RISK MANAGEMENT IN CONSTRUCTION INDUSTRY IN SAUDI ARABIA: A CONTRACTORS PERSPECTIVE

BY

MOHAMMED SHOEB

A Thesis Presented to the
DEANSHIP OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN, SAUDI ARABIA

In Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

CONSTRUCTION ENGINEERING & MANAGEMENT

December, 2014

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

DHAHRAN- 31261, SAUDI ARABIA

DEANSHIP OF GRADUATE STUDIES

This thesis, written by **MOHAMMED SHOEB** under the direction of his thesis advisor and approved by his thesis committee, has been presented and accepted by the Dean of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING AND MANAGEMENT.**

Dr. Ali Shash
(Advisor)

Dr. Khalaf Al-Ofi
Department Chairman

Dr. Abdulaziz Bubshait
(Member)

Dr. Salam A. Zummo
Dean of Graduate Studies

Dr. Sadi Assaf
(Member)

22/1/15

Date

عمادة الدراسات العليا
DEANSHIP OF GRADUATE STUDIES


بسم الله الرحمن الرحيم

Dedication

I Solely Dedicate my Thesis to My Beloved Father and Mother

ACKNOWLEDGMENTS

I would like to express my deep sense of indebtedness for my advisor Dr. Ali Shash for his professional guidance, valuable advice, unlimited support and continuous encouragement to make this research possible.

Deepest thanks to Dr. Sadi Assaf and Dr. Abdulaziz Bubshait for their academic and scientific supervision throughout my study at the King Fahd University.

I express my special gratitude and remain ever in debt to my parents, who made faithful supplication (Duaa) to Allah for my success and also for, understanding, encouragement and support during my study and research.

Finally, my appreciation is extended to all construction contractors who participated in the survey and provided me with the valuable data to accomplish my research.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PMI	:	Project Management Institute
PMBOK	:	Project Management Book of Knowledge
RMP	:	Risk Management Process
PKK	:	Pusat Khidmat Kontraktor

THESIS ABSTRACT - ENGLISH

Full Name : Mohammed Shoeb

Thesis Title : Risk Management in Construction Industry in Saudi Arabia: a Contractors perspective

Major Field : Construction Engineering & Management

Date of Degree : December, 2014

Risk management is an integral part of any construction industry particularly in a developing country like Saudi Arabia where there are massive construction projects to be handled in the future. An effective risk management method can not only help contractors to understand the types of risks they might incur in different phases of a project, but will also facilitate them in management of those risks. The main objectives of this study are to investigate whether contractors in Saudi Arabia consider risk management in their organization and if it is being considered then how it is being practiced. Also, to determine the risk evaluation techniques and risk factors which contractors consider and the strategies which they design, implement and control to eliminate or mitigate the impact of risks in projects. An intense literature review was conducted to determine the risk techniques, risk factors and risk management actions that are suitable for the construction industry in Saudi Arabia. A close ended questionnaire was developed to collect the required data from grade 1, 2 and 3 building contractors of the Eastern province of Saudi Arabia classified by the Ministry of Municipality and Rural Affairs. The data obtained was analyzed and the results indicated that most of the contractors in Saudi Arabia are practicing risk management in

their business operation but there is a lack of risk professionals in the contractor's organization and the contractors are not following a systematic approach in dealing with risks. The contractors are using proper techniques for evaluating risks which have been proven acceptable and effective in the construction industry. The contractors are considering lot of risk factors both internal and external to the project in their business operations. The contractors are using suitable risk preventive and mitigative actions which are acceptable in the construction industry to reduce the aftermaths of occurrence of risk.

THESIS ABSTRACT - ARABIC

الاسم الكامل : محمد شعيب

عنوان الرسالة : إدارة المخاطر في صناعة البناء في المملكة العربية السعودية: منظور المقاولين

التخصص : هندسة البناء وإدارة

تاريخ الدرجة العلمية : ديسمبر, 2014

إدارة المخاطر هو جزء أساسي من صناعة الانشاءات وخصوصا في الدول النامية مثل السعودية العربية حيث كم هائل من المشاريع الإنشائية لا يزال في انتظار التنفيذ مستقبلا. الإدارة الفعالة للمخاطر لا تمكن المقاولين فقط من إدراك الأنواع المختلفة للمخاطر التي يمكن ان يتعرضوا لها خلال مراحل تنفيذ المشروع، ولكنها أيضا تسهل عليهم إمكانية التعامل مع هذه المخاطر بشكل مناسب.

الأهداف الرئيسية لهذا البحث تتمثل في دراسة ما إذا كان المقاولون في السعودية يستخدمون أدوات إدارة المخاطر في مؤسساتهم، وكذلك تحديد وتقييم هذه الأدوات وتقنيات المستخدمة ان وجدت. بالإضافة، الى تحديد معاملات المخاطرة وأدوات التقييم المستخدمة في اعداد استراتيجيات للوقاية او الحد من تأثير المخاطر على المشروع.

