participants that have not previously been considered in most studies of project management.

- The results of this research can be used to effectively control the cost and time objectives of construction projects in practice, which in turn will promote a proactive approach towards minimising time and cost overruns, as well as contributing to the body of knowledge regarding the Libyan construction industry. This study fills the gap left by previous research in developing a list of risk mitigation measures for the factors causing delay and cost overruns. Unlike most existing studies, this research has developed a good practice checklist that can be used to effectively control the cost and time objectives of construction projects in practice. The ranking of these mitigation measures according to their effectiveness on time and cost overrun of construction projects implemented in the Libyan construction industry.

- The analysis of Questionnaire I and the interviews revealed that the processes of project control are common throughout the world, but the failure of Libyan construction projects to meet objectives lies in overlapping responsibilities and a lack of commitment. The major problem faced by the professionals in the Libyan construction industry was in developing a consensus about participants' responsibilities in the construction process. In order for the controlling processes to take place, responsibilities of project team must be defined so that job descriptions can be developed, not just for doing the work, but also for controlling and managing it.

The author therefore argues for the great importance of accompanying project control with a list of planned and clearly defined responsibilities for (contractor, consultant, and client) parties at every stage of the project, from the planning or design stage through to the completion of construction, in order to facilitate achievement of the project's goals.

The study also identifies roles of (contractor, consultant and client) parties involved in construction projects clarifying the grey area of responsibility which, if left unassigned, can cause disputes. These responsibilities were derived from the relevant literature reviews and recommendations made by the participants during interviews. The identification of parties' responsibilities included the detailing of activities, accomplishments, milestones and problems. The system will help clarify requirements including the destination of reports, the reporting templates and the reporting cycle, to ensure that the generation of reports will be systematic and well organised.

- This research is, to the author's knowledge, the first attempt to develop a framework for minimising time and cost overruns in Libyan construction projects as presented in Fig 8.2. This study has combined theory and practice through a literature review and the involvement of practitioners in an attempt to develop a framework for minimizing cost and time overruns in Libyan construction projects. It is envisaged that the framework will bring future changes in such projects, because it enables practitioners to be more systematic in dealing with the factors that lead to cost and time overruns and support the improvement of current practice to deliver construction projects with better quality, client satisfaction and minimum cost and time overruns. It is also anticipated that the use of this framework along with the project control strategy can help the LCI to:

    - realize the necessity of minimising cost and time overruns in construction projects
    - be aware in dealing with the factors contributing to time and cost overruns
    - assist all parties involved in construction projects to control time and cost overruns
    - stimulate future improvements in the LCI by promoting a culture of continuous improvement.

9.4 Limitations of the study

This research suffered from several limitations:

- Conducting research in the LCI is not easy, especially considering the duration of this research which took place from October 2010 to October 2014 in a very complex political situation in Libya. Most Libyan construction projects have been suspended and funding has stopped since February 2011 due to border closures, resulting in many companies losing hundreds of thousands of dollars in damaged and stolen property.

- It was difficult to obtain a suitable response rate using postal services owing to Libya's social and technical circumstances. To overcome this limitation, the researcher employed hand- to- hand and face-to-face methods in administering questionnaires. A personal contact approach was employed, supplemented by telephoning and visiting companies and sending reminders to increase the number of responses.

- A lack of previous studies and data relevant to the process of project cost and time control in LCI was one of the key limitations of this study. However, the available information relevant to the LCI was very limited and characterized by contradiction. To overcome this limitation, the researcher had to collect almost all data personally.

- The responsibilities outlined in the framework are offered to clarify working relationships within the project team (contractor, consultant and client). However, the list is not intended to be exhaustive, nor does it supersede any other obligations or responsibilities contained in the applicable contracts or other documentation.

9.5 Recommendations for future research studies

The research has aimed to investigate Libyan project control practices and to identify the major risk factors causing time and cost overruns in Libyan projects, as well as to develop and validate a framework to proactively minimise time and cost overruns in Libyan construction projects. Several issues have emerged that could be the subject of future study, and their results would enhance the present findings in order to improve the current poor performance in LCI. These issues are:

- This study endeavours to develop a framework for minimising cost and time overruns in construction projects. Nevertheless, successful project control is evaluated in terms of quality and timely completion within acceptable cost limits. It is therefore suggested that further research could investigate project quality as well as cost and time in order to develop a framework incorporating all three conditions as regards Libyan construction projects.

- The mitigation measures that have been incorporated into the developed project control framework may also not contain all the actions that could facilitate project cost and time control in practice. Therefore, the framework could be improved by adding more remedial actions that might be used as alternative solutions to the control of cost and time overruns problems in the Libyan construction projects.

- The responsibilities outlined in the framework are intended to clarify working relationships between contractors, consultants and clients. It is therefore suggested that further research should explore and identify the responsibilities of other parties involved in construction projects in order to apply the project control framework process more accurate and effective.

References

AALBREGTSE, R.J., HEJKA, J.A. and McNELEY, P.K. (1991). TQM: how do you do it? *Automaton*, 38, 30-32.

ABDUL-KHALIQ, A., HARMINA, M. and EMAM, S. (1982). The relationship between attitudes mental illness and psychology female students. *In: Personality and Behaviour Research*. Cairo, Dar Al-Maaref. pp.131-146.

ABDULLAH, M.O. and BATTAINEH, H.T. (2002). *causes of construction delays: traditional contracts*, Journal of Project Management, 20, 67- 73

ABDUL-RAHMAN, H., BERAWI, M. A., BERAWI, A. R., MOHAMED, O., OTHMAN, M., & YAHYA, I. (2006). Delay mitigation in the Malaysian construction industry. *Journal of Construction Engineering and Management (ASCE)*, 132(2), 125-133.

AHMED, S. M., AZHAR, S., and AHMAD, I. (2002). *Evaluation of Florida general contractors' risk management practices*. (Construction Engineering Journal). 17(1), pp. 4-10.

AHMED, S.M., AZHAR, S., KAPPAGANTULA, P., and GOLLAPUDI, D., (2003). Delays in construction: a brief study of the Florida construction industry. *In: Proceedings of the 39th Annual Conference of the Associated Schools of Construction held at Clemson University, Clemson, South Carolina.*

AIBINU, A. and ODEYINKA, H. (2006). Construction delays and their causative factors in Nigeria. *Journal of Construction Engineering and Management*, 132(7), 667–677.

Al-AGHBARI, W., ABDUL KADIR, M., SALIM, A. and ERNAWATI. (2007). The significant factors causing delay of building construction projects in Malaysia. *Engineering, Construction and Architectural Management*, 14(2), 192-206.

AL-GATHAFI, M.M. (2005). *Riskiness of time and cost overruns and the effectiveness of risk response measure strategies in the Libyan construction industry*. Unpublished Ph.D. dissertation, University of Liverpool.

ALI, K. (2012). The role that could be played by the Senate in the balance of political forces in Libya Free. [online]. Available from: http://www.libya-al-mostakbal.org/news/clicked/20593. [Accessed 13th February 2013].

ALKASS, S. and HARRIS, F. (1991). Construction contractor's claims analysis: an integrated system approach. An integrated system that aids in the analysis of contractor's claims resulting from delays. *Building Research and Information*, 19(1), 56-64.

AL-KHALIL, M.I. and AI-GHAFLY M.A. (1999 a). Delay in public utility projects in Saudi Arabia, *International Journalof Project Management*, 17(2), 101-106.

AL-KHALIL, M.I. and AL-GHAFLY, M.A. (1999 b). Important causes of delay in public utility projects in Saudi Arabia. *Construction Management and Economics*, 17(5), 647-655.

AL-MOMANI, A.H. (2000). Construction delay: a quantitative analysis. *International Journal of Project Management*, 18(1), 51-59.

ALWI, S. and HAMPSON, K. (2002). Identifying the important causes of delays in building construction projects. *In*: *Proceedings of the 9th East Asia-Pacific Conference on Structural Engineering and Construction*, Bali, Indonesia, 2003.

ALZOHBI, M. G., STEPHENSON. P. and GRIFFITH, A. (2011). An investigation of problematic issues associated with site management: a case study of the great man-made river projects in Libya. *In*: *Culture in construction: a workshop linked with the first seminar in the ERSC Seminar Series – Culture Perspectives and Prospects*, Loughborough University, UK, 2011. Association of Researchers in Construction Management (ARCOM), 28(2), 12-23.

AMER, W. (1994). *Analysis and evaluation of delays in construction projects in Egypt.*, Unpublished Masters dissertation, Zagazig University, Egypt.

AMMENWERTH, E. and MANSMANN, U. (2003). Can evaluation studies benefit from triangulation? a case study. *International Journal of Medical Informatics*, 70(2-3), 237-248.

ANDI. (2006). *The importance and allocation of risks in Indonesian construction projects', Construction Management and Economics*, vol. 24, pp. 69-80.

ARDITI, D. AKAN, G.T. and GURDAMAR, S. (1985). Cost overruns in public projects. *International Journal of Project Management,* **3**(4), 218-224.

ASSAF, S. and AL-HEJJI, S. (2006). Causes of delay in large construction projects, *International Journal of Project Management*, **24**(4), 349-357.

ASSAF, S.A., AL-KHALIL, M. and AL-HAZMI, M. (1995). Causes of delay in large building projects. *Journal of Management in Engineering*, **11**(2), 45-50.

ASSOCIATION OF PROJECT MANAGEMENT (2002). *Directing change; A guide to governance of project management.* Association of Project Managers: London. Available at www.apm.org.uk.

AVEN, T. and RENN, O. (2010). *Risk management and governance: concepts, guidelines and applications*. Berlin, Springer.

AWOTONA, A. (1990). Housing in Libya: 1950-1980. *Habitat International*, **14**(1), 55-85.

AZZUZ, I. (2000). Contemporary Libyan architecture: possibilities vs. realities. *Journal of Applied Acoustics*[online], **62**, 63.

BABBIE, E. (2004). *The practice of social research*. 10th ed., Belmont, CA, Thompson Learning.

BADIRU, A. (2008) *Industrial project management: concepts, tools and techniques*. Boca Raton, FL, CRC Press.

BADIRU, A. (1996). *Project management in manufacturing and high-technology operations*. New York, NY, Wiley.

BADIRU, A. B. (2008). *Triple C Model of project management: communication, cooperation, and coordination*. Boca Raton, FL, CRC Press.

BADIRU, D. (2009). *Getting things done through project management*. Bloomington, IN, Universe.

BAGULEY, P. (2008). *Project management*. London, Hodder Education.

BAKER, S. and BAKER, K. (1992). *On time / on budget: a step-by-step guide for managing any project*. Englewood Cliffs, NJ, Prentice Hall.

BALOI, D. and PRICE, A. (2003) Modelling global risk factors affecting construction cost performance. *International Journal of Project Management*, **21**(4), 261-269.

BERNARD, H. RUSSELL. (2011). *Research methods in anthropology: qualitative and quantitative approaches*. 5th ed., Lanham, MD, AltaMira Press.

BEST, S. (2012). *Understanding and doing successful research: data collection and analysis for the social sciences*. Harlow, Pearson.

BIDGOLI, H. (ed.) (2004). *The Internet encyclopedia*. Hoboken, NJ, Wiley.

BLASTER, L., HUGHES, C. and TIGHT, M. (2008). *How to research*, Maidenhead, Open University Press.

BREWER, J. and HUNTER, A. (2006). *Foundations of multimethod research: synthesizing styles*. Thousand Oaks, CA, Sage.

BRITISH STANDARDS INSTITUTE (1996). *BS6079: Guide to Project Management*. London, British Standards Institute.

BROMILOW, F.J. (1969). Contract time performance expectation and the reality, *Building Forum*, **1**(3), 70-80.

BROMILOW, F.J. and HENDERSON, J.A. (1977). *Procedures for reckoning and valuing the performance of building contracts*. CSIRO, Divison of Building Research.

BROMILOW, F.J., HINDS, M.F. and MOODY, N.F. (1980). AIQS survey of building contract time performance. *The Building Economist*, **19**(2), 79-82.

BROOM J. (1998). *The effect of the new engineering contract on the management of change*. Unpublished Ph.D. dissertation, University of Birmingham, UK.

BRYMAN, A. and BELL, E. (2007). *Business research methods*. 2nd ed., Oxford, Oxford University Press.

BURTONSHAW-GUNN, S. (2009). *Risk and financial management in construction*. Farnham, Gower.

Cambridge advanced learner's dictionary (2005). 2nd ed., Cambridge, Cambridge University Press.

CAMILLERI, E. (2011). *Project success: critical factors and behaviours*. Farnham, Gower.

CARBONE, T.A. and TIPPETT, D.D. (2004). Project risk management using the project risk FMEA. *Engineering Management Journal*, **16**(4), 28–35.

CARR, W., & KEMMIS, S. (1986). *Becoming critical: Education, knowledge and action research*. Geelong: Deakin University Press.

CASE, R., ANDREWS, M. and WERNER, W. (1988). *How can we do it? An evaluation training package for development educators*. New York, NY, Interaction.

CHALABI, F.A. and CAMP, D. (1984). Causes of delays and overruns of construction projects in developing countries. *Proceedings of the CIB, W65*, **2**, 723-734.

CHAN, A.P.C. (2001). Time-cost relationship of public sector projects in Malaysia. *International Journal of Project Management*, **19**(4), 223-229.

CHAN, D. and KUMARSWAMY, M. (2002). Compressing construction duration: lessons learned from Hong Kong building projects. *International Journal of Project Management*, **20**(1),. 23-35.

CHAN, D.W. (1998) *Modelling construction durations for public housing in projects in Hong Kong*. Unpublished Ph.D. dissertation, The University of Hong Kong.

CHAN, D. W. M. & KUARASWAMY, M. M. (1995) *A study of the factors affecting construction durations in Hong Kong*. Journal of Construction and Economics. Vol. 13, pp. 319-333.

CHAN, D. W. M. & KUARASWAMY, M. M. (1996). *An evaluation of construction time performance in the building industry*. Building and Environment. Vol. 31(6), pp. 579-578.

CHAN, S. and PARK, M. (2005). Project cost estimation using principal component regression. *Construction Management and Economics*, **23**(3), 295-304.

CHANG, A. (2002). Reasons for cost and schedule increase for engineering design projects. *Journal of Management in Engineering*, **18**(1), 29-36.

CHAPMAN, C. and WARD, S. (2002). Project risk management; the required transformations to become project uncertainty management. *In:* D. Slevin, D. Cleland and J. Pinto (eds), *The frontier of project management research*. Newton Square, PA, Project Management Institute.

CHEN, W.T. and HUANG, Y.H. (2006). Approximately predicting the cost and duration of school reconstruction projects in Taiwan. *Construction Management and Economics*, **24**(12), 1231-1239.

CHENG, J. and PROVERBS, D. (2006). Modelling strategic decisions and satisfaction: a conceptual model for construction clients. *In: Proceedings of World Conference for Accelerating Excellence in the Built Environment held in Birmingham.*

CHILISA, B. (2011). *Indigenous research methodologies*: Thousand Oaks, CA, Sage.

CHOUDHURY, I. and PHATAK, O. (2004). Correlates of time overrun in commercial construction. *In: Proceedings of the 4th Annual ASC Conference held at Brigham Young University, Provo, Utah.*

CHOUDHURY, S. (1988). *Project management*. Tata McGraw Hill Education.

CHRISTIANS, C.G. (2005). Ethics and politics in qualitative research. *In:* N. Denzin and Y. Lincoln (eds.). *Handbook of qualitative research*, 3rd ed.. Thousand Oaks, CA, Sage.