في هذا البحث تم اجراء مراجعة شاملة للدراسات السابقة التي تم تنفيذها في مجالات تحديد تقنيات التعامل مع المخاطر ومعاملات الخطر والإجراءات الإدارية المستخدمة للتعامل مع الاخطار والتي تتلاءم مع صناعة الانشاءات في السعودية. تم جمع المعلومات المتعلقة بمقاولين الانشاءات في المنطقة الشرقية من السعودية عن طريق اعداد استبانة مغلقة. تم استهداف المقاولين من الدرجة الأولى والثانية والثالثة حسب تصنيف وزارة الشئون البلدية والقروية.

في المرحلة التالية تم تحليل البيانات التي جمعت من المقاولين وقد أظهرت النتائج ان معظم المقاولين يمارسون إدارة المخاطر داخل مؤسساتهم ولكنهم يفتقرون الى الخبراء والمحترفين في هذا المجال، وكذلك فانهم لا يتبعون طريقة منظمة للتعامل مع المخاطر. وكذلك أظهرت ان المقاولون يستخدمون الأدوات والتقنيات الفعالة في التعامل مع المخاطر

وهي أدوات مقبولة وذات فعالية وتأثير في صناعة الانشاءات. في الوضع الطبيعي يأخذ المقاولون الكثير من معاملات الخطر الداخلية والخارجية في الحسبان اثناء تنفيذ عملياتهم التجارية. يستخدم المقاولون الإجراءات الوقائية المناسبة للوقاية والتخفيف من تداعيات وقوع المخاطر وهي إجراءات فعالة ومقبولة داخل صناعة الانشاءات

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Risk management can be generally described as a systematic means of observing areas of risk and identifying how these risks should be treated. It is a management tool which aims at determining the causes of risk and uncertainty, evaluating their impact, and creating appropriate risk management responses. An effective risk management method can not only help to understand the types of risks to be faced, but also in managing these risks that might occur in different phases of a project. Due to its growing significance, today, risk management has been accepted as an essential requirement in most industries and for which a set of techniques have been created to manage the impacts that might be brought by the potential risks (Patrick XW Zou et al).

In every industry, from IT related business, automobile or pharmaceutical industry, to the construction sector, the concept of risk management is used. Each industry has identified and developed their own Risk Management standards, but the overall idea of the risk management concept generally remains the same regardless of the industry (Gajewska et al, 2011). According to the Project Management Institute (PMI) (2004), one of the nine most crucial parts of project commissioning is project risk management. This shows that there is a strong relationship between project success and risk management. Although

managing risks is described as the most challenging area within construction management, its application is supported in all the projects in order to prevent negative consequences of the risks (Potts, 2008).

1.2 STATEMENT OF THE PROBLEM

Many industries have become more proactive and aware of using analyses in projects. Likewise, Risk Management has become a timely issue which is widely discussed across industries. However, with regard to the construction industry, risk management is not commonly used (Klemetti, 2006). More construction companies are starting to become aware of risk management, but are still not using any systematic approach aimed for managing risks. This contradicts the fact that the industry is trying to be more cost and time efficient as well as have more control over projects (Gajewska et al, 2011). Risk is associated to any project regardless the industry and thus Risk Management should be of interest to any project manager. Risks differ between projects due to the fact that every project is unique, especially in the construction industry (Gould and Joyce, 2002). However, there are still many practitioners that have not realized the importance of including risk management in the process of delivering the project. Even though there is an awareness of risks and their consequences, some organizations do not approach them with established Risk Management methods (Smith et al., 2006). Risks have a significant impact on a construction project's performance in terms of cost, time and quality. The consequences of project risks are several times more severe in construction industries. As the size and complexity of projects have increased, the ability to manage risks throughout

the construction process has become one of the challenging management tasks for construction contractors (Kululanga, 2010). Compared with many other industries, the construction industry is subject to more risks due to the unique features of construction activities, such as long period, complicated processes, unpleasant environment, financial intensity and dynamic organization. Hence, taking effective risk management techniques to manage risks associated with variable construction activities, increasing costs and time delays and increasing contractual obligations has never been more important for the contractor (PXW Zou et al). Construction projects are becoming increasingly complex and dynamic in their nature, and the introduction of new procurement methods means that contractors have to rethink their approach to the way risks are treated within their projects and organizations (Carr, 2001). Previous research has found that these risks spread through the whole project life cycle and many risks occur at more than one phase, with the construction stage as the most risky phase, followed by the feasibility stage (PXW Zou et al). There is a lack of an accepted method of risk management among professionals in the construction industry compared with the financial, health and other professions all over the world (Mulholland 1999). There is no other industry that involves the proper application of business practices when compared to the construction industry. There are many variables in the construction industry and the complex relationships that exist between these variables must be considered so as to make sound business practices and decisions. The variable environment surrounding the construction industry requires complicated decisions to be made regarding the use of labor, materials and equipment. In addition, governmental influence and labor practices have a great influence on business decisions that must be made by the contractor (Abu Mousa, 2005). Construction projects usually include huge

capital investments, thus, tremendous emphasis is laid on a well formalized risk management process. But, due to the complexities involved in the construction industry, risks do occur and once the various construction risks start cropping up, meeting the budget expectations besides completing the project on time looks barely possible (Khaliluddin, 2010).