CLOUGH, R.H. and SEARS, G.A. (1994). *Construction contracting*. 6th ed., New York, NY, Wiley.

CLOUGH, R.H., SEARS, G.A., and SEARS, S.K. (2000). *Construction project management*. 4th ed., New York, NY, Wiley.

COLEAN, M. L. and NEWCOMB, R. (1952). *Stabilizing construction: the record and potential*. New York, NY, McGraw-Hill.

COLLINS, H. (2010). *Creative research: the theory and practice of research for the creative industries*. Lausanne, AVA Academia.

COLLIS, J. and HUSSEY, R. (2003). *Business research: a practical guide for undergraduate and postgraduate students*. 2nd ed., New York, NY, Palgrave McMillan.

COPI, I. M., & BURGESS-JACKSON, K. (1995). *Informal logic*. Upper Saddle River, NJ: Prentice Hall.

INTERNATIONAL STANDARDS ORGANISATION (2009). *ISO 31000:2009 Risk management: risk assessment techniques*. Geneva, International Standards Organisation.

CONNAWAY, L.S. and POWELL, R.R. (2010). *Basic research methods for librarians*. 5th ed., Santa Barbara, CA, Libraries Unlimited.

CONSTRUCTION INDUSTRY RESEARCH AND INFORMATION ASSOCIATION (2002). *A simple guide to controlling risk*. London, CIRIA.

COUGHLAN, P. and COGHLAN, D. (2002). Action research for operations management. *International Journal for Operations and Production Management*, **22**(2), 220-240.

CRESWELL, J.W. (2009). *Research design: qualitative, quantitative, and mixed methods approaches*. 3rd ed., Los Angeles, CA, Sage.

CRETU, O., STEWART, R. and BERENDS, T. (2011). *Risk management for design and construction*. Hoboken, NJ, John Wiley.

CUSWORTH, J.W. and FRANKS, T.R. (eds.) (1993). *Managing projects in developing countries*. Harlow, Longman Scientific and Technical.

DALE, B.G. (2003). *Managing quality*. 4th ed., Oxford, Blackwell Scientific Publications.

DAVID, M. and SUTTON, C. (2004). *Social research: the basics*. London, Sage.

DAYMON, C. and HOLLOWAY, I. (2011). *Qualitative research methods in public relations and marketing communications*. 2nd ed., London, Routledge.

DAZA, M. (1982). *Understanding the Built Environment: Crisis Change and Issue FN*

Needs In the Concept of Habitations and Settlement in Libya, Unpublished PhD Thesis, University of Pennsylvania, U. S. A.

DE MARCO, A. (2011). *Project management for facility constructions: a guide for engineers and architects*. Berlin, Springer.

DHILLON, B.S. (2002). *Engineering and technology management tools and applications*. Boston, Artech House.

Di Piazza, F. (2005). Libya in Pictures (Visual Geography (Twenty-First Century)). Minneapolis: Lerner Publishing Group.

DILLMAN, A. (2000). *Mail and Internet surveys: the tailored design method*. New York, NY, John Wiley.

DLAKWA, M. and CULPIN, M.F. (1990). Reasons for overrun in public sector construction projects in Nigeria. *International Journal of Project Management*, **8**(4), 237-241.

DULAMI, M.F. and HWA, T.F. (2001). Developing world class construction companies. *Construction Management and Economics*, **19**(6), 591-599.

ECONOMICS AND SOCIAL RESEARCH COUNCIL (ESRC) (2012). *ERSC Framework for Research Ethics (FRE) 2010: updated September 2012*. [online]. Swindon, Economics and Social Research Council. Last accessed 9th October 2012 at: http://www.esrcsocietytoday.ac.uk/ESRCInfoCentre/Images/ESRC_Re_Ethics_Frame_tcm6-11291.pdf.

EJINIMMA, C. (2004).*What do derivative instruments offer by way of risk management in oil and gas project financing?* [online]. CEPMLP Gateway, University of Dundee. Last accessed 11th January 2012 at: http://www.dundee.ac.uk/cepmlp/gateway/index.php?category=68&pg=3

ELINWA, A.U. and BUBA, S.A. (1993). Construction cost factors in Nigeria. *Journal of Construction Engineering and Management*, **119**(4), 698-713.

ELINWA, A.U. and JOSHUA, M. (2001). Time-overrun factors in Nigerian construction industry. *Journal of Construction Engineering and Management*, **127**(5), 419-425.

EL-KMESHI, B.E. (2006) *The project implementation delay due to the owner*. Unpublished Masters dissertation, Al-Fateh University.

EL-SAYEGH, S.M. (2008). Risk assessment and allocation in the UAE construction industry. *International Journal of Project Management*, **26**(4), 431-438.

ENDUT, I.R., AKINTOYE, A. and KELLY, J. (2006). Relationship between duration and cost of Malaysian construction projects. *In: Proceedings of the International Conference in the Built Environment in the 21st Century (ICiBE 2006) held in Kuala Lumpur*. pp.299-309.

ENSHASSI A., LISK, R., SAWALHI, I. and RADWAN, I. (2003). Contributors to construction delays in Palestine. *The Journal of the American Institute of Constructors*, **27**(2), 45-53.

ESTEVES, J. (2004). *Definition and analysis of critical success factors for ERP implementation projects*. Unpublished Ph.D. dissertation, Universitat Politècnica de Catalunya, Spain.

FANIRAN, 0. (1999). The role of construction project planning in improving project delivery in developing countries: case study of the Nigerian construction industry. *In: Proceedings of the 2nd International Conference on Construction Industry Development held in Singapore*.

FARIDI, A.S. and EL-SAYEGH, S.M. (2006). Significant factors causing delay in the UAE construction industry. *Construction Management and Economics*, **24**(11), 1167-1176.

FAY, J. (2011). *Contemporary security management*. 3rd ed., Burlington, MA, Butterworth-Heinemann.

FELLOWS, R. and LIU, A. (2008). *Research methods for construction*. 3rd ed., Oxford, Wiley-Blackwell.

FERRY, D.J. and BRANDON, P.S. (1980). *Cost planning of buildings*. 4th ed., London, Granada.

FLANAGAN, R. and JEWELL, C. (2005). *Whole Life Appraisal for construction. Oxford*: Blackwall Publishing Ltd.

FLANAGAN, R. and NORMAN, G. (1993). *Risk management and Construction.* Oxford, Blackwell Science.

FONG, N.K., WONG, L.Y. and WONG, L.T. (2006). Fire services installation related contributors of construction delays. *Building and Environment*, **41**(2), 211-222.

FOX, RICHARD (1998) 'Layered abduction and abductive inference', *Edinburg, TX: University of Texas*, Computer Science.

FOX, S., MARSH, L. and COCKERHARN, G. (2003). Assessing the capability of construction processes to realize building designs. *Construction Management and Economics*, **21**(1), 7-10.

FRIMPONG, Y., OLUWOYE, J and CRAWFORD, L. (2003). Causes of delay and cost overruns in construction of groundwater projects in developing countries: Ghana as a case study. *International Journal of Project Management*, **21**(5), 321-326.

GAGNON, Y-C. (2010). *The case study as research method: a practical handbook.* Québec, Presses de l'Université du Québec.

GALLIERS, D. (ed.) (1992). *Information systems research: issues, methods and practical guidelines*. Oxford, Blackwell Scientific.

GARDNER, J.W. (1961). *Excellence: can we be equal and excellent too?* New York, NY, Harper.

GEORGE, J.R. (1994). *Total construction project management*, New York, NY, McGraw- Hill.

GIDO, J. and CLEMENTS, J.P. (2009). *Successful project management*. 4th ed., Mason, OH, South-Western Cengage Learning.

GILLEY, J.W. et al. (2001). *The manager as change agent: a practical guide for developing high-performance people and organisations*. Cambridge, MA, Perseus.

GRATTON, C. and JONES, I. (2010). *Research methods for sports studies*. London, Routledge.

GREENHALGH, B. and SQUIRES, G. (2011). *Introduction to building procurement.* Abingdon, Spon .

GRIFA, M.A. (2006). The construction industry in Libya, with particular reference to operations in Tripoli. Unpublished Ph.D. thesis, Newcastle University.

GRIFFIN, J.A. (2010). *Residential construction management: managing according to the project lifecycle.* Plantation, FL, J. Ross.

GRIFFITH, A., STEPHENSON, P. and WATSON, P. (2000). *Management systems for construction.* Harlow, Longman.

GROVES, R. M., FOWLER, F. J. J., COUPER, M. P., LEPKOWSKI, J. M., SINGER, E., & TOURANGEAU, R. (2009). *Survey Methodology*, 2nd edition. Hoboken, NJ: Wiley-Interscience.

GUBA, E.G. and LINCOLN, Y.S. (2005). Paradigmatic controversies, contradictions, and emerging confluences. *In:* N. K. Denzin and Y. S. Lincoln (eds.) *The Sage handbook of qualitative research.* 3rd ed., Thousand Oaks, CA, Sage. pp.191-215.

HAKIM, B. (1986). Arabic-Islamic cities: Building and Planning Principles. kpl, London.

HAM A. (2007). Libya, 2nd Edition, London: Lonely Planet.

HAMILTON, A. (2001). *Managing projects for success: a trilogy.* London, Thomas Telford.

HARPUM, P. (ed.) (2010). *Portfolio, program, and project management in the pharmaceutical and biotechnology industries.* Hoboken, NJ, John Wiley and Sons.

HARRINGTON, H.J. (2006). *Process management excellence: the art of excelling in process management.* Chico, CA, Paton Press.

HARRIS, F. and McCAFFER, R. (2006). *Modern construction management.* 6th ed., Oxford, Blackwell.

HAY-GIBSON, N.V. (2009). Interviews via VoIP: Benefits and disadvantages within a PhD study of SMEs. Library and Information Research, 33 (105), 39-50.

HELDMAN, K. and MANGANO, V. (2011). *PMP: project management professional exam review guide*. 2nd ed., Hoboken, NJ, Wiley.

HENDRICKSON, CHRIS, and AU, TUNG. (2000). *Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects, and Builders*, Prentice Hall.

HILL, G.M. (2008). *The complete project management office handbook.* 2nd ed., Boca Raton, FL, Auerbach.

HILLSON, D. (2002). Extending the risk process to manage opportunities. *International Journal of Project Management*. **20**(3), 235-240.

HILLSON, D. (2004). *Effective opportunity management for projects: exploiting positive risk.* New York, NY, Marcel Dekker.

History of the Central Bank of Libya (in Arabic). (2009). [online]. Last accessed 4th November 2011 at: http://www.cbl.gov.ly.

HOARE, D. (1996). Construction management research methodology: a personal view of recent developments. *In: Proceedings of the 12th Annual Conference of the Association of Researchers in Construction Management (ARCOM), held at Sheffield Hallam University*. pp.478-487.

HOFFMAN, G.J., THAL JR., A. E., WEBB, T. S. and WEIR, J. D. (2007). Estimating performance time for construction projects. *Journal of Management in Engineering*, **23**(4), 193-199.

HOKOMA, R.A., KHAN, M.K. and HUSSAIN, K. (2006), The current status of MRPII implementation in some key manufacturing industries within Libya: a survey investigation. *In: Proceedings of the 22nd International Conference on CAD/CAM, Robotics and Factories of the Future, India.* University of Bradford pp.483-490.

HOKOMA, R.A., KHAN, M.K. and HUSSAIN, K. (2007). Investigation of the senior management strategy towards implementing manufacturing, planning and control techniques/philosophies within the Libya cement industry: a case study. *In: Proceedings of the 23rd ISPE International Conference on CAD/CAM, Robotics and Factories of the Future, held in Bogota, Colombia.*

HOKOMA, R.A., KHAN, M.K. and HUSSAIN, K. (2008). Investigation into the implementation stages of manufacturing and quality techniques and philosophies within the Libyan cement industry. *Journal of Manufacturing Technology Management*, **19**(7), 893-907.

HORNBY, A.S. (1995). *Oxford advanced learner's dictionary of current English.* 5th ed., Oxford, Oxford University Press.

HORNER, M. and DUFF, R. (2001). *More for less: a contractor's guide to improving productivity in construction.* London, CIRIA.

HOSSEN, F.A. and HICKS, C. (2000). *Risk management in engineer-to-order companies*, Newcastle, Newcastle University.

HUBBARD, D. (2009). *The failure of risk management: why it's broken and how to fix it.* Hoboken, NJ, Wiley.

ICS. (2009). *Investment Climate Statement Bureau of Economic, Energy and Business Affairs*. [online]. Last accessed 14th January 2012 at: http://libya.usembassy.gov/topic-of-interest/economic-affairs/recent-economic-reports.html

INTAN ROHANI, E., AKINTOYE, A., and KELLY, J. (2009). Cost and time overruns of projects in Malaysia. Last accessed 4th December 2011 at: *http://www.irbnet.de/daten/iconda/CIB10633.pdf*

IYER, K.C. and JHA , K.N. (2005). Factors affecting cost performance evidence from Indian construction projects. *International Journal of Project Management*, **23**(4), 283-295.

JAAFARI, A. (2001). Management of risks, uncertainties and opportunities on projects: time for a fundamental shift. *International Journal of Project Management*, **19**(2), 89-101.

JACKSON. J. (1999). *Facility construction cost overruns: analysis for Navy construction contracts. A report for CE675-Civil Engineering Department, North Carolina State University*. Raleigh, N.C., North Carolina State University.

JALOTE, P. (2008). *A concise introduction to software engineering*. London, Springer.

JASKOWSKI, P. and BIRUK, S. (2011), "The conceptual framework for construction project risk assessment. *Reliability: Theory and Applications*, **2**(3), 27-35.

KAKA, A.P. and PRICE, A.D.F. (1991). Relationship between value and duration of construction projects. *Construction Management and Economics*, **9**(4), 383-400.

KALIBA, C., MUYA, M. and MUMBA, K. (2009). Cost escalation and schedule delays in road construction projects in Zambia. *International Journal of Project Management*, **27**(5), 522-531.

KAMING, P.F. et al. (1997). Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics*, **15**(1), 83-94.

KANGARI, R. (1995). Risk management perceptions and trends of US construction. *Journal of Construction Engineering and Management*, **121**(4), 422-429.

KARTAM, N.A. and KARTAM, S.A. (2001). Risk and its management in the Kuwaiti construction industry: a contractors' perspective. *International Journal of Project Management*, **19**(6), 325-335.

KELLEHER Jr., T.J. and SMITH, G.S.W. (2009). *Smith, Currie and Hancock's common sense construction law: a practical guide for the construction professional*. 4th ed., Hoboken, NJ, Wiley.

KERZNER, H. (2009). *Project management: a systems approach to planning, scheduling and controlling*. 10th ed., Hoboken, NJ, Wiley and Sons.

KERZNER, H. (2010). *Project management best practices: achieving global excellence*. 2nd ed., Hoboken, NJ, International Institute for Learning.

KOUSHKI, P.A. and KARTAM, N.A. (2004). Impact of construction materials on project time and cost in Kuwait. *Engineering, Construction and Architectural*

Management, **11**(2), 126-132.

KOUSHKI, P.A., AL-RASHID, K. and KARTAM, N. (2005). Delays and cost increases in the construction of private residential projects in Kuwait. *Journal of Construction Management and Economics*, **23**(3), 285-294.

KREJCIE, R.V. and MORGAN, D.W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, **30**, 607-610.

KUMARASWAMY, M.M. and CHAN, D.W.M. (1995). Determinants of construction duration. *Construction Management and Economics*, **13**(3), pp. 209-217.

KUMARASWAMY, M.M. and CHAN, D.W.M. (1998). Contributors to construction delays. *Construction Management and Economics*, **16**(1), 17-29.

KUMARASWAMY, M.M. and DISSANAYAKA, S.M. (1998). Linking procurement systems to project priorities. *Building Research and Information*, **26**(4), 223-238.

KURUOOGLU, M. and ERGEN, E. (2000). The effects of economic development on project management in developing countries. *In: 2nd International Conference on Construction in Developing Countries: challenges facing the construction industry in developing countries, held in Gabarone, Botswana.*

KWAKYE, A.A. (1997). *Construction project administration in practice.* Harlow, Longman, co-published with the Chartered Institute of Building.

LAAGE-HELLMAN, J. and GADDE, L. (1996). Information technology and the efficiency of materials supply: the implementation of EDI in the Swedish construction industry. *European Journal of Purchasing and Supply Management*, **2**(4), 221-228.

LEE, A. (1991). Integrating positivist and interpretivist approaches to organisational research. *Organisational Science*, **2**(4), 342-365.

LE-HOAI, L., LEE, Y.D. and CHO, J.W. (2009). Construction of time-cost model for building projects in Vietnam. *Korean Journal of Construction Engineering and Management*, **10**(3), 130-138.

LEVIN-ROZALIS, M. (2003). Evaluation and research: Differences and similarities. *The Canadian Journal of Program Evaluation*, 18 (2), 1-31.

LIBBY, R. and FISHBURN, P.C. (1977). Behavioral models of risk taking in business decisions, a survey and evaluation, *Journal of Accounting Research*, **15**(2), 272-292.

Libya (2011). AFRICAN ECONOMIC OUTLOOK. [online]. Last accessed 17th January 2012 at: http://www.africaneconomicoutlook.org/fileadmin/uploads/aeo/Country_Notes/2011/Full/Libya.pdf.

LIBYA IN PICTURES. Di Piazza, Francesca. "History and Government: Guerilla War [p. 29]." 2006.

LIBYA. GENERAL COUNCIL FOR PLANNING (2002a). *A report on employment regulations, policies and the organisation of foreign workforce in Libya*. Tripoli, Government Printers.

LIBYA. GENERAL COUNCIL FOR PLANNING (2002b). *Housing polices: present conditions and future needs*. Tripoli, Government Printers.

LIBYA. GENERAL COUNCIL FOR PLANNING (2002c). *An evaluation of the implementation of the transformation budget for the financial year 2000*. Tripoli, Government Printers.

LIBYA. GENERAL PEOPLE'S COMMITTEE (2003). *Decision no. (22), 2003, regarding permission for investors to execute their investment activities in Libya*.

LIBYA. MINISTRY OF ECONOMY AND TRADE. CENSUS AND STATISTICAL DEPARTMENT (1966). *Statistical abstracts*.

LIBYA. MINISTRY OF HOUSING (1968). *The preliminary report on the squatter rehousing and resettlement programme in Libya, vol.2*. Tripoli, Government Printers.

LIBYA. THE GENERAL PEOPLE'S COMMITTEE OF FACILITIES AND HOUSING IN LIBYA, retrieved December 5, 2006 http:// www.gpc.gov.ly, 2006.

LIBYA. GENERAL PEOPLE'S COMMITTEE (2004). *Administrative contract regulation No. 265*.

LING, F.Y.Y. (2004). How project managers can better control the performance of design-build projects. *International Journal of Project Management*, **22**(6), 477-488.

LOCK. D. (2007). *Project management*. 9th ed., Aldershot, Gower.

LONG, L.H., YOUNG, D.L., and JUN, Y.L. (2008). *Delays and cost overrun in Vietnam large construction projects: A comparison with other selected countries*. KSCE Journal of Civil Engineering, 12, 367-377.

LONGMAN, A. and MULLINS, J. (2005). *The rational project manager: a thinking team's guide to getting work done*. Hoboken, NJ, John Wiley.

LOOSEMORE, M., DAINTY, A. and LINGARD, H. (2003). *Human resource management in construction projects*. London, Taylor and Francis.

LOPES, J., RUNDDOCK, L. and RIBERIRO, F. (2002). Investment in construction and economic growth in developing countries. *Building Research and Information*, **30**(3), 152 159.

LOVE, P.E.D., TSE, R.Y.C. and EDWARDS, D.J. (2005). Time-cost relationships in Australian building construction projects. *Journal of Construction Engineering and Management.* **131**(2), 187-194.

MALHOTRA, N.K. (2009). *Marketing research: an applied orientation*. 6th (global) ed., London, Pearson Education.

MANSFIELD, N.R., UGWU, O.O. and DORAN, T. (1994). Causes of delay and cost overruns in Nigerian construction projects. *International Journal of Project Management*, **12**(4), 254-260.

MERAN, T. and NJIRU, C. (2002). *Financing infrastructure projects*. London, Thomas Telford.

MEREDITH, J.R. and MANTEL, S.J. (2000). *Project management: a managerial approach*. 4th ed., New York, NY, Wiley.

MERETT, A.J. and SYKES, A. (1973). *The finance and analysis of capital projects*. London, Longman.

MERNA, T. and AL-THANI, F.F. (2008). *Corporate risk management: an* *organisational perspective*. 2nd ed., Hoboken, NJ, John Wiley.

MEZHER, T.M. and TAWIL, W. (1998). Causes of delay in the construction industry in Lebanon. *Engineering, Construction and Architectural Management*, **5**(3), 252-260.

MILES, M.B. and HUBERMAN, A.M. (1994). *Qualitative data analysis: an expanded sourcebook*. 2nd ed., Thousand Oaks, CA, Sage.

MILLER, R. and LESSARD, D. (2001). Understanding and managing risks in large engineering projects. *International Journal of Project Management*, **19**(8), 437-443.

MILLS, A. (2001). A systematic approach to risk management for construction. *Structural Survey*, **19**(5), 245-252.

MORRIS, P.W.G. and PINTO, J.K. (2007). *The Wiley guide to project, program, and portfolio management*. Hoboken, NJ, Wiley.

MUBARAK, S. (2010). *Construction project scheduling and control*. 2nd ed., Hoboken, NJ, Pearson Education.

MUIJS, D. (2004). *Doing quantitative research in education with SPSS*. London, Sage.

MULEKEZI L. (1994). *The design of project estimating systems*. Unpublished Ph.D. dissertation, Birmingham University.

MURRAY, M and LANFORD, D. (2003). *Construction reports 1944-98*. Oxford: Blackwell Science.

NAJMI, M. and KEHOE, D.F. (2000). An integrated framework for post-ISO 9000 quality development. *International Journal of Quality and Reliability Management*, **17**(3), 226-258.

NAOUM, S.G. (1998). *Dissertation research and writing for construction students*. Boston, MA, Butterworth-Heinemann.

NAOUM, S.G. and MUSTAPHA, F.H. (1995). Relationship between the building team, Procurement methods and project performance. *Journal of Construction Procurement*, **1**, 50-63.

NEWELL, M.W. (2005). *Preparing for the Project Management Professional (PM)*

Certification Exam. 3rd ed., New York, NY, AMACOM.

NGAB, A.S. (2007). *Libya: the construction industry: an overview*. [online]. Electronic proceedings of the International Workshop, Cement Based Materials and Civil Infrastructure (CBM-CI). (Last accessed 19th March 2012 at: http://enpub.fulton.asu.edu/cement/cbm_CI/CBMI_Separate_Articles/Article%2021.pdf

NIRMAL, L. and KIM, Y.D. (2005). Delay in building construction projects in developing countries: a case study of Nepal. *Journal of the Korean Society of Maintenance Engineers*, **10** (3), 81-95.

OBEIDA, S. (2007). The Libyan economy: a historical perspective (in Arabic). *Economy and Trade Magazine*, **11**, 31-27.

ODEH, A.M., and BATTAINEH, H.T. (2002). Causes of construction delay: traditional contracts. *International Journal of Project Management*, **20**(1), 67-73.

OFORI, G. (1981). *The construction industries of developing countries: the applicability of existing theories and strategies for their improvement and lessons for the future: the case of Ghana*. Unpublished Ph.D. dissertation, University of London.

OFORI, G. (1990). *The construction industry: aspects of its economics and management*. Singapore, Singapore University Press.

OFORI, G. (1994). Practice of construction industry development at the crossroads. *Habitat International*, **18**(2), 41-56.

OFROI, G. (1984). Improving the construction industry in declining developing economies. *Construction Management and Economics*, **2**(2), 127-132.

OGLESBY, C.H., PARKER, H.W. and HOWELL, G.A. (1989). *Productivity improvement in construction*. New York, NY, McGraw-Hill.

OGUNLANA, S., PROMKUNTONG, K. and JEARKJIRM, V. (1996). Construction delays in a fast-growing economy: comparing Thailand with other economies. *International Journal of Project Management*, **14**(1), 37-45.

OGUNSEMI, D.R. and JAGBORO, G.O. (2006). Time-cost model for building projects in Nigeria. *Construction Management and Economics*, **24**(3), 253-258.

OKPALA, D.C. and ANIEKWU, A.N. (1988). Causes of high costs of construction in Nigeria. *Journal of Construction engineering and Management*, **114**(2), 233-244.

OPPENHEIM, A. N. (2003). *Questionnaire design, interviewing and attitude measurement*. Continuum New York. New Edition.

PALLANT, J. (2001) *SPSS survival manual: a step-by-step guide to data analysis using SPSS for Windows (Version 10)*. Buckingham, Open University Press.

PANNEERSELVAM, R. and SENTHILKUMAR, P. (2009). *Project management*. New Delhi, PHI Learning Pvt. Ltd.

PATRICK, C. (2004). *Construction project planning and scheduling*. Upper Saddle River, NJ, Pearson/Prentice Hall.

PEETERS, W. and MADAUSS, B. (2008). A proposed strategy against cost overruns in the space sector: the 5C approach. *Space Policy*, **24**(2), 80-89.

PHILLIPS, J. (2006). *Project management professional study guide*. 2nd Edition, McGraw Hill, California.

PHILLIPS, R. and LUPTON, S. (2000). *Architect's plan of work. London*: RIBA Publications

PILCHER, R. (1985). *Project cost control in construction*. London, Collins.

PMI (2004). *A guide to the project management body of knowledge*. 3rd ed., Newton Square, PA, Project Management Institute.

PROJECT MANAGEMENT INSTITUTE. (1996). *A guide to the project management body of knowledge* – 1996 edition. Project Management Institute.

PUNCH, K.F. (2005). *Introduction to social research: quantitative and qualitative approaches*. 2nd ed., London, Sage.

RAD, P. and ANANTATMULA, V. (2005). *Project planning techniques*. Vienna, VA, Management Concepts.

RAMADAN, A. (2002). *Human resource planning and staffing practice in Libyan public sector organisations*. Unpublished Ph.D. dissertation, Liverpool John Moores University.

RAMP (2007). *Risk management, risk analysis and management for projects*. [online]. Accessed 23rd June 2011 at:
http://www.ramprisk.com/riskmanagement/identification.asp.

REPORT BUYER (2013). *Libya infrastructure report 2011* [online]. Business Monitor. Last accessed 11th Jun 2013 at:
http://www.reportbuyer.com/countries/africa/libya_infrastructure_report.html

RITZ, G. (1990). *Total engineering project management*. New York, NY, McGraw-Hill.

RITZ, G. J. (1994). *Total Construction Project Management*. McGraww-Hill, Printed in Singapore.

ROBINSON, H.W. (1939). *The economics of building*. London, P. S. King & Son.

ROBSON, C. (1994). *Real world research: a resource for social scientists and practitioner researchers*. Oxford, Blackwell..

ROBSON, C. (2002) *Real world research: a resource for social scientists and practitioner researchers*. 2nd ed., Oxford, Blackwell.

ROUNDS, J.L. and SEGNER, R.O. (2011). *Construction supervision*. Hoboken, NJ, John Wiley & Sons.

ROUSE, A and DICK, M. (1994). *The Use of NUDIST, a computerized analytical tool, to support qualitative information systems research*. Information Technology & People 7(3), 50-62.

ROYAL INSTITUTION OF BRITISH ARCHITECTS. (1992). *Standard form of agreement for the appointment of an architect: SFA/92*. London: RIBA Publications Ltd.

ROYAL INSTITUTION OF BRITISH ARCHITECTS. (1995). *Conditions of engagement for the appointment of an architect: CE/95*. London: RIBA Publications Ltd.

ROYAL INSTITUTION OF BRITISH ARCHITECTS. (1997). *Plan of work for design team operation*. London: RIBA Publications Ltd.

RUDOFSKY, B. (1964). *Architecture without architects: a short introduction to non-pedigreed architecture. Catalogue of an exhibition shown at the Musuem of Modern Art, 1964-5*. London, Academy Editions (originally published: New York, NY, Museum of Modern Art).

SAGOR, R. (2000). *Guiding School Improvement with Action Research*. Alexandria, VA, Association for Supervision and Curriculum Development.

SALEH MUBARAK. (2010). *Construction Project Scheduling and Control*, 2nd Edition, John Wiley & Sons, Inc., ISBN 978-0-470-50533-5.

SAMBASIVAN, M. and SOON, Y.W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, **25**(5), 517-526.

SAUNDERS, M., THORNHILL, A. and LEWIS, P. (2009). *Research methods for business students*. 5th ed., Harlow, Financial Times Prentice Hall.

SCHATTEMAN, D., et al. (2006). A methodology for integrated risk management and proactive scheduling of construction projects. *Journal of Construction Engineering Management*, **134**(11), 885-893.

SCHOLZ, R.W. and TIETJE, O. (2002). *Embedded case study methods: integrating quantitative and qualitative knowledge*. Thousand Oaks, CA, Sage.

SCHWALBE, K. (2010). *Information technology project management*. 6th ed., Boston, MA, Course Technology/Cengage Learning.

SEARS, S.K., SEARS, G.A. and CLOUGH, R.A. (2008). *Construction project* *management: a practical guide to field construction management*. 5th ed., Hoboken, NJ, John Wiley.

SELASSIE, S. (1978). Construction estimates and national incomes accounting in developing countries. *Habitat International*, **3**(1/2), 53-55.

SHAIBOUB, A. (1979). *Domestic architecture in Libya*. Unpublished Ph.D.disseration, University of Manchester.

SHAWESH, E. (2000). *The Changing Identity of the Built Environment in Tripoli Libya*, PhD Thesis, University of Newcastle upon Tyne UK.

SHERRER, A. (2010). *Project management road trip for the project management professional: your key to PMP certification and understanding the* PMBOK. 4th ed., Raleigh, NC, Lulu Enterprises Inc.

SIMEON, K. (2012). Companies treat Libya with caution. *Middle East and North Africa*. Available at

http://www.ft.com/cms/s/0/71721f18-c5cd-11e1-a5d5-00144feabdc0.html#axzz3aIjrCvl7

ŠMITE, D., MOE, N.B. and ÃGERFALK, P.J. (eds.) (2010). *Agility across time and space: implementing agile methods in global software projects*. Heidelberg, Springer.

SMITH, A.D. (1998). *Nationalism and modernism: a critical survey of recent theories of nations and nationalism*. London, Routledge.

SMITH. N.J. (ed.) (1999). *Managing risk in construction projects*. Oxford, Blackwell Science.

SMITH, N.J. (2003). *Construction Management Series: Appraisal, Risk and Uncertainty*. London: Thomas Telford Publishing.