Thus, it can be said that risk is always present in the construction industry and it requires proper analysis and mitigation in order to avoid the contractor from the aftermath of cost overruns and delay. Risk in the construction industry can only be minimized but not completely eliminated because of complications in the construction projects. With rapid changes in the construction industry and aggressive owners seeking more from contractors over the past years, there are no surprises that the construction projects tend to involve legal actions when things go wrong. In other words contractors are facing more risk than before. As various parties including Owner, Contractor, Sub-Contractors, Consultant, and Material Suppliers etc are involved in a single project, risks has become crucial to be analyzed. Risk management has become an important part of the management process for any project. It is essential to understand where and when risks arise to avoid delays, conflicts, change orders etc. The main idea of risk management should be to manage the risks efficiently. There are simple principles that a contractor should follow in risk management which may include that he should be fully aware of all the risks that he may encounter during a project, he should have the necessary tools that are required to monitor and minimize them, and also the necessary risk attitude and resources to deal with. If the contractor neglects these principles, then there would be an evident case of project delay, confusion, ultimately causing substantial financial losses to the contractor.

Risk management therefore is an integral part of any construction industry particularly in a developing country like Saudi Arabia where there are massive construction projects to be handled in the future. The total value of ongoing projects in the GCC region currently stands at $2.62 trillion, with Saudi Arabia accounting for $875 billion which indicates that a lot of amount is invested in the construction industry (Construct Arabia .com). Thus risk management should be considered as an important aspect by the contractors in Saudi Arabia for their organizations in order to mitigate the risks which might occur and to prevent huge losses. Despite the importance of such an issue, researchers have not paid attention to it. Few researchers have carried out studies in Saudi Arabia regarding allocation of risk to contractors, owner, designer etc. but no researcher has addressed the management of risk which the contractors face in Saudi Arabia. Thus, it can be said that this study is very important and beneficial as it attempts to investigate and reveal the risk management practices among construction contractors in Saudi Arabia.

1.3 RESEARCH QUESTIONS

1). Who in contractors organizations is responsible for studying risks in projects?

2). What are the techniques that contractors in the Eastern Province of Saudi Arabia considers for evaluating risks in projects?

3). What are the factors that contractors consider in the Eastern Province of Saudi Arabia as risks in projects?

4). What are the techniques that contractors in the Eastern Province of Saudi Arabia uses to manage risks in projects?

1.4 RESEARCH OBJECTIVE

The main objective of this study is to investigate how contractors in the Eastern Province of Saudi Arabia manage risks in their organizations. Specifically, the objectives of this study are to determine:

1). The risk evaluation techniques and risk factors which contractors in the Eastern Province of Saudi Arabia evaluate to manage risk in projects

2). The strategies which contractors in the Eastern province of Saudi Arabia design, implement and control to eliminate or mitigate risks in projects.

1.5 SIGNIFICANCE OF THE STUDY

The construction industry is subject to more risks and uncertainties than any other industry. Projects in construction involve hundreds or even thousands of interacting activities, each with cost, time, quality and sequencing problems. Each of these activities carries some risks and uncertainties and if these risks are not managed properly, losses will take place. To minimize these losses, risks and uncertainties must be identified, classified, analyzed and administered. The way these risks are allocated, their importance and their effects on the project will outline the best techniques to be used for managing risks associated with the construction industry. The construction industry in Saudi Arabia is one of the biggest

and fastest growing industries, especially with the new discoveries of oil and natural gas fields. In 1998, the construction industry in Saudi Arabia employed 16% of the total labor force and accounted for on estimated 8.7% and approximately 8% of GDP (at current prices) in 1990 and 2000 respectively (The Economist Intelligence Unlimited, 2001, seventh Development Plan, 2000). The Ninth Development Plan for the Kingdom of Saudi Arabia sets out plans to invest SAR 1,444 billion (US $385 billion) in social and economic infrastructure between 2010 and 2014 (Construct Arabia.com). Saudi Arabia has been experiencing a large construction boom but the construction industry, due to its special nature, is exposed to a number of risks. The contractor is the first one who encounters these risks and if he could not get over them, he would fail and nobody would benefit. Although there were no exact statistics, but, a sample conducted by the Makkah province, shows that projects defaulted and failed in 18% of the government projects (Bajaber, 2012). Abdul Rahman Al Zamil, chairman of Riyadh chamber of commerce and industry, said banks in the largest Arab economy have been more reluctant to provide loans after an increase in contractors' debt to one of its highest levels at end-2012. "In 2013, we expect the debt Figures will be much higher. This is discouraging banks from providing loans to contractors in the kingdom," he told a construction conference in Riyadh, according to the Arabic language daily Al Madina. In such a situation, all indications show that the value of failing projects in 2013 will be nearly double the 2012 value, which officials estimated at SAR 40 billion (www.zawya.com, Nov 26 2013). Construction work has dropped 30 percent this year compared to last year’s Figures due to a rise in the prices of building material and a shortage in manpower, Saudi contractors told local media. They indicated that the contracting sector is facing a crisis categorized by a labor shortage and increase in