SMITH, N.J., MERNA, T. and P. JOBLING. (2006). Managing Risk in Construction Projects. Oxford: Blackwell.

SMYTH, H.J. and MORRIS, P. (2007). An epistemological evaluation of research into projects and their management: methodological issues. *International Journal of Project*

Management, **25**(4), 423- 436.

SOCIETY FOR RISK ANALYSIS (2003). Glossary. [online]. Last accessed 16th January 2013 at: http://www.sra.org/glossary.

SUNNY BAKER and KIM BAKER. (2000). *The Complete Idiot's Guide to Project Management*, Alpha Books

THAGARD, P. (2007). Abductive Inference: From Philosophical Analysis to Neural Mechanisms. In A. Feeney & E. Heit (Eds.), *Inductive Reasoning: Experimental, Developmental, and Computational Approaches.* Cambridge: Cambridge University Press.

THE GENERAL SECRETARIAT OF PLANNING (1982). *The main aspects of economic and social development in Jamahiriya during 1970-1980.* Tripoli.

THE MINISTRY OF PLANNING (2005). *Economic and social orientation in Libya* (1990-2004). **472**(3), 2/13. Musrata, Industrial Information Centre (in Arabic).

THE PUBLIC COMMITTEE OF PROJECT MONITORING AND FOLLOW- UP (2004). *The Annual Reports of projects following-up*, Tripoli, Libya.

The Report: Libya 2008. (2008). London, Oxford Business Group.

THEN, D.S-S. (1996). *A study of organisational response to the management of operational property assets and facilities support services as a business resource – real estate management.* Unpublished Ph.D. dissertation, Harriet-Watt University.

THOMAS, A.V., KALIDINDI, S.N. and GANESH, L.S. (2006). Modelling and assessment of critical risks in BOT road projects. *Construction Management and Economics*, **24**(4), 407
424.

THOMPSON, N. (2000). *Theory and practice in human services*. Buckingham, Open University Press.

THOMPSON, P.A. and Perry, J.G. (1992). *Engineering construction risks: a guide to project risk analysis and assessment implications for project clients and project* *managers*. London, Thomas Telford.

THOMSETT, M. (1990). *The little black book of project management*. New York, NY, American Management Association.

TIKU, G.L. (2002). *A manual on project management*, New Delhi, Atlantic.

TOOR, SHAMAS-UR-REHMAN, and STEPHEN O. OGUNLANA. "*Beyond the _iron Triangle': Stakeholder Perception of Key Performance Indicators (KPIs) for Large-Scale Public Sector Development Projects*." International Journal of Project Management 28.3 (2010): 228-36. Print.

TOURAN, A and LOPEZ, R. (2006). *Modelling cost escalation in large infrastructure projects. Journal of Construction Engineering and Managemen*. Vol. 132(8), pp. 853-860.

TRIGUNARSYAH, B. (2004). Constructability practices among construction contractors in Indonesia. *Journal of Construction Engineering and Management*, **130**(5), 656-669.

TURNER, J. (2006). *Towards a theory of project management: The functions of project management International Journal of Project Management*,2 4 (3), pp. 187- 189.

TWATI, J.M. and GAMMACK. J.G. (2006). The impact of organisational culture innovation on the adoption of IS/IT: the case of Libya. *Journal of Enterprise Information Management*, **19**(2), 175-191.

TZORTZOPOULOS, P. (2004). *The design and implementation of product development process models in construction companies*. Unpublished Ph.D. dissertation, University of Salford, UK.

UNITED KINGDOM: MINISTRY OF DEFENCE (2002). *Ministry of Defence acquisition management system, risk management guidance* (updated September 2002). [online}. http://www.ams.mod.UK/ams/content/risk/docs/INDEX.HTM

UNITED NATIONS DEPARTMENT OF HUMANITARIAN AFFAIRS (UNDHA). (1992). *Internationally agreed glossary of basic terms related to disaster management*. [online]. Geneva, UNDHA. Last accessed 11th January 2011 at:

http://reliefweb.int/sites/reliefweb.int/files/resources/004DFD3E15B69A67C1256C4C006225C2-dha-glossary-1992.pdf.

UNITED STATES. STATE DEPARTMENT (2009). *Investment Climate Statement: Libya*. [online]. Last accessed 5th December 2010 at: http://www.state.gov/e/eeb/rls/othr/ics/2009/index.htm

VANASSE J. (1985). Culture and project management. *In:* W. Vriethoff, C. Visser. and H. Boerma, *Project Management: Clarity for the 90's: Proceedings of the 8th INTERNET World Congress held at De Doelen*. Rotterdam, The Netherlands. p.96-103.

VENDITTI, M. (2005). Kufra carrot to tempt big oil firms. *The Times*, 16 May 2005, 5.

VENKATARAMAN, R.R. and Pinto, J.K. (2008). *Cost and value management in projects*. Hoboken, NJ, John Wiley & Sons.

WALKER, A. (2002). *Project management in Construction*, Blackwell science, UK

WALKER, A. (2007). *Project management in construction*. 5th ed., Oxford, Blackwell.

WALKER D. H. T. (1995 a). *An investigation into construction time performance", Construction Management and Economics*, Vol. 13, No. 3, pp. 263-74.

WALKER D. H. T. (1995b). *The influence of client and project team relationships upon construction time performance*, Journal of Construction Procurement, Vol. 1, No. 1

WALLACE, J. and WILKINSON, B. (2004). *Doing business with Libya*. 2nd ed., London, Kogan Page.

WALLIMAN, N.S.R. (2006). *Social research methods*. London, Sage.

WALSHAM, G., (1993) *Interpreting Information Systems in Organisations*, Wiley, Chichester

WANG, S.Q., DULAIMI, M.F., and AGURIA, M.Y. (2004). Risk management framework for construction projects in developing countries. *Construction Management and Economics*, 22(3), 237-252.

WATERS, D. (2011). *Supply chain risk management: vulnerability and resilience in* *logistics*. 2nd ed., London, Kogan Page.

WEBER, R. (2004). The rhetoric of positivism versus interpretivism: a personal view. *MIS Quarterly*, 28(1), 3-12.

WELLS, J. (1984). The construction industry in the context of development: a new perspective. *Habitat International*, 8(3/4), 9-28.

WELLS, J. (1985). The construction industry: issues and strategies in developing countries: the World Bank, IBRD, Washington. *Habitat International*, 9(3/4), 335-341.

WELLS, J. (1986a). *The construction industry in developing countries: a strategy for development*. Unpublished Ph.D. dissertation, University College of Swansea.

WELLS, J. (1986b). *The construction industry in developing countries: alternative strategies for development*. London, Croom Helm.

What is the historical background of the Libyan Cement Company.(2004). [online]. World Report International Ltd. Last accessed 17th November 2011 at: http://www.worldreport-ind.com/libya/.

WINCH, G. (2010). *Managing construction projects*. 2nd ed., Oxford, Wiley-Blackwell.

WITTWER, J.W. (2004). *A practical guide to Monte Carlo Simulation Basics*. [Online]. Last accessed 26th May 2011 at: http://www.vertex42.com/ExcelArticles/mc/MonteCarloSimulation.html.

WORLD BANK. (1984). *The construction industry: issues and strategies in developing countries*.Washington, D.C., World Bank.

WULKE, R and COOL, J. (2009). *The road to best practices – using lessons learned in cost management*. [Online]. Kildrummy Technologies White Paper. Last accessed 13th January 2011 at:
http://www.kildrummy.com/white_papers/Lessons%20Learned%20wpaper%20UK.pdf.

WYSOCKI, R.K (2009). *Effective project management: traditional, agile, extreme*. 5th ed., Indianapolis, IN, Wiley.

YAKUBU, O. (2010). *Cost and time control practice of construction projects in the UK: the pursuit of effective management control*. Unpublished Ph.D. dissertation, University of the West of England, Bristol.

YAXIN and WILLIAMS, MAR-ANNE, EDS. (2010). Knowledge Science, Engineering and Management, 4th International Conference, KSEM 2010. 1 pp. Springer.

YIN, R.K. (2003). *Case study research: design and methods.* 3rd ed., Thousand Oaks, CA, Sage.

YIN, R.K. (2004). *The case study anthology.* Thousand Oaks, CA, Sage.

YOGESWARAN, K., KUMARASWAMY, M. and MILLER, D. (1998). Claims for extensions of time in civil engineering projects. *Construction Management and Economics*, **16**(3), 283-293.

YOUNG, T. (2006). *Successful project management.* 2nd ed., London, Kogan Page.

YOUNG, T. (2007). *The handbook of project management: a practical guide to effective policies and processes.* London, Kogan Page.

YUSON, Albert S. (2001). *The Philippine construction industry in the 21st century: Is there a globalization of the local construction industry? Report for the ILO (Sectoral Activities Department) and for the IFBWW.* Geneva, ILO.

ZACHARAKIS. A.L., Meyer, G.D. and DeCastro, J. (1999). Differing perceptions of new venture failure: a matched exploratory study of venture capitalists and entrepreneurs. *Journal of Small Business Management*, **37**(3), 1-14

ZANELDIN, E.K. (2006). Construction claims in United Arab Emirates: types, causes, and frequency. *International Journal of Project Management*, **24**(5), 453-459.

ZIELINSKI, D. (2005). *'SOFT SKILLS, HARD TRUTH', TRAINING*, VOL. 42, NO. 7, P. 18.

ZULIANI, L. (2011). *Libya industry sectors.* [online]. Economy Watch. Last accessed 11th May 2012 at: http://www.economywatch.com/world_economy/libya/industry-sector industries.html.

ZWIKAEL, O. and SMYRK, J. (2011). *Project management for the creation of organisational value*. London, Springer.

Bibliography

ABDUL KADIR M.R., LEE W.P., JAAFAR M.S., SAPUAN S.M. A. and Ali A.A.A. (2005). Factors affecting construction labour productivity for Malaysian residential projects. *Structural Survey*, **23**(1), 42-54.

ABDUL-KADIR, M. and PRICE, A. (1995). Conceptual phase of construction projects. *International Journal of Project Management*, **13**(6), 387-393.

ACHARYA, N.K., LEE, Y.D. AND KIM, J.K. (2006). Conflicting factors in Korean construction industry. *Korean Journal of Construction Engineering and Management* (KICEM), 7(2), 171-180.

AFRICAN ECONOMIC OUTLOOK (2008). Libya. [Online]. Last accessed: http://www.africacommitments.org/dataoecd/12/52/40578167.pdf . [Accessed 11th January 2012].

AGAPIOU, A. (1998). A review of recent development in construction operative training. Construction Management and Economics, 16, 511-520.

AGAPIOU, A., PRICE, A.D.F. and McCAFFER, R. (1995). Planning future construction skill requirements: understanding labour resource issues. Construction Management and Economics, 13(2), 149-161.

AKINTOLA, S. A. and MALCOLM, J. M. (1997). Risk analysis and management in construction. *International Journal of Project Management*, **15**(1), 37-44.

AL-GAHTANI, K.S. and MOHAN, S.B. (2007). Total float management for delay analysis. *Cost Engineering*, **49**(2), 32-37.

AL-OTAIBI, S.M. (2007). *Evaluation of cost and time overrun risk factors in Kuwait's construction projects*. Unpublished MBA. dissertation, Maastricht School of Management, The Netherlands.

AL-SALEH. F. (1980). *A case study and evaluation of a technological delivery system: construction management in Saudi Arabia*. Unpublished Ph.D. dissertation, University of Washington.

ANTHONY, H. (2007). *Libya*. 2nd ed., London, Lonely Planet.

ASHWORTH, A. (1994). *Cost studies of buildings*. Harlow, Longman.

ASSAAD, R. (1993). Formal and informal institutions in the labor market, with applications to the construction sector in Egypt. *World Development*, **21**(6), 925-939.

BACCARINI, D. and ARCHER, R. (2001). The risk ranking of projects: a methodology. *International Journal of Project Management*, **19**(3), 139-145.

BANSAL, D. (2010). *Employment opportunities in Libya, an upcoming career destination*. EzineArticles.com [online]. Accessed 17th March 2011 at: http://ezinearticles.com/?Employment-Opportunities-in-Libya,-an-Upcoming-Career-Destination&id=4034145.

BARRIE, D. and PAULSON Jr., B.C. (1992). *Professional construction management*. New York, NY, McGraw-Hill.

BARTON, S. L. (1988) Diversification strategy and systematic risk: another look. *Academy of Management Journal*, **31**(1), 166-175.

BELASSI, W. and TUKEL, O.L. (1996). A new framework for determining critical success/failure factors in projects. *International Journal of Project Management*, **14**(3), 141-151.

BENNETT, F. (2003). *The management of construction: a project life cycle approach*. Oxford, Butterworth-Heineman.

BENT, J. and HUMPHREYS, K. (1996). *Effective project management through applied cost and schedule control*. New York, NY, Marcel Dekker.

BERG, B.L. (2004). *Qualitative research methods for the social sciences*. 5th ed., Boston, MA, Pearson.

BI, M.Y. and WILLIAMS, M-A. (2010). *KSEM '10: Proceedings of the 4th International Conference on Knowledge Science, Engineering and Management held in Belfast, Northern Ireland*. Berlin, Springer-Verlag.

BISHOP, D. (1975). Productivity in the construction industry. *In*: Turin, D.A. (ed.)

Aspects of the economics of construction. London, Godwin.

BRYAN. Tony (2010). *Construction technology: analysis choice*. 2nd ed., Oxford, Wiley-Blackwell.

CHAPMAN, C. B. and WARD, S. (1997). *Project risk management: processes, techniques and insights*. Chichester, John Wiley.

CHAPMAN, C.B. and COOPER, D.F. (1983). Risk analysis: testing some prejudices. *European. Journal of Operational Research*, **14**(3), 238-247.

CHAROENNGAM, C. and YEH, C. Y. (1998). Contractual risk and liability sharing in hydropower construction. *International Journal of Project Management*, **17**(1), 29-37.

CHARTERED INSTITUDE OF BUILDING (2002). *Code of practice for project management for construcyion and development*. 3rd ed., Oxford, Blackwell.

CHARTERERD INSTITUTE OF BUILDING (1996). *Code of practice for project management for construction and development*. 2nd ed., Harlow, Longman.

CONLIN, J. and RETIK, A. (1997). The applicability of project management software and advanced IT techniques in construction delays mitigation. *International Journal of Project Management*, **15**(2), 107-120.

COOK, A.E. (1991). *Construction tendering: theory and practice*. London, Batsford.

CORRIE, R. (1991). *Project evaluation*. London, Thomas Telford.

CROSTHWAITE, D.(2000). The global construction market: a cross sectional analysis. Construction Management and Economics, 18(5), 619-627.

CROSTHWAITE, D and CONNAUGHTON, J.(2008). World construction 2007- 2008. London, Davis Langdon Management Consulting.

CUSHMAN, R.F, CARTER, J.D and GORMAN, P.J. (2001). Construction disputes: representing the contractor. 3rd ed., New York, NY, Aspen.

DAY, D.A. and BENJAMIN, N.B.H. (1991). *Construction equipment guide*. New York, NY, Wiley.

DENSCOMBE, M. (2007). *The good research guide: for small-scale social research projects*. Maidenhead, Open University Press.

DEVAPRIYA, K.A.K. and GANESAN, S. (2002). Technology transfer through subcontracting in developing countries. *Building Research and Information*, **30**(3), 171-182.

Developing Countries: Challenges facing the construction industry in developing countries, held in Gabarone, Botswana.

DEY, P.K. (2002). Project risk management: a combined analytic hierarchy process and decision tree approach. *Cost Engineering*, **44**(3), 13-27.

DINSMORE, P. C. and CABNIS, J. (2011). *The AMA handbook of project management*. 3rd ed., New York, NY, AMACOM.

DJEBARNI, R. (1993). *Leadership patterns in the construction industry in Algeria*. Unpublished Ph.D. dissertation, University of Reading.

DREWER, S. (1980). Construction and development: a new perspective. Habitat International, 5(3/4), 395-428.

DREWER, S. (2001). A perspective of the international construction system. Habitat International. 25(1), 69-79.

DUNCAN, R.B. (1972). Characteristics of organisational environments and perceived environmental uncertainty. Administrative Science Quarterly, 313-327.

Economic Impact 2012: Libya. (2012). [online]. World Travel and Tourism Council. Last accessed 21th January 2012at: http://www.wttc.org/bin/pdf/temp/libya.html.

EDMONDS, G. and MILES, D. (1984). Foundations for change: aspects of the construction industry in developing countries. London, Intermediate Technology Publications.

EDWARDS, L. (1995). Practical risk management in the construction industry. London, Thomas Telford.

ELLIS, R.D. and THOMAS, H.R. (2002). *The root causes of delays in highway construction. Paper submitted for presentation at the 82nd annual meeting of the*

Transportation Research Board, Washington DC. [online]. Last accessed 11th September 2011 at http://www.ltrc.lsu.edu/TRB_82/TRB2003-000646.pdf.

ESKESEN, S.D., TENGBORG, P., KAMPMANN, J., and VEICHERTS, H. T. (2004). Guidelines for tunnelling risk management. International Tunnelling Association, Working Group No. 2. *Tunnelling and Underground Space Technology*, **19**(3), 217–237.

FERGUSON, H. and CLAYTON, L. (1988). *Quality in the constructed project: a guideline for owners, designers, and constructors*. New York, NY, ASCE.

FRANKEL, E.G. (1990). *Project management in engineering services and development*. London, Butterworths.

GAHLOT, P.S. and DHIR, B.M. (2007). *Construction planning and management*. New Delhi, New Age International.

GANESAN, S. (1978). The building industry in Sri Lanka and problems of common interest to developing countries. *Habitat International*, **3**(1/2), 57-63.

GANESAN, S. (2000). *Employment, technology and construction development: with case studies in Asia and China*. Aldershot, Ashgate.

GARDINER, P.D. (2005). *Project management a strategic planning approach*. Basingstoke, Palgrave Macmillan.

GILLARD, S. (2009). Soft skills and technical expertise of effective project managers. [online]. *Issues in Informing Science and Information Technology*, **6**, 723-729. Last accessed 9th December 2011 at: http://iisit.org/Vol6/IISITv6p723-729Gillard599.pdf.

GOROG, M. (2009). A comprehensive model for planning and controlling contractor cash-flow. *International Journal of Project Management*, **27**(5), 481-492.

GORYNSKI, J. (1978). The role of construction in global socio-economic development. *Habitat International*, **3**(1/2), 71-76.

GOULD, F.E. (2002). *Managing the construction process: estimating, scheduling, and project control*. Upper Saddle River, NJ, Prentice Hall.

GRAY, C.F. (1981). *Essentials of project management*. Princeton, NJ, PBI.

GRAY, C.F. and Larson, E.W. (2008). *Project management: the managerial process*. 4th ed., Boston, MA, McGraw-Hill/Irwin.

GREAT BRITAIN. NATIONAL AUDIT OFFICE (2001). *Modernising construction: report by the Comptroller and Auditor General*. London, The Stationery Office.

GREAT BRITAIN. OFFICE FOR NATIONAL STATISTICS (2007). *United Kingdom national accounts: the blue book*. Basingstoke, Palgrave Macmillan.

GREAT BRITAIN. OFFICE OF GOVERNMENT COMMERCE (2007). *Management of risk: guidance for practitioners*. 2nd ed., London, The Stationery Office.

GREAT BRITAIN. TREASURY (2004). *The orange book: management of risk – principles and concepts*. London, The Stationery Office.

GRIFFITH, A. (1992). Small building works management. Basingstoke, Macmillan.

GRIFFITH, A. and WATSON, P. (2004). Construction management: principles and practice. Basingstoke, Palgrave Macmillan.

GROÁK, S. (1992). *The idea of building: thought and action in the design and production of buildings*. London, E and FN Spon.

GRUNEBERG, S.L. and IVE, J.G. (2000). *The economics of the modern construction centre*. London, Macmillan Press.

HAKIM, B.S. (1988). *Arabic-Islamic cities: building and planning principles*. London, Kegan Paul International.

HALPIN, D.W. and RIGGS, L.S. (1992). *Planning and analysis of construction operations*. New York, NY, Wiley.

HAMPSON, K.D., PETERS, R.J. and WALKER, D.H.T. (2001). Negotiation and conflict in innovative procurement environments: the National Museum of Australia. *In: Proceedings of the CIB World Building Congress held in Wellington.*

HAMPTON, J.J. (1993). *Essentials of risk management and insurance*. New York, NY, ANACOM.

HAN, S.S. and OFORI, G. (2001). Construction industry in China's regional economy,1990-1998. *Construction Management and Economics*, **19**(2), 189-205.

HARRISON, S.W. and SINHA, B.P. (1995). A study of alternative building materials and technologies for housing in Bangalore, India. Construction and Building Materials, 9(4), 211-217.

HARVEY, R.C. and ASHWORTH, A. (1993). The construction industry of Great Britain. Oxford, Newnes.

HAUGAN, G.T. (2002). Project planning and scheduling. Vienna, VA, Management Concepts.

HAYES, R. W., PERRY, J. G., THOMPSON, P. A. and WILLMER, G. (1986) Risk management in engineering construction, London: Thomas Telford Ltd

HELDMAN, K. (2003). Project management jumpstart. San Francisco, CA, Sybex.

HILLEBRANDT, P. M., CANNON, J. and LANSLEY, P. (1995). The construction company in and out of recession. Basingstoke, Macmillan.

HILLEBRANDT, P.M. (1984). Analysis of the British construction industry. London, Macmillan.

HILLEBRANDT, P.M. (1985). Economic theory and the construction industry. 2nd ed., London, Macmillan.

HILLEBRANDT, P.M. (1999). Contractor development. In: proceedings of the Second Meeting of the CIB Task Group 29 (TG29): construction in developing countries, Kampala, Uganda.

HILLEBRANDT, P.M. (2000). Econonmic theory and the construction industry. 3rd ed., Basingstoke, Macmillan.

HILLEBRANDT, P.M. and CANNON, J. (1990). The modern construction firm. London, Macmillan.

HILLEBRANDT, P.M. and CANNON, J. (eds.) (1989). The management of construction firms: aspects of theory. London, Macmillan.

HILLSON, D. (1999). Developing effective risk responses. In: Proceedings of the 30th Annual Project Management Institute Seminars and Symposium held in Sylva, NC. Project Management Institute.

IBRAHIM, A.O. (1987). The labour force in Libya: problems and prospects. Unpublished Ph.D.dissertation, University of Durham.

ICE (1998). Risk analysis and management for projects. London, Thomas Telford.

Imbert, I. D. C. (1991). The management of construction projects with particular reference to human resources. London, Macmillan.

INSTITUTE OF MARKETING, CONSTRUCTION INDUSTRY MARKETING GROUP (1974). Marketing in the construction industry. London, Heinemann.

JANNADI, 0.A. and BU-KHAMSIN.M.S. (2002). Safety factors considered by industrial contractors in Saudi Arabia. *Building and Environment*, **37**(5), 539-547.

JUMAILI, H. (2008). *Transparency and credibility of statistical data in the fields of development.* Academy of Graduate Studies, Tripoli Libya.

KHEDR, M.K. (2006). Project risk management using Monte Carlo simulation. AACE International Transactions.

KIRMANI, S. (1988). *The construction industry in development: issues and options*. Infrastructure and Urban Development Department discussion paper no. INU 10. [online]. Washington, D.C., World Bank. Last accessed 15th January 2013 at: http://documents.worldbank.org/curated/en/1988/02/1558381/construction-industry-development-issues-options.

KLENKE, K. (2008). *Qualitative research in the study of leadership*. Bingley, Emerald.

KNAPP, B.W. (2010). *A project manager's guide to passing the project management (PMP) exam* Phoenix, AZ, Project Management Excellence Center.

LABORDE, M. and SANVIDO, V. (1994). Introducing new process technologies into construction companies. Journal of Construction Engineering and Management, 120(3), 488-508.

LATHAM, Sir M. (1994). Constructing the team. Joint review of procurement and contractual arrangements in the United Kingdom construction industry: final report. London, HMSO.

LEVY, S.M. (2010). *Construction process planning and management: an owner's guide to successful projects*. Oxford, Butterworth-Heinemann.

LIM, E.C. and PRICE, A.D.F. (1995). Construction productivity measurements for residential buildings in Singapore. *In: Innovation and dynamism for future prosperity: Proceedings of the First International Conference on Construction Project Management*. Singapore, pp. 605-612

LINK, J.A. (2008). *The I.T. little black book : pocket advisor*. Leicester, Troubador.

LOFTUS, J. (ed.) (1999). *Project management of multiple projects and contracts*. London, Thomas Telford.

MAGINN, P.J. (2004). *Urban regeneration, community power and the (in) significance of "race"*. Aldershot, Ashgate.

MALONEY, W.F. (1997). Strategic planning for human resource management in construction. *Journal of Management in Engineering*, **13**(3), 49-56.

MARCH, J.G. and SHAPIRA, Z. (1987). Managerial perspectives on risk and risk taking. *Management Science*, **33**(11), 1404-1418.

MARIA-SANCHEZ, P. (2005). *Neuronal risk assessment system for construction projects*. Renningen, Expert-Verlag.

MARTIN, P. and BATESON, P. (1986). Measuring behaviour: an introductory guide. Cambridge, NY, Cambridge University Press.

MARTIN. P.K. and TATE, K. (2001). Getting started in project management. New York, NY, Wiley.

MEIKLE, J. (2001). A review of recent trends in house construction and land prices in Great.Britain. Construction Management and Economics, 19(3), 352-260.

MELHADO, S.B. (1998). Designing for lean construction In: Ballard, G. et al. (eds), Proceedings of the sixth annual conference of the International Group for Lean Construction (IGLC-6), Guaruja, Brazil.

MILLINGTON, K. (2001). Country Report / Libya, New York, Travel and Tourism

MINTZBERG, H. (1976). The manager's job: folklore and fact. *In:* Levinson, H. (ed.) *Designing and managing your career*, Boston, MA, Harvard Business School Press.

MOAVENENZADEH, F. (1987). The construction industry. *In*: L. Rodwin (ed.) *Shelter, settlement and development*, Boston, Allen and Unwin, pp.73-109.

MYERS, D. (2008). *Construction economics: a new approach.*2nd ed., London, Taylor and Francis.

NAM, C. and TATUM, C. (1988). Major characteristics of constructed products and resulting limitations of construction technology. *Construction Management and Economics*, **6**(2), 133-147.

NEGA, F. (2008). *Causes and effects of cost overruns on public building construction projects in Ethiopia*. Unpublished Ph.D disseration, Addins Ababa University.

NEWCOMBE, R., LANGFORD, D and FELLOWS, R. (1990). *Construction Management, vol 1: Organisation systems*. London, Mitchell in association with the Chartered Institute of Building.

NG, S.T., MAK, M.M.Y., SKITMORE, R.M., LAM, K.C. & VARNAM, M. (2001). The predictive ability of Bromilow's time-cost model, *Construction Management and Economics*, Vol. 19, No. 2, pp. 165-173.

NGUYEN, V.U. (1985). Tender Evaluation by Fuzzy Sets. *Journal of Construction Engineering and Management*, **111**(3), pp. 231-243.

NOGOWI, A. (1998). Is construction procurement a key to sustainable development? *Building Research and Information*, **26**(6), 340-350.

OPPENHEIM, A.N. (1992). *Questionnaire design, interviewing and attitude measurement*. 2nd ed., London, Continuum.

Oxford English Dictionary (1961). Oxford: Oxford University Press.

PELHAM, N. (2011). *The Battle for Libya*. [Online]. The New York Review of Books. Last accessed 11th April 2012 at:

http://www.nybooks.com/articles/archives/2011/apr/07/battle-libya/

PEQUEGNAT, W., STOVER, E. and BOYCE, C.A. (eds.) (2010). *How to write a successful research grant application.* 2nd ed., New York, NY, Springer.

REPUBLIC OF IRELAND. DEPARTMENT OF THE ENVIRONMENT AND LOCAL GOVERNMENT (2000). *Risk assessment – Public Private Partnership Guidance Note 11.* [online]. Accessed 26th May 2011 at: http://www.privatefinance-i.com/ media/pdf/guidancenote11.pdf.

ROTHKOPF, M.H. (1975). *On measuring risk (working paper).* Palo Alto, CA, Xerox Palo Alto Research Center.

RUBIN, R.A., FAIRWEATHER, V. and GUY, S.D. (1999). *Construction claims: prevention and resolution.* 3rd ed., New York, NY, John Wiley.

RUTTER, P. and MARTIN, A. (1990). *Management of design offices.* London, Telford.

SANGHERA, P. (2007). PgMP: *Program management professional exam: study guide.* San Francisco, CA, John Wiley.

SHI, J.J., CHEUNG, S.O. and ARDITI, D. (2001). Construction delay computation method. *Journal of Construction Engineering and Management*, **127**(1), 60-65.

SIMON, P., HILLSON, D. and NEWLAND, K. (eds.) (1997). *PRAM: Project Risk Analysis and Management guide.* Norwich, Association for Project Management.

SIMON, P., HILLSON, D. and NEWLAND, K. (eds.) (1997). *Project risk analysis and management guide.* Norwich, APM Group Ltd.

SINGH, A. (2001). *Creative systems in structural and construction engineering: proceedings of the First International Structural Engineering and Construction Conference held in Honolulu.* Rotterdam, A.A. Balkema.

SMALLMAN, C. and ELKINGTON, P. (2002). Managing project risks: a case study from the utilities sector. *International Journal of Project Management*, **20**(1), 49-57.

SOANES, C. and STEVENSON, A. (2004). The concise Oxford English dictionary. New ed., Oxford, Oxford University Press.

SOANES, C. and STEVENSON, A. (2004). The concise Oxford English dictionary. [online]. Last accessed 11th January 2011 at: http://www.oxfordreference.com.

STOLZER, A., HALFORD, C. and GOGLIA, J. (2008). Safety management systems in aviation. Aldershot, Ashgate.

STRASSMANN, P. (1970). The construction sector in economic development. Scottish Journal of Political Economy, 17(3), 391-410.

STRAUSS, A. and CORBIN, J. (2008). Basics of qualitative research: techniques and procedures for developing grounded theory. 3rd ed., Los Angeles, CA, Sage.

SONUGA, F., ALIBOH, 0. and OLOKE, D. (2002). Particular barriers and issues associated with projects in a developing and emerging economy: case study of some abandoned water and irrigation projects in Nigeria. International Journal of Project Management, 20(8), 611-616.

STAHL, B. (2005). A critical view of the ethical nature of interpretive research: Paul Ricœur and the other. In: Proceedings of the 13th European Conference on Information Systems (Information Systems in a Rapidly Changing Economy). Regensburg.

STRUEBING, L. and KLAUS, L.A. (1999). Smaller businesses thinking big. Quality Progress, February, 23-27.