the prices of construction provisions. Abdel Aziz Al-Hanafi, an engineer and former chairman of the contractors committee at the Jeddah Chamber of Commerce and Industry (JCCI), said that the sector is experiencing an unprecedented state of recession, which stands at 30 percent compared to the 20 percent figure registered last year (www.arabnews.com, 17 September 2013). Thus, it can be said that although there is a lot of construction being carried out in Saudi Arabia, there are different risks arising which are causing loss, delays and failures to the contractors. This study will shed some light on assessing the risk management practices of construction contractors in Saudi Arabia. Risk assessment in construction in Saudi Arabia is a new concept. This study will help to identify the current risk management practices of construction contractors in Saudi Arabia and will help the contractors to understand the importance of risk management and how effective they are in managing the risks that are coming from project. It will help contractors minimize losses and to save the extra costs which they might incur by better understanding how these risks are allocated and dealt with. It will also help the local contractor's identify the best approach to deal with the risks not only coming from the project but also the risks coming from within his organization, subcontractors, man power, vendors, government etc.

1.6 SCOPE AND LIMITATIONS

This research will help to understand the risk management practices of construction contractors in Saudi Arabia.

- This study will be carried out in the Eastern Province of Saudi Arabia due to the limitations of time and cost, but the results and conclusions can be applied to the construction industry in other areas of Saudi Arabia because of the similarities of the rules, regulations and business environment. Moreover, most of the large construction contractors have offices in other areas of Saudi Arabia. Because of the above reasons and for the purpose of this study, the words Easter Province of Saudi Arabia and Saudi Arabia will be used interchangeably.
- This study will be limited to the Grade 1, 2, and 3 contractors as per classified by Ministry of Municipal and Rural Affairs in the Eastern Province of Saudi Arabia. This is because these are the large contractors who undertake huge projects and thus will be dealing with high risks.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The first part of this chapter defines and explains the basic concepts such as risk, certainty and uncertainty. These concepts are linked not only to risk management but, they are an integral part of the conditions and decision making process as such. People make decisions every day, in private life, in all kinds of business organizations, fields of industry, and on all levels of the business cycle. It could easily be said that human life is one endless sequence of decision-making. Most simple decisions are reached spontaneously without much thought and analysis. However, a certain number of complex, even very complex decisions depend upon the systematic study of many factors of influence, adequate and quality information, choosing among numerous alternatives, and using suitable models and techniques for choosing the optimum, i.e. the most favorable alternative. The second part of this chapter explains what is risk management and since when it is being used. It will explain how different researchers have described risk management in the construction industry. The third part of this chapter will discuss the risk management process. As risk management is a very critical issue, it cannot be carried out haphazardly but, should follow a systematic approach in order to be effective. The fourth part of this chapter contains previous similar studies that have been carried out in 10 different countries. Risk management has been considered a very significant issue in many countries and a lot of research has been done to understand how risk management should be carried out and what

parameters should be considered in order to make risk management effective and to prevent the potential losses that might occur.

2.2 RISK

Decision-making occurs under conditions of certainty, risk or uncertainty. Certainty is a condition in which all the factors of influence can be quantified and where the use of adequate decision-making methods results in an exactly predictable outcome. This happens very rarely and is faced only in closed systems. Construction practically never runs under conditions of certainty. If two or more alternatives are to be decided among, in which all the factors of influence cannot be quantified, then decision-making occurs under conditions of risk or uncertainty. A decision is made under conditions of risk if the decision-maker is able to assess rationally or intuitively, with a degree of certainty, the probability that a particular event will take place and using his information about similar past events or his personal experience as a basis for the current decision Ceric (2003).

The Oxford Dictionary of Current English defines risk as a chance or possibility of loss or adverse consequences. Jaafari (2001) defined risk as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude. Events are said to be certain if the probability of their occurrence is 100% or totally uncertain if the probability of occurrence is zero percent. In between these extremes the uncertainty varies quite widely. Chapman and Cooper (1983) define risk as exposure to the possibility of economic or financial loss or gains, physical damage or injury or delay as a consequence of the uncertainty associated with pursuing a course of action. Yoe (2000) defined risk as

a characteristic of a situation, action, or event in which a number of outcomes are possible, the particular one that will occur is uncertain, and at least one of the possibilities is undesirable. Wideman (1986) defined risk as a chance of certain occurrences adversely affecting project objectives. It is the degree of exposure to negative events, and their probable consequences. Zayed and Chang (2002) defined risk as the presence of potential or actual constraints that could stand in the way of project performance, causing partial or complete failure either during construction or at the time of use. Liem and Ludin (1997) define risk as the occurrence of an event that has consequences or impacts on projects. Greene (2001) stated that there is no all-encompassing definition of risk and defined risk as a product of hazard and exposure where hazard is the way in which an event can cause harm and exposure is the extent to which likely recipient of harm can be influenced by the hazard. According to Smith (1999), risk exists when a decision is expressed in terms of a range of possible outcomes and when known probabilities can be attached to the outcomes.