STUCKENBRUCK, L. (ed.) (1981). The implementation of project management: the professional's handbook. Reading, MA, Addison-Wesley.

SUGDEN, J. (1975). The place of construction in the economy. In: D.A. Turin (ed.) Aspects of the economics of construction. London, Godwin.

TATUM, C. B. (1988). Organizing to increase innovation in construction firms. Journal of Construction Engineering Management, 115(4), 602-617.

TAYLOR, G.D. (2001). Materials in construction: an introduction. 3rd ed., Harlow, Longman.

TAYLOR, J. (2007). Project scheduling and cost control: planning, monitoring and controlling the baseline. Fort Lauderdale, FL, J. Ross.

TAYLOR, W.J. and WATLING, T.F. (1979). Successful project management. 2nd ed., London, Business Books.

TIWARI, P. (2001). Housing and development objectives in India. *Habitat International*, **25**(2), 229-253.

TUFTE E.R. (1989). *Visual Design of the User Interface*. Armonk, NY, IBM.

TURIN, D.A. (1978). Construction and development. *Habitat International*, **3**(1/2), 33-45.

TURIN, D.A. (2003) Building as a process. Building Research and Information, 31(2), 180-187.

VIDALIS, M.S. and NAJAFI, T.F. (2002). Cost and time overruns in highway construction. *In: 4th Transportation Specialty Conference of the Canadian Society for Civil Engineering held in Montreal, Canada*. p.5-8.

WARNER, Sir F. (1992). *Risk: analysis, perception and management*. London, The Royal Society.

Appendix (1)

Research Questionnaire (I) in English

Sheffield Hallam University

Faculty of Development and Society

THE RESEARCH QUESTIONNAIRE SURVEY (I)

A Project Control Framework for Libyan Construction Industry

Research by: Huwaida Tahir

Supervised by: Prof. P. Stephenson

Sheffield Hallam University

Faculty of Development and Society

Appendix I: Covering letter sent with the questionnaire (I)

Dear Sir/ Madam:

Subject: Survey

I am currently conducting research at PhD level on project control in the Libyan Construction Industry (LCI) at Sheffield Hallam University in the UK. The overall aim of this study is to examine the risk factors that significantly influence project performance in order to develop a framework by which to proactively minimize time and cost overruns in Libyan construction projects. The main objective of this questionnaire is to gather and analyse your views on the factors that contribute to time and cost overruns in projects in Libya. An important element of the research is to conduct a questionnaire I in order to gather vital information regarding project (cost and time) control of Libyan construction companies, which will then be taken into consideration during the development of the initial project control framework, which is currently under development. This survey will help recognise the best framework for control time and cost in Libyan construction projects

I respectfully request you to complete the attached questionnaire I on or before 22/ 4/ 2012, as the data collected from this phase of the study will be essential to the progress of the research. Please note that your complete, serious and honest responses in this regard would be greatly appreciated and will be used purely for academic purposes. Your name and all the information you supply about your company will remain confidential as far as the results are concerned. I would to thank you in advance for your assistance and cooperation.

Thank you for participating in our survey.

Researcher: Huwaida Tahir hatahir@my.shu.ac.uk Tel +447939440168
Faculty of Development and Society
School of Built Environment, (Unit 9 Science Park)
Sheffield Hallam University
Sheffield S11 WB UK.

Part (I): General Information relating to respondents

For the following questions please tick (√) the appropriate response(s).

1.1 What is the type of the company or organisation you are working with?

□Contractor

□Client

□Consultant

1.2 What is the nature of your company's business?

□Quantity surveying

□Engineering/Architecture/Planning

□Project management

□Construction site management

□Risk management

□Other roles (please specify)...............................

1.3 What sector type you are currently working with?

□Libyan government-linked

□Libyan private

□Foreign-owned

□Other (please specify).......................................

1.4 How long have you personally been involved in construction projects?

□ <5 years

□ 5- 10 years

□ 11- 20 years

□ >20 years

1.5 What is your specialization in building construction? (You can select more than one)

□Commercial building

□Industrial building

□Housing

□Civil building

□Other (please give details)...............................

1.6 What is the value of your project?

□ <£5 m

□ £5 - 10 m

□ £11 - 15 m

□ £16 -20 m

□ >£20 m

□ If > £100 m, please give details.................

1. 7 How many employees are employed in your organisation?

□ Less than 10

□ 10- 49

□ 50- 250

□More than 250 (please give details)

1.8 State how important time and cost performance is in Libyan construction projects?

□ Not important

□ Not very important

□ Important

□ Very important

Part II: Project time and cost control

2.1 How often does your organisation encounter problems of time and cost overruns? Please tick (√) the appropriate box

□ Always

□ Often

□ Sometimes

□ Rarely

2.2 What is/are the method(s) used by your organisation to determine the time and cost of activities in construction projects? Please tick the appropriate box (es)

□By assessment based on experience

□By calculations based on quantities and production rates of labour and plant

□We do not estimate durations and costs of activities

□By other technique (please specify)...

Part III: Factors influencing time and costs overruns of Libyan construction projects

Based on your overall experience in construction projects in Libya, please rank the extent to which the following causes are responsible for the cost and time overruns of construction projects on a scale of 1 to 5 (1 = low, 2 = somewhat low, 3 = medium, 4 = somewhat high, 5 = high)

Based on your observation, please also give your opinion as to the party responsible for each factor by ticking as appropriate.

NO.	Factors causing cost and time overruns	Influence on cost and time overruns										Please tick (√) the party you feel is most responsible for each factor			
		Time					Cost					Contractor	Consultant	Owner	External party or parties
		1	2	3	4	5	1	2	3	4	5				
1	**Construction**														
1.1	Lack of experience and performance of project management team														
1.2	Poor management and supervision on site														
1.3	Mistakes during construction														
1.4	Lack of timely decisions and corrective actions														
1.5	Lack of detailed information														
1.6	Inappropriate construction methods														
1.7	Poor communications and misunderstandings														
1.8	Slowness in issuing instructions														
1.9	Lack of regular sessions to address work problems														
1.10	Lack of technically skilled staff														
1.11	High quality of work required														
1.12	Poor judgment in estimating time and resources														
1.13	Lack of a strong organizational culture														
1.14	Shortages of craftsmen														

1.15	Lack of new technology or new construction methods														
1.16	Shortage of site workers														
1.17	Rework of bad quality performance														
1.18	Inaccurate estimates														
1.19	**Indecision by the supervising team in dealing with the contractor's** queries														
1.20	Deficiencies in coordination between parties (client, consultant and contractor)														
1.21	Improvements to standard drawings during construction stage														
1.22	Wrong choice of site														
1.23	Errors and omissions in bills of quantities														
1.24	Delays in subcontractors' work														
1.25	Unrealistic contract durations imposed by client														
1.26	Lack of commitment to consultants' instructions														
1.27	Poor level of subcontractor skills and performance														
1.28	low labour productivity														
1.29	Absence of consultant's site staff														
1.30	Lack of job security for the consultancy team														
1.31	Consultants' centralized decision-making process														
1.32	Requirements for external work														
1.33	Inadequate construction planning														
2	**Weather and natural calamities**														
2.1	Unpredictable weather conditions														
2.2	Level of uncertainty of soil conditions														
2.3	Storms and heavy dusty winds														
3	**Equipment**														
3.1	Equipment allocation problems														
3.2	Shortages of tools and equipment on site														
3.3	Lack of equipment maintenance														
4	**Materials**														

4.1	Market shortages of construction materials														
4.2	Price fluctuations of materials														
4.3	Damage to materials in storage														
4.4	Delay of delivery of materials to site														
4.5	Low quality of materials														
4.6	Difficulties in obtaining construction materials at official prices														
5	**Contractual procedures**														
5.1	Inappropriate types of contract used														
5.2	Unethical contractor behaviour in order to maximize profit														
5.3	Inadequate contractor experience														
5.4	Poor contract management														
6	**Design change**														
6.1	Poor experience of design team														
6.2	Lack of co-ordination between design team and contractor														
6.3	Complexity of design														
7	**Funding**														
7.1	Financial problems														
7.2	Delay payments to contractors for completed work														
7.3	Slow payment for completed work														
7.4	Lack of cost reports during construction stage														
8	**Legal changes**														
8.1	Workers' different political affiliations														
8.2	Lack of communication by donors to compensate for the uncertain political situation														
8.3	Delays in government decision-making														
8.4	Political instability														
8.5	Strikes and border closures														
8.6	Changing government policies and regulations														
8.7	Difficulties in obtaining construction licences														

Appendix (2)

RESEARCH QUALITATIVE INTERVIEW GUIDE

- Could you please describe the project control process used by Libyan organisations?

- In terms of cost and time control, do Libyan companies adopt these processes that you just mentioned to control their projects?

- Please kindly describe the overall procedures and processes (including tools and techniques) that Libyan organisations follow to guarantee that their project do not overrun cost and time. Please give me examples where possible from your practice

- With reference to your experience, please give explanation of any barrier you practice during the process of cost and time control?

- What do you think about the skills and abilities available within Libya organisations to address risk?

- Who is responsible for the risk management process in the construction companies in Libya?

  Please give me detailed explanation of the processes and practices of time control that Libyan organisation has been utilised? Please give examples from your practice

- I would be grateful if you provide me detailed explanation of the processes and practices of cost control that Libyan organisation has been utilised? Please give examples from your practice

- Do well do you feel that the process of control of cost and time overruns of Libya organisation is evolving?

- So, Please can you tell me as many as you can, in your opinion what processes and activities that can be develop to improve in order to the performance of the time control in Libyan construction organisations

- Please kindly can you tell me as many as you can, in your opinion what process of cost control in Libyan organisations is able to do more? What improvements you could suggest in the cost control process.

Appendix (3)

QUALITATIVE ANALYSIS THEMATIC CHART

concepts and understan ding of project control	the variables that need to control	• when project will be at the risk	the policy of project control	• the affect of the civil war	how the control of project	difference concepts of project control	Factors that need to be controlled	Cost and time control	Disparities in the applicatio n of project control	separate or integrated process	the State role to support the projects control								
The extent of the applicatio n of control in practice	the type of client	general attitude of organisati ons	The satisfactio n of the profession als	initiate the process of control	Cooperati on between the project team	the effect of the size of project													
processes used to control time and cost in practice	Procedure s in the planning stage	Procedure s in the constructi on stage	tools and technique s that follow	Serious attempts by the State 5,8	the preparatio n of reports 1,3,5,8,9	project manager	resources available 1,2,3	Overcome the negligence 2	allocate budget 1,2,3,4,7,9	good skills 3,7,9	regular meetings 2	proper plan 7	the client requireme nts 8	good communic ation 5,6,8	estimate the materials 9	Process of mentoring	Software used 1,8	Bills of quantity 5,9	Responsib ilities of staffing 6
Barriers encounter ed the process of control.	Lack of specialist staff 1	no uniform set of procedure s or actions	lack of meaningf ul document ation 1	The difficulty putting risk plans into action 1,3,4,7,9	Shortage project control tools 1,2,3,4,7,8 ,9	weather change factor 1,2,3,4,9	Shortage and cost of materials 1,2,3,4,5,6 ,8,9	capacities and capabilitie 3	Lack of level of detail 4,7	unexpecte d circumsta nces 3,4,8	centralisat ion in regulating	Corruptio n 5,8	complex procedure s	Bureaucra cy 3,7,8	improper planning	lack of commitme nt 4,7,8,9	lack of a proper analysis system 3,7	Unrealistic estimatio ns 7	Looking at profits 5,9
skills and abilities to address risk 1,2,3,4,6,7 ,8,9	lack any in-house expertise 7	Need systematic ally training systems 1,5,8	Need update the workers knowledg e 2	need skilled labour 2	the responsibi lity are overlaps 1	project manager responsibi lity	lack of specialists 1	quantity surveyor and planner 2,3,7,8,9	(contracto rs, owners and consultant s	absence of risk managers 1,3,9	share the responsibi lities 6								
the developm ent of process of projects control	Project plan and resources 1,2,6	Schedule work in series using 2	Kick-off meeting 5,6	Report on the progress	Recovery plan 6	Track the project performan ce 1,2,3,5,6,7 ,8,9	Using work breakdow n structure 1	Primavera planning software 2,8	Bills of quantity 5,9	Earned value analysis 3	Using S-curve 1,4,5,9	The grant chart 2	Milestone schedule 6,9	Adopt mitigation measures 9	Identify recourses needed	Conduct internal meetings 2,4	Effect type of contract 1,2,3,4,5,6 ,7,8,9	Access to informatio n 7	Project cost-value reconciliat ion 1,2,3,6,8
processes affect the performa nce of time and cost control	Need to update the plan every year 1, 9	Take advantage s of resource availabilit y 1, 9	involve a risk consultant 5	resolving the problem and conflicts 7, 8	The board should notice changes 1,2,4,5,7	The coordinati on of labour forces 4,9	effective communic ation between project tem 5,6,8	recording measures and a series of reviews 1,5	a risk manageme nt departmen t 5	stop the habit of reinventin g the wheel 1,9	develop a uniform set of procedure s 1	use of computeri sed systems, software and programs 1,3	apply all necessary mitigation measures 1,3,5,8,9	timetable follow up and progress monitorin g 1,2,3,4,6,8	A daily visit to the project programm e 2,3,4,7,8	regular review meetings 2,3,4,6	Re-think the strategy that follow 2	cost report every month 6	a clause in contract to adjust the price 1,2

Appendix (4)

VALIDATION OF RISK MITIGATION MEASURES

Sheffield Hallam University

Faculty of Development and Society

Dear Sir/ Madam:

Subject: Survey

I am currently conducting research at PhD level on project control in the Libyan Construction Industry (LCI) at Sheffield Hallam University in the UK. The overall aim of this research is to develop a framework by which to proactively minimize time and cost overruns in Libyan construction projects. As part of the validation process, I would to invite you to figure the attached mitigation measures regarding to their effectiveness for the project control. This survey will help to develop a framework for control time and cost in Libyan construction projects

Please note that your complete, serious and honest responses in this regard would be greatly appreciated and will be used purely for academic purposes. Your name and all the information you supply will remain confidential as far as the results are concerned. I would to thank you in advance for your assistance and cooperation.

Thank you for participating in our survey.

Researcher: Huwaida Tahir hatahir@my.shu.ac.uk Tel +447939440168
Faculty of Development and Society
School of Built Environment, (Unit 9 Science Park)
Sheffield Hallam University
Sheffield S11 WB UK.

If you would like to receive a summary of the research findings, please provide your name, contact number and address.

Name: ....

Contact number...

Address..

The Effectiveness of a mitigation measure for a risk refers to the extent the measure will enable Libyan contractors, consultants and clients to mitigate the risk. Please figure the following response measures regarding to their effectiveness for the project control on a scale of 1 to 5. 1= Not effective at all, 2= Slightly effective, 3= Effective, 4= Very effective, 5= Exceptionally effective

A1	Mitigation Measures for Construction	Effectiveness				
A1.1	Ensure good design report for the project and examine by consultant and client before its commences	1	2	3	4	5
A1.2	Arrange preconstruction meetings for explanation procedures in the course of carrying out construction work	1	2	3	4	5
A1.3	Conduct visits to the construction site and check materials	1	2	3	4	5
A1.4	Adopt good supervision and proper quality control procedures	1	2	3	4	5
A1.5	Monitor and control construction process activities properly	1	2	3	4	5
A1.6	Determine of quantities properly during the bidding phase	1	2	3	4	5
A1.7	Develop appropriate plans, and control costs and schedules	1	2	3	4	5
A1.8	Adopt proper management systems and safety programs	1	2	3	4	5
A1.9	Adopt as much as possible local employers to save cost	1	2	3	4	5
A1.10	Provide regular updating of the construction work plans and regular reports on project progress	1	2	3	4	5
A1.11	Utilize modern programmed planning techniques	1	2	3	4	5

B1	Mitigation Measures for Material	Effectiveness				
B1.1	Conduct visits and check materials at the factory	1	2	3	4	5
B1.2	Use as much as possible local materials to save cost	1	2	3	4	5
B1.3	Attempt to obtain materials directly from suppliers	1	2	3	4	5
B1.4	keeping an inventory at optimum level to guarantee availability of materials during construction phase	1	2	3	4	5
B1.5	Prepare detailed material planning to use along with project engineering and planning	1	2	3	4	5
B1.6	Selecting vendors not on lowest cost criteria basis but for critical items	1	2	3	4	5
B1.7	Schedule construction activities along with materials delivery	1	2	3	4	5
B1.8	Provide incentives and effective training for plant operators	1	2	3	4	5

C1	Mitigation Measures for Contractual Procedures	Effectiveness				
C1.1	Arrange preconstruction meetings for explanation of contract requirement in the course of carrying out construction work	1	2	3	4	5
C1.2	Provide clauses for extra payment in contract, which happen due to change in law or new rules	1	2	3	4	5
C1.3	Include clauses on extra payments if caused by any party	1	2	3	4	5
C1.4	Seek incorporation delay clauses in contract	1	2	3	4	5
C1.5	Have clear contractual terms; define clear responsibility and authority in contract; agree on one accounting standard	1	2	3	4	5
C1.6	Provide comprehensive terms of default in contract	1	2	3	4	5
C1.7	Incorporate escalation clauses for delays and inflation rates in contract	1	2	3	4	5

C1.8	Pay careful awareness to contract interpretation	1	2	3	4	5
C1.9	Provide construction extension clauses in contract	1	2	3	4	5
C1.10	Identify compensation clauses in contract for payment	1	2	3	4	5
C1.11	Employ a good legal advisor who is familiar with the industry in drafting the contract	1	2	3	4	5

D1	**Mitigation Measures for Design Change**	**Effectiveness**				
D1.1	Undertake investigation and exploration to construction site before design phase	1	2	3	4	5
D1.2	Provide and submit all required design information on time	1	2	3	4	5
D1.3	Undertake pre-project planning to reduce errors during the design phase	1	2	3	4	5
D1.4	Organize for vetting and appraisal of design criteria by at least one independent architect or engineer	1	2	3	4	5
D1.5	Standardized designs should be updated as per necessity to minimize errors and save time	1	2	3	4	5
D1.6	Adopt design strategy during initial stages of planning	1	2	3	4	5
D1.7	Prepare the work specification taking work breakdown structure, implementation methodology and the output of risk analysis study into account	1	2	3	4	5
D1.8	Provide adequate computer software in order to improve correctness in design	1	2	3	4	5
D1.9	Determine the cost and time implication of a design change	1	2	3	4	5
D1.10	Determine the cost and time implication of any given design change	1	2	3	4	5
D.11	Notification of all the parties involving in the project of how they will be impacted and the cost and schedule implication of a design change before going ahead with the change	1	2	3	4	5

E1	**Mitigation Measures for Funds**	**Effectiveness**				
E1.1	Create a book for recording payments	1	2	3	4	5
E1.2	Supervise present financial status of organisation	1	2	3	4	5
E1.3	All parties involved in construction project should agree on one accounting standard and hire one independent accountant	1	2	3	4	5
E1.4	Contractor should secure standby cash flow in advance	1	2	3	4	5
E1.5	Review the differential taxation and find reasonable measures to reduce taxes	1	2	3	4	5
E1.6	Obtain payment and performance bonds from international and local banks	1	2	3	4	5
E1.7	Consult a financial consultant to conduct the verifying the financial report of the project	1	2	3	4	5

Appendix (5)

EVALUATION THE FRAMEWORK

Sheffield Hallam University

Faculty of Development and Society

Dear Sir/ Madam:

I am currently conducting research at PhD level on project control in the Libyan Construction Industry (LCI) at Sheffield Hallam University in the UK. The overall aim of this research is to develop a framework by which to proactively minimize time and cost overruns in Libyan construction projects. As part of the evaluation processes, I would to invite you to comment on the usefulness of the framework that you provided for the construction industry in Libya.

We have attached the copy of the framework validation questionnaire. Should you require any details or further information, do not hesitate to contact us on telephone: +447939441068

Yours sincerely,

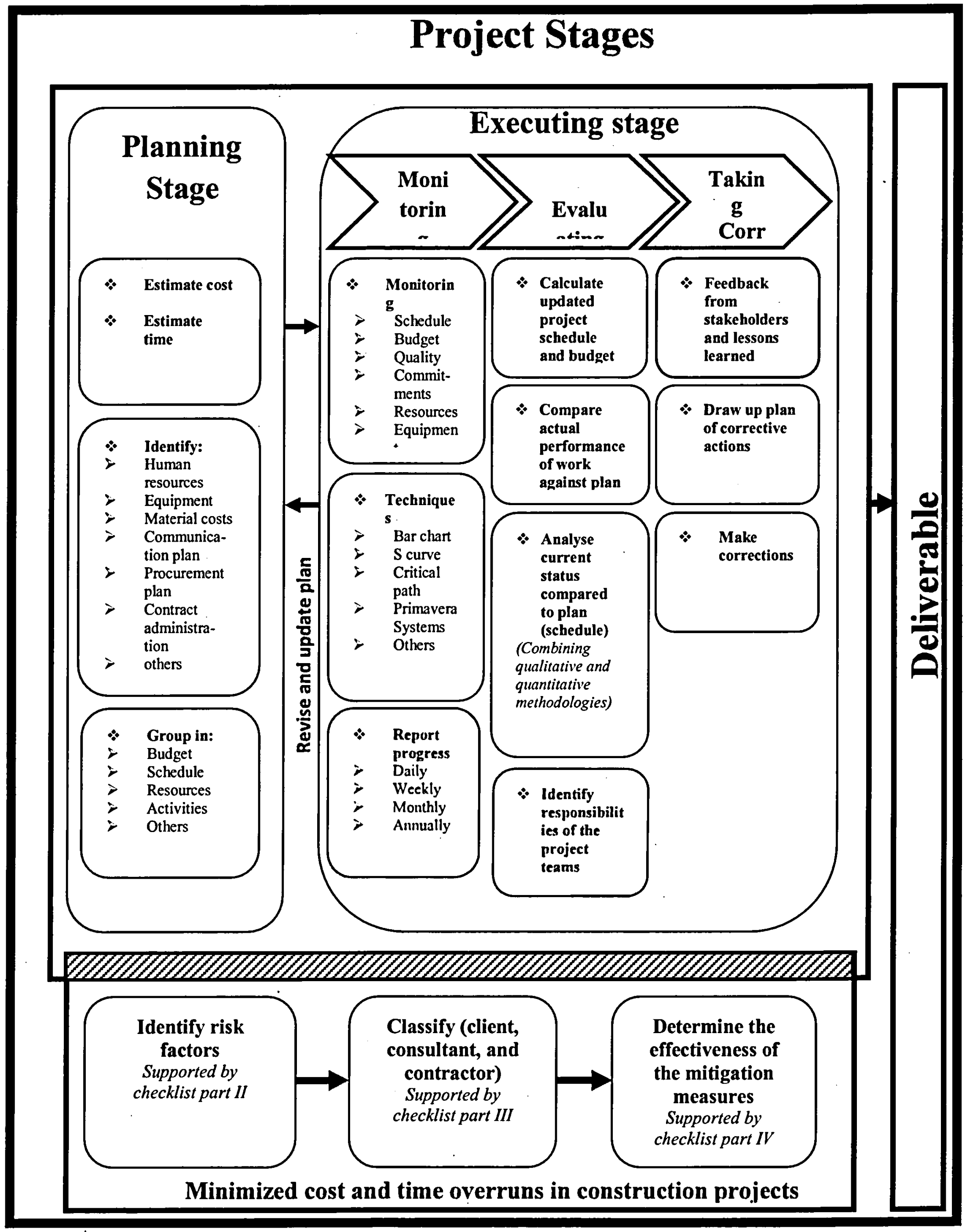
Researcher: Huwaida.T
Faculty of Development and Society
School of Built Environment, (Unit 9 Science Park)
Sheffield Hallam University
Sheffield S11 WB UK.

If you would like to receive a summary of the research findings, please provide your name, contact number and address.

Name: ....

Contact number...

The proposed framework for project cost and time control



Key:

Interface of the Project Control Stages with Minimized Cost and Time Overruns Stage

Impression on the framework's processes

As part of the evaluation processes, I request you to comment on the usefulness of the framework that you provided for the construction industry in Libya. Based on your observation, please point out your opinion to each factor by ticking the appropriate scale.

1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

F1	Criteria	Your opinion				
		1	2	3	4	5
F1.1	Appropriate identification of framework phases					
F1.2	Appropriate identification of the planning stage					
F1.3	Appropriate identification of the monitoring stage					
F1.4	Appropriate identification of the project evaluation stage					
F1.5	Appropriate identification of the phase of the actions required by the organizations					
F1.6	Appropriate identification of the minimized risk factors stage to be provided					
F1.7	Appropriate identification of responsibilities of project parties					
F1.8	Completeness					
F1.9	Comprehensibility					
F1. 10	Ease of use					
F1.11	Providing systematic stages for successful implementation of time and cost control					
F1.12	Applicability to prospective time and cost control organizations					
F1.13	Applicability to complex projects					

- Please kindly provide suggestion(s) on how you think the framework can be improved the space provided below (continue on a separate sheet if necessary)

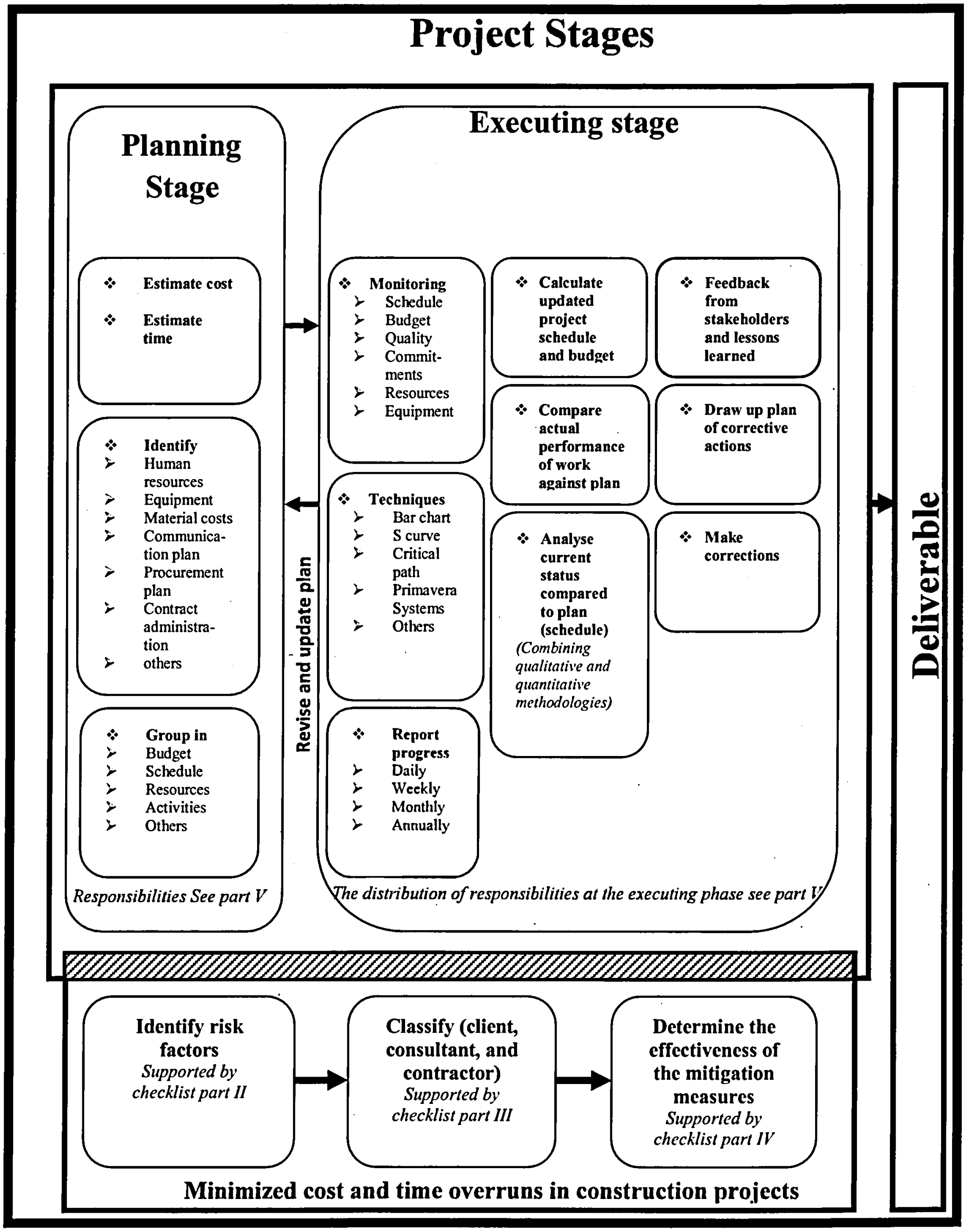
....
....
....
....
....
....
....
....
....