Researchers in construction industry define risk in a similar fashion but in accordance to the characteristics of the construction industry:

Kangari (1995) defined risk as an occurrence that can effectively change, both adversely and positively the outcome of all construction projects. Erikson (1979) defines risk in construction as exposure to possible economic loss or gain arising from involvement in the construction process. Jaafari and Schub (1990) define risk as the presence of potential or actual construction that could stand in the way of project performance causing partial or complete failure either during construction and commissioning or at the time of utilization. Al Bahar and Crandall (1990) define risk as the exposure to the chance of occurrence of events adversely or favorably affecting project objectives as a consequence of uncertainty.

Hayes (1986) stated that risk and uncertainty are inherent in all construction work no matter what the size of the project.

Risk has been defined in various ways by many researchers in order to understand the nature and importance of it to the construction market. Thus it can be concluded that risks are inevitable in all the construction projects and the prime objective is to establish a good risk management agenda, thereby relieving contractors from huge cost over-runs and delays. Risks are not the ones to be ignored straight away as they affect the progress of the project by inducing cost and time overruns. Now, the cost overrun and time extension means loss to at least one of the members of the contracting party, which in this study is the contractor. Risks in construction projects need to be anticipated well in advance but, despite that sometimes unexpected risks creep in to the project affecting the progress, so, one should be prepared. The effective and efficient way of managing projects will depend on the thorough understanding of the risks and its eventualities.

2.3 RISK MANAGEMENT

Risk management is a discipline for living with the possibility that future events may cause adverse effects (Flanagan and Norman, 1993). In the global sense, risk management is the process that, when carried out, ensures that all that can be done will be done to achieve the objective of the project, within the constraints of the project (Clark et al, 1990). The basic goal of project management is to realize the project within the predicted time, planned costs and satisfactory quality. Contrary to this is project realization under conditions of uncertainty, and when the outcomes of all foreseen events cannot be predicted with

certainty. This is what makes it necessary to turn uncertainty into risk and to manage that risk (Cleric, 2003).

The topic of risk management has been important ever since the early age of humans on earth. According to Grier (1981), the first signs of risk management dated back as far as 3200BC in the Tigris-Euphrates valley with a group of people called the Asipu. One of their functions was to act as risk consultants. Their procedure would be to identify the important dimensions of the problem, propose alternative solutions, and collect data on the likely outcome. Their data sources were signs from Gods. According to Mills (2001), risk management is not new, nor does it employ black box magical techniques. Traditionally it has been applied instinctively, with risks remaining implicit and managed by judgment, and informed by experience.

Risk management is generally regarded as a management tool with the objective of identifying the sources of risks and uncertainties, determining their impact, and stating mitigation steps (Uher, 2003). A systematic process of risk management which starts with risk classification, risk identification, risk analysis, and risk response and will assist in understanding not only the prevalent risks but also in managing the risks for optimizing project success. (Berkeley et al., 1991). Kahkonen and Huovlla (1999) define systematic project risk management as advanced preparation and decision making for minimizing the consequences of possible adverse future events and, on the contrary, to maximize the benefits of positive future events. Flanagan, R. (1999) defines a risk management program as a system which aims to identify and quantify all risks to which the business or project is exposed so that, a conscious decision can be taken on how to manage the risks. He added that the risk management system must be practical, realistic and cost effective.

According to Akintoye (1997), construction risk is generally perceived as events that influence project objectives of cost, time and quality. Analysis and management of risk in construction depend mainly on intuition, judgment and experience. Because of the lack of knowledge and doubt on the suitability of risk analysis procedures, formal and systematic risk analysis and management procedures are rarely used in the construction industry. Hayes et al, (1986) state that the construction industry is one of the most dynamic, risky and challenging businesses. However, the industry has a very poor reputation for managing risk, with many major projects failing to meet deadlines and cost targets. This is influenced greatly by variations in weather, productivity of labor and plant, and quality of material. All too often, risks are either ignored, or dealt with in a completely arbitrary way; simply adding 10 per cent contingency onto the estimated cost of a project is typical. Bing et al. (1999), state that a systematic approach to risk management is not a widely-spread practice in the construction industry due to the complex nature and involvements of this industry. According to Khaliluddin (2010), risk management is an art of identifying, analyzing, and creating ways to tackle the potential risks arising out of any project in the construction industry. According to Baker et al (1999), formal risk management in construction has become an integral process only in the past few decades. The reason for this is the rapid advancement of technology regarding risk and its management. Therefore risk has become a specialized subject in itself.

According to Godfrey, (1996), the systematic risk management program helps to:

• Identity, assess, and rank risks, and make the risks explicit.

• Focus on the major risks of the project.