Thank you for your cooperation to complete this questionnaire

Appendix (6)

A FINAL PROJECT COST AND TIME CONTROL FRAMEWORK AND LIST OF CORE PROCESS

Part I: The Framework



Key:

Interface of the Project Control Stages with Minimized Cost and Time Overruns Stage

Part II: List of factors causing delays and cost overruns in Libyan construction projects as perceived by all parties (contractors, clients and consultants)

NO	Ranking factors causing delays in Libyan construction projects
F1	Lack of experience and performance of project management team
F2	low labour productivity
F3	Lack of timely decisions and corrective actions
F4	Inaccurate estimates
F5	Changes in prices of materials
F6	Lack of proper financial appraisal of the project
F7	Strikes and border closures
F8	Slowness in giving instructions
F9	Deficiencies in coordination between parties (clients, consultants and contractors)
F10	Market shortages of construction materials
F11	Poor communications and misunderstanding
F12	High quality of work required
F13	Poor judgment in estimating time and resources
F14	Inadequate contractor experience
F15	Lack of design team experience
F16	Poor subcontractor skills and performance
F17	Poor management and supervision on site
F18	Delay of material deliveries to site
F19	Difficulties in obtaining construction materials at official current prices
F20	Lack of technically skilled staff
F21	Indecision by the supervising team in dealing with the contractor's queries

NO	Ranking factors causing delays in Libyan construction projects
F22	Lack of new technology or new construction methods
F23	Delays in decision making by Government
F24	Lack of commitment to consultants' instructions
F25	Lack of co-ordination between design team and contractors
F26	Delay in payments to contractors on completing work
F27	Changing government policies and regulations
F28	Poor contract management
F29	Errors and omissions in bills of quantities
F30	Shortages of tools and equipment on site
F31	Mistakes during construction
F32	Inappropriate types of contract used
F33	Unrealistic contract expiry dates imposed by owners
F34	Inadequate construction planning
F35	Political instability
F36	Lack of a strong organizational culture
F37	Unpredictable weather conditions
F38	Improvements to standard drawings during the construction stage
F39	Shortages of site workers
F40	Requirements for external work
F41	Difficulties in obtaining construction licences
F42	Consultants' centralized decision-making processes
F43	Poor quality of materials
F44	Lack of equipment maintenance

NO	Ranking factors causing delays in Libyan construction projects
F45	Slow payment for completed work
F46	Absence of consultants' site staff
F47	Shortage of craftsmen
F48	Level of uncertainty of soil conditions
F49	Wrong choice of site
F50	Lack of job security for the consultancy team
F51	Damage to materials in storage
F52	Rework of bad quality performance
F53	Lack of detailed information
F54	Complexity of design
F55	Delay in subcontractors' work
F56	Inappropriate construction methods
F57	Lack of cost reports during construction stage
F58	Equipment allocation problems
F59	Unethical contractor behaviour in order to achieve the highest possible level of profit
F60	Different political affiliation of workers
F61	Too few regular sessions to address work problems
F62	Storms and heavy dusty winds
F63	Poor communication by donors to compensate for any bad results that may come from the political situation

NO	**Ranking factors causing cost overrun in Libyan construction projects**
F1	Political instability
F2	Poor management and supervision on site
F3	Lack of proper financial appraisal of the project
F4	Delays in decision-making by government
F5	Inaccurate estimates
F6	Poor quality materials
F7	Deficiencies in coordination between parties (clients, consultants and contractors)
F8	Lack of experience and performance of project management team
F9	Market shortages of construction materials
F10	Delays in material deliveries to site
F11	Lack of design team experience
F12	Inappropriate types of contract used
F13	Poor communication and misunderstanding
F14	Changes in prices of materials
F15	Difficulties in obtaining construction materials at official current prices
F16	Poor contract management
F17	Poor judgment in estimating time and resources
F18	Strikes and border closures
F19	Lack of timely decisions and corrective actions
F20	Lack of new technology or new construction methods
F21	Unpredictable weather conditions
F22	Inadequate contractor experience
F23	Errors and omissions in the bills of quantities
F24	Rework of bad quality performance
F25	Damage of materials in storage

NO	Ranking factors causing cost overrun in Libyan construction projects
F26	High quality of work required
F27	Shortage of site workers
F28	Improvements to standard drawings during the construction stage
F29	Inappropriate construction methods
F30	Inadequate construction planning
F31	low labour productivity
F32	Shortages of tools and equipment on site
F33	Lack of technically skilled staff
F34	Level of uncertainty of soil conditions
F35	Lack of communication from donors to compensate for uncertainties resulting from poor political situation
F36	Lack of equipment maintenance
F37	Poor quality of subcontractor's skills and performance
F38	Indecision by the supervising team in dealing with the contractor's queries
F39	Equipment allocation problems
F40	Changing government policies and regulations
F41	Complexity of design
F42	Absence of consultant's site staff
F43	Delay in payments to contractors of completing work
F44	Lack of commitment to consultants' instructions
F45	Mistakes during construction
F46	Unrealistic contract expiry dates imposed by owner
F47	Wrong choice of site
F48	Lack of cost reports during construction stage

NO	Ranking factors causing cost overrun in Libyan construction projects
F49	Slow payment for completed work
F50	Slowness in giving instruction
F51	Unethical contractor behaviour in order to achieve the highest possible level of profit
F52	Lack of co-ordination between design team and contractor
F53	Shortages of craftsmen
F54	Lack of a strong organizational culture
F55	Lack of job security for the consultancy team
F56	Storms and heavy dusty winds
F57	Centralized consultants' decision making processes
F58	Different political affiliation of workers
F59	Lack of detailed information
F60	Requirements for external work
F61	Lack of regular sessions to address work problems
F62	Difficulties in obtaining construction licences
F63	Delay in subcontractors' work

Part III: Categorisation of time and cost overrun factors based on the party responsible

NO	Important factors causing cost and time overruns	The most responsible party for risk factors
F1	Lack of experience and performance of project management team	Contractor
F2	Poor management and supervision on site	Contractor
F3	Mistakes during construction	Contractor
F4	Lack of timely decisions and corrective actions	Consultant
F5	Lack of detailed information	Consultant
F6	Inappropriate construction methods	Contractor
F7	Poor communication and misunderstanding	Consultant
F8	Slowness in giving instructions	Consultant
F9	Lack of regular sessions to address work problems	Contractor
F10	Lack of technically skilled staff	Contractor
F11	High quality of work required	Contractor
F12	Poor judgment in estimating time and resources	Contractor
F13	Lack of a strong organizational culture	Contractor

NO	Important factors causing cost and time overruns	The most responsible party for risk factors
F14	High quality of work required	Contractor
F15	Lack of new technology or new construction methods	Contractor
F16	Shortage of site workers	Contractor
F17	Rework of bad quality performance	Contractor
F18	Inaccurate estimates	Consultant
F19	Indecision by the supervising team in dealing with the contractor's queries	Consultant
F20	Deficiencies in coordination between parties (clients, consultants and contractors)	Contractor
F21	Improvements to standard drawings during the construction stage	Consultant
F22	Wrong choice of site	Client
F23	Errors and omissions in the bills of quantities	Contractor
F24	Delay in subcontractors' work	Contractor
F25	Unrealistic contract expiry dates imposed by owner	Contractor
F26	Lack of commitment to consultants' instructions	Contractor
F27	Poor standard of subcontractor's skills and performance	Contractor

NO	Important factors causing cost and time overruns	The most responsible party for risk factors
F28	low labour productivity	Client
F29	Absence of consultant's site staff	Consultant
F30	Lack of job security for the consultancy team	Consultant
F31	Centralized consultants' decision-making processes	Consultant
F32	Requirements for external work	External party
F33	Inadequate construction planning	Consultant
F34	Unpredictable weather conditions	External party
F35	Level of uncertainty of soil conditions	External party
F36	Storms and heavy dusty winds	External party
F37	Equipment allocation problems	Contractor
F38	Shortages of tools and equipment on site	Contractor
F39	Lack of equipment maintenance	Contractor
F40	Market shortages of construction materials	External party
F41	Changes in prices of materials	External party

NO	Important factors causing cost and time overruns	The most responsible party for risk factors
F42	Damage of materials in storage	Contractor
F43	Delays in material deliveries to site	Contractor
F44	Poor quality materials	Contractor
F45	Difficulties in obtaining construction materials at official current prices	External party
F46	Inappropriate types of contract used	Client
F47	Unethical contractor behaviour in order to achieve the highest possible level of profit	Contractor
F48	Inadequate contractor experience	Contractor
F49	Poor contract management	Consultant
F50	Lack of design team experience	Client
F51	Lack of co-ordination between design team and contractor	Consultant
F52	Complexity of design	Consultant
F53	Lack of proper financial appraisal of the project	Client
F54	Delay in payments to contractors of completing work	Contractor
F55	Slow payment of completed works	Contractor

NO	Important factors causing cost and time overruns	The most responsible party for risk factors
F56	Lack of cost reports during construction stage	Contractor
F57	Different political affiliation of workers	Contractor
F58	Lack of communication from donors to compensate for uncertainties resulting from poor political situation	External party
F59	Delays in decision making by government	External party
F60	Political instability	External party
F61	Strikes and border closures	External party
62	Changing government policies and regulations	External party
F63	Difficulties in obtaining construction licences	External party

Part IV: Mitigation measures

NO	Mitigation measures for risk factors causing cost and time overruns
M1	Standardised designs should be updated as per necessity to minimise errors and saves time.
M2	Monitor and control construction process activities properly
M3	Develop an appropriate plans and control cost and schedule
M4	Undertake investigation and exploration to construction site before design phase
M5	Schedule construction activities along with materials delivery
M6	Adopt design strategy during initial stages of planning
M7	Secure standby cash flow in advance by the contractor
M8	Ensure good design report for the project and examine by consultant and client before its commences
M9	Provide regular updating of the construction work plans and regular reports on project progress
M10	Provide clauses for extra payment in contract, which happen due to change in law or new rules
M11	Review the differential taxation and find reasonable measures to reduce taxes
M12	Prepare work specification with the consideration of work breakdown structure, implementation methodology, the output of risk analysis study
M13	Provide adequate computer software in order to improve correctness in design

NO	Mitigation measures for risk factors causing cost and time overruns
M14	Adopt good supervision and proper quality control procedures
M15	Determine the cost and time implication of a design change
M16	Notification of all the parties involving in the project of how they will be impacted and the cost and schedule implication of a design change before going ahead with the change
M17	Consult a financial consultant to conduct the verifying the financial report of the project
M18	determine of quantities properly during bidding phase
M19	Arrange preconstruction meetings for explanation procedures in the course of carrying out construction work
M20	Provide incentives and effective training for plant operators
M21	Incorporate escalation clauses for delays and inflation rates in contract
M22	Undertake pre-project planning to reduce errors during design phase
M23	Organize for vetting and appraisal of design criteria by at least one independent architect or engineering
M24	Selecting vendors not on lowest cost criteria basis but for critical items
M25	Provide construction extension clauses in contract
M26	All parties involved in construction project should agree on one accounting standard and hire one independent accountant
M27	Utilize modern programmed planning techniques

NO	Mitigation measures for risk factors causing cost and time overruns
M28	Adopt proper management system, safety programs
M29	keeping an inventory at optimum level to guarantee availability of materials during construction phase
M30	Pay careful awareness to contract interpretation
M31	Conduct visits to the construction site and check materials
M32	Identify compensation clauses in contract for payment
M33	Obtain payment and performance bonds from international and local banks
M34	Prepare detailed materials planning to use along with project engineering and planning
M35	Seek incorporation delay clauses in contract
M36	Provide comprehensive terms of default in the contract
M37	Supervise present financial status of organisation
M38	Provide and submit all required design information on time
M39	attempt to obtain materials directly from suppliers
M40	Include clauses on extra payment if caused by any party
M41	Arrange preconstruction meetings for explanation of contract requirement in the course of carrying out construction work

NO	Mitigation measures for risk factors causing cost and time overruns
M42	Have clear contractual terms; define clear responsibility and authority in contract; agree on one accounting standard
M43	Determine the cause of a design change
M44	Use as much as possible local materials to save cost
M45	Employ a good legal advisor who is familiar with the industry in drafting the contract
M46	Adopt as much as possible local employers to save cost
M47	Conduct visits and check materials at factory
M48	Create book for recording payments

Part V: Identified project parties' responsibilities

Project parties' responsibilities in the Planning phase

No.	Responsibility	Phase	Responsible
R1	Assessing tenders	Planning	Consultant
R2	Preparing cost and time plans, estimates and cash flow projections	Planning	Consultant
R3	Preparing tender pricing documents	Planning	Consultant
R4	plan effectively for the delivery of materials and equipment in time	Planning	Contractor
R5	Submitting a comprehensive plan of action and stipulate how each item will be executed	Planning	Contractor
R6	Verifying the resources and capabilities of the lowest-bidding contractors before awarding the contract	Planning	Client
R7	Collating and issuing tender documentation	Planning	Consultant
R8	Preparing bills of quantities	Planning	Consultant
R9	Preparing a time schedule that clarifies the needs for equipment on site	Planning	Contractor

No.	Project parties' responsibilities in the Planning phase	Phase	Responsible
R10	Allocating the required amount of manpower to the construction site	Planning	Contractor
R11	Determining a realistic duration for the project	Planning	Client
R12	Facilitating the emergence of licenses needed to begin project work	Planning	Client
R13	Obtaining approval after delivering the risk management plan	Planning	Consultant
R14	Arranging and attending pre-construction meetings	Planning	Consultant
R15	Ensuring familiarity with work sites and all documents and plans prior to bidding	Planning	Contractor
R16	Defining requirements as a prerequisite for planning	Planning	Client
R17	Hiring qualified technical staff to manage the project competently	planning	Consultant
R18	Ensuring that project personnel are qualified and properly trained	planning	Contractor
R19	Attending pre-construction meetings and ensuring that appropriate personnel, including the project superintendent	Planning	Contractor
R20	Facilitating the laboratory testing of construction materials and products	planning	Consultant
R21	Approving design documents, shop drawings, and the payments of contractor	planning	Consultant

Project parties' responsibilities in the Execution phase

No.	Responsibility	Phase	Responsible
R22	Preparing regular reports including work progress, expenditures, progress estimates and estimated final expenditures	Execution	Consultant
R23	Reviewing the contractors' monthly payment certificates	Execution	Consultant
R24	Focusing on reviewing and approving design documents	Execution	Consultant
R25	Ensuring permanent and temporary work and all equipment and materials brought to the site	Execution	Contractor
R26	Ensuring that site administrative and technical staff are assigned as soon as the contract is awarded	Execution	Contractor
R27	Paying progress payments regularly to contractors	Execution	Client
R28	Minimizing changes in orders during construction	Execution	Client
R29	Revising bid documents such as technical specifications, drawings, bills of quantities and the project design	Execution	Client
R30	Conducting interviews in cases of disputes between contractors and consultants to prevent such problems affecting the project's quality and completion	Execution	Client
R31	Attending meetings and making sure that contractors follow the plan that has been drawn up	Execution	Consultant
R32	Monitoring contractors for compliance with the construction contract and taking appropriate action when the standards or specifications are not being met	Execution	Consultant

No.	Project parties' responsibilities in the Execution phase	Phase	Responsible
R33	Discussing any problems with the project team and seeking approval/direction/agreement	Execution	Consultant
R34	Focusing on planning and scheduling tasks during the construction process by matching the available resources and time	Execution	Contractor
R35	Improving communication and coordination between the local construction and international funding agencies to solve the material financial issues	Execution	Client
R36	Meeting with contractors monthly to review progress payments	Execution	Consultant
R37	Managing work undertaken by sub-consultants	Execution	Consultant
R38	Notifying the project sponsor of all claims in a timely manner	Execution	Consultant
R39	Arranging continuous work training programmes for industry personnel	Execution	Contractor
R40	Meeting monthly with consultants to review progress payment estimates	Execution	Contractor
R41	Inspecting mistakes and discrepancies in design documents.	Execution	Consultant
R42	Ensuring proper communication and coordination among project stakeholders	Execution	Consultant
R43	Reviewing and approving the design documents within the agreed schedule	Execution	Client
R44	Confirming that contractors have the necessary materials and assessing their financial ability to implement the project	Execution	Client
R45	Providing technical staff who are able to manage the different stages of the project and to follow the performance percentages, and who can also compare actual with planned performance	Execution	Client

No.	Project parties' responsibilities in the Execution phase	Phase	Responsible
R46	Notifying the client of any potential scope changes that may affect the fees payable in a timely manner, before any additional work is done	Execution	Consultant
R47	Completing a self-evaluation and submitting it with final details to the project sponsor	Execution	Consultant
R48	Managing financial resources and planning cash flow by utilizing progress payments and managing the contingency budget	Execution	Contractor
R49	Taking full responsibility for the adequacy, stability and safety of all site operations, labour and construction methods	Execution	Contractor
R50	Checking the action steps, discovering obstacles and seeking alternatives and solutions	Execution	Consultant
R51	Providing solutions to the client's problems and negotiating those solutions with project team members	Execution	Consultant
R52	Motivating workers to improve their skills and awarding pay rises	Execution	Contractor
R53	Informing the consultant and project sponsor in writing regarding any problems that are not being resolved on site	Execution	Contractor
R54	Notifying the consultant and project sponsor of any other problems such as those concerning landowner issues, utility movements and public traffic	Execution	Contractor
R55	Correcting all deficiencies and carrying out all necessary repairs in a timely manner	Execution	Contractor