• Make informed decisions on the provision for adversity.

• Minimize potential damage if the worst scenario happens.

• Control the uncertain aspects of construction projects.

• Clarify and formalize the company's role and the roles of others in the risk management processes

• Identity the opportunities to enhance project performance

Miller (2001) states that systematic risk management is expecting the unexpected. It is a tool which helps control risks in construction projects and it has the following advantages:

• Questions the assumptions that most affect the success of your project

• Concentrates attention on actions to best control risks

• Assesses the cost benefit of such actions

Many researchers have described the benefits of risk management, some of which will be discussed in this study. According to Smith et al (2006), to maximize the efficiency of risk management, the RMP should be continuously developed during the entire project. In this way, risks will be discovered and managed throughout all the phases. According to Perry (1986), the benefit of working with risk management is increased level of control over the whole project and more efficient problem solving processes which can be supported on a more genuine basis. It results from an analysis of project conditions already in the beginning of the project. According to Thomas (2009), the benefits from RM are not only observed for the project itself, but also for the actors involved. The main incentives are clear understanding and awareness of potential risks in the project. In other words, risk management contributes to a better view of possible consequences resulting from unmanaged risks and how to avoid them. According to Cooper et al (2005), risk management provides a procedure which can reduce possible and sudden surprises.

Within the risk management, three approaches can be distinguished based on a company's approach. The first one is the risk-natural firm which does not invest much in risk management but is still aware of the most important risks. The second approach is the risk-averse, where no investments are made in order to reduce the probability of occurrence of risk. The last one is the risk-seeker where the organization is prepared to face all risks and is often called gambler. In the long term, the risk-seeking companies can get a lower profitability compared to risk-natural firms. This is because of the large investments and losses when repeating the risk management processes over and over again to ensure all risks have been managed before the risks actually occurs (Winch, 2002). Different attitudes towards risk can be explained as cultural differences between organizations, where the approach depends on the company's policy and their internal procedures (Webb, 2003).

2.4 RISK MANAGEMENT PROCESS

The management of risk is a continuous process and should span over all the phases of the project (Smith, 1999). Risks and their effects should be observed on all the key sites of decision-making throughout the project and by all the participants in the decision-making process. Throughout the project's life cycle it is necessary to continuously identify causes that may have a detrimental effect on the project, analyze their possible adverse consequences and prepare a response for it. The investor and his project manager have the greatest responsibility for identifying risks, analyzing them and responding to them. Project managers should do all they can to realize the project, undertake activities that decrease or eliminate the effects of risk or uncertainty. Thus, risk management is inseparable from project management and cannot be viewed as a separate activity (Ceric, 2003). An effective

risk management technique assists in understanding not only the prevalent risks but also in managing the risks for optimizing project success. Moreover, risk management methods are mostly targeted to construction projects which are extremely risky with highly inflexible risk management (Khaliluddin, 2010).

A number of variations of risk management process have been proposed. According to Raz & Michael (2001), risk management is a process consisting of two main phases: risk assessment, which includes identification, analysis and prioritization, and risk control which includes risk management planning, risk resolution and risk monitoring planning, tracking and corrective action. Ahmed et al (1999), defined the risk management as a formal orderly process for systematically identifying, analyzing, and responding to risk events throughout the life of a project to obtain the optimum or acceptable degree of risk elimination or control. Shen (1997), suggested a systematic process including risk identification, risk analysis and risk response, where risk response has been further divided into the four actions: risk retention, risk reduction, risk transfer and risk avoidance. According to the Project Management Body of Knowledge (PMI, 1996), risk management forms one of the so-called nine functions of project management (the other eight being integration, communications, human resources, time, cost, scope, quality and procurement management). The traditional view is that these functions should form the basis of planning and that each should be the focus of attention in each phase of the project. It presented four phases of the risk management process: identification, quantification, responses development and control. According to Mead (2007), risk management process can be implemented in the fundamental stages of the project to gain more momentum in avoiding the uncertainties and risks at the very early stages of the project. Risk identification and

management has become increasingly important for all kinds of commercial organizations operating in today's environment. In any Risk management process, there are four steps leading to risk control. Risk management process needs a thorough monitoring and review to help negotiate the detrimental effects of risks on construction projects. The initial step is to identify the risks, followed by analyzing, evaluating, and treating the risks. Analyzing risks leads to identifying existing controls like determining consequences, determining likelihood, and determining level of risk. The next set of actions involves evaluating risks by comparing against criteria and setting priorities. The final step involves identifying and assessing options in order to prepare and implement risk mitigation plans. Dembo & Freeman (1998), suggested that risk management measures the potential changes in value that will be experienced in a portfolio as a result of differences in the environment between now and some point of time in future. Flanagan & Norman (1993), suggested that the risk management system must be practical, realistic and cost effective. The depth to which one analyzes risk obviously depends upon ones circumstance. The importance to be placed on a structured risk analysis can be judged based only on ones circumstances. Conventional education does little to foster an awareness of how unpredictable reality can be.

According to Simmons (1998), it is possibilities that can be accommodated. It is the management's job to do the planning that will accommodate the possibilities. The customer is the final judge, but internal goals should be to a higher level than customer expectations. Risk management as a shared or centralized activity must accomplish the following tasks:

a. Identity concerns.
b. Identify risks & risk owners.
c. Evaluate the risks as to likelihood and consequences.
d. Assess the options for accommodating the risks.

e. Prioritize the risk management efforts.
f. Develop risk management plans.
g. Authorize the implementation of the risk management plans.
h. Track the risk management efforts and manage accordingly.

Grammer and Trollope (1993) realized the cyclical risk management process and divided them into 5 phases:

a. Identify risks
b. Analyze risks
c. Reduce risks
d. Plan against and manage risks
e. Review risks

Chapman and Ward (1997) outlined a generic risk management process consisting of nine phases:

a. Define the key aspects of the project;
b. Focus on a strategic approach to risk management;
c. Identify where risks may arise;
d. Structure the information about risk assumption and relationships;
e. Assign ownership of risks and responses;
f. Estimate the extent of uncertainty;
g. Evaluate the relative magnitude of the various risks;
h. Plan response;
i. Manage by monitoring and controlling execution.

According to Carter et al. (1994), the risk management process consists of 6 phases that cyclically repeat themselves:

a. Risk identification and documentation
b. Risk quantification and classification
c. Risk modelling (often called risk analysis)
d. Risk reporting and strategy development

e. Risk mitigation, reduction and/or optimization
f. Risk monitoring and control

In this study the risk management process which is used consists of risk identification, risk analysis and risk response which are discussed in the following parts.

2.4.1 RISK IDENTIFICATION

This is the first stage in risk management and it entails capturing all the potential risks that could arise within the project. It is commonly acknowledged that of all the stages of risk management process, risk identification stage has the largest impact on the accuracy of any risk assessment (Chapman, 1998). Risk management always starts with risk identification, which may be considered the most important phase of the risk management process (Smith, 1998). To facilitate risk identification, risks can also be broadly categorized as controllable and uncontrollable risks (Flanagan and Norman, 1993). Further, controllable risks are those risks which a decision maker undertakes voluntarily and whose outcome is, in part, within our direct control; and uncontrollable risks as those risks which we cannot influence (Chege & Rwelamila, 2000). Risk identification consists of determining which risks are likely to affect the project and documenting the characteristics of each. Risk identification is not a onetime event; it should be performed on a regular basis throughout the project (PMI, 1996). The identification of risks consists of a method used to generate risks, and guidance on what those risks should look like when written down (Isaac, 1995). Risk identification should address both internal and external risks. Internal risks are things that the project team can influence, such as staff assignments and cost estimates. External risks are things beyond the control or influence of the project team, such as government actions. In project context, risk identification is also concerned with opportunities (positive outcomes) as well

as threats (negative outcomes) (PMI, 1996). A failure to recognize the existence of one or more potential risks may result in a disaster or foregoing an opportunity for gain resulting from proper corrective action (Enshassi & Mayer, 2001). According to Abu Mousa (2005), when attempting to identify risk, it is rather like trying to map the world. Maps of the world tend to be centered on the location of the map maker. Much of the world is not visible from where you stand. Some territory which is familiar and obvious to you may not be obvious to everyone. Similarly, looking at a large project from the top, with multiple layers of planning, complex vertical and horizontal interactions, and sequencing problems, resembles looking into the world map through a fog. Management's ability to influence the outcome is limited to what they can see. The great temptation is to focus upon what should happen, rather than what could happen. A clear view of the event is the first equipment, focusing on the sources of risk and effect of the event (Flanagan & Norman, 1993). While extensive catalogues of risk can be devised, these are always likely to be incomplete and therefore inadequate. This may lead to decision-makers failing to consider the full spectrum of potential risks for a project. Developing categories of risk is one way of identifying risks so that this danger can be minimized (Enshassi & Mayer, 2001). Thus, risk identification can be described as a process of compiling a list of risks that are important for a particular project. To form this list, it is first necessary to research the potential sources of risk, adverse events that include risk, and the unfavorable effects of an undesirable scenario.

2.4.2 RISK ANALYSIS

Risk analysis, a component of the risk management process, deals with the causes and effects of events which cause harm. The aim behind such analysis is a precise and objective calculation of risk. To the extent that this is possible, it allows the decision making process

to be more certain (Estate Management Manual, 2002). The essence of risk analysis is that it attempts to capture all feasible options and to analyze the various outcomes of any decision. For building projects, clients are mainly interested in the most likely price, but projects do have cost over-runs and, too frequently, the 'what if' question is not asked (Flanagan & Norman, 1993). The use of risk analysis gives an insight into what happens if the project does not proceed according to plan. When active minds are applied to the best available data in a structured and systematic way, there will be a clearer vision of the risks than would have been achieved by intuition alone (Flanagan & Norman, 1993). Risk analysis can be described as short listing risks with the highest impact on the project, out of all threats mentioned in the identification phase (Cooper et al. 2005).

In the analysis of the identified risk, two categories of methods – qualitative and quantitative – have been developed. The qualitative methods are most applicable when risks can be placed somewhere on a descriptive scale from high to low level. The quantitative methods are used to determine the probability and impact of the risks identified and are based on numeric estimations (Winch, 2002). Companies tend to use a qualitative approach since it is more convenient to describe the risks than to quantify them (Lichtenstein, 1996). In addition, there is also one approach called semi-quantitative analysis, which combines numerical values from quantitative analysis and description of risk factors, the qualitative method (Cooper et al. 2005).

Various risk analysis techniques, adapted from (Ward and Chapman, 1997) are shown below in Table 2.1.

Table 2.1 Classification of risk analysis methods

Risk Analysis	
Qualitative	**Quantitative**
a. Direct judgment b. Ranking options c. Comparing options d. Descriptive analysis	a. Probability analysis b. Sensitivity analysis c. Scenario analysis d. Simulation analysis

2.4.3 RISK RESPONSE

This third step of the RMP indicates what action should be taken towards the identified risks and threats. The response strategy and approach chosen depend on the kind of risks concerned (Winch, 2002). Other requirements are that the risk needs to have a supervisor to monitor the development of the response, which will be agreed by the actors involved in this risk management process (PMI, 2004). Each identified risk, depending on the level of risk exposure, is classed as unacceptable, undesirable, acceptable or negligible. This classification affects the decision about how to respond to it (Smith, 1999). Winch (2002) describes that sometimes it is difficult to take a decision based on too little information. This may be avoided by waiting until the appropriate information is available in order to deal with the risk. This way of acting is called “Delay the decision” but this approach is not appropriate in all situations, especially when handling critical risks.

2.4.3.1 RISK AVOIDANCE / PREVENTION

If the risk is classified as bringing negative consequences to the whole project, it is of importance to review the projects aim. In other words, if the risk has significant impact on the project, the best solution is to avoid it by changing the scope of the project or, in the

worst scenario, cancel it. There are many potential risks that a project can be exposed to, and which can impact its success (Potts, 2008). This is why risk management is required in the early stages of a project instead of dealing with the damage after the occurrence of the risk (PMI, 2004).

The avoidance means that by looking at alternatives in the project, many risks can be eliminated. If major changes are required in the project in order to avoid risks, Darnall and Preston (2010), suggest applying known and well developed strategies instead of new ones, even if the new ones may appear to be more cost efficient. In this way, the risks can be avoided and work can proceed smoothly because strategy is less stressful to the users.

Cooper et al. (2005) list some activities that can help to avoid potential risk:

- More detailed planning
- Alternative approaches
- Protection and safety systems
- Operation reviews
- Regular inspections
- Training and skills enhancement
- Permits to work
- Procedural changes
- Preventive maintenance

2.4.3.2 RISK REDUCTION / MITIGATION

By having an overview over the whole project it is easy to identify problems which are causing damage. In order to reduce the level of risk, the exposed areas should be changed (Potts, 2008). This is a way of minimizing the potential risks by mitigating their likelihood (Thomas, 2009). One way to reduce risks in a project is to add expenditures that can provide

benefits in the long term. Some projects invest in guarantees or hire experts to manage high-risk activities. Those experts may find solutions that the project team has not considered (Darnall and Preston, 2010).

Mitigation strategies can, according to Cooper et al. (2005), include:

- Contingency planning
- Quality assurance
- Separation or relocation of activities and resources
- Contract terms and conditions
- Crisis management and disaster recovery plans

Those risks which should be reduced can also be shared with parties that have more appropriate resources and knowledge about the consequences (Thomas, 2009). Sharing can also be an alternative, by cooperating with other parties. In this way, one project team can take advantage of another's resources and experience. It is a way to share responsibilities concerning risks in the project (Darnall and Preston, 2010).

2.5 PREVIOUS STUDIES IN OTHER COUNTRIES

Risk management is not a new concept and is being carried out since many years. Construction industry is very ambiguous due to the complex activities it involves and the potential risks it carries. Due to its importance many studies have been carried out in many countries to identify the best risk management approach in order to overcome the aftermath of the risks which if incurred can cause huge loss in terms of both time and money to all the participants in the construction industry. In this section, similar studies carried out previously in Saudi Arabia and 10 other countries will be discussed. The objective of each study, the methodology they adapted in order to achieve their objective and the findings of their study will be discussed. Two studies carried out in Saudi Arabia, one in Kuwait, U.A.E, Palestine, U.S, Pakistan, China, Malaysia, Indonesia and Thailand will be discussed below.

2.5.1 RISK MANAGEMENT IN CONSTRUCTION PROJECTS FROM CONTRACTORS AND OWNERS PERSPECTIVES IN PALESTINE (Jaser, 2005)

The main objectives of this study were to identify the key risk factors and to investigate the severity and the allocation of each identified risk factor according to the perspectives of contractors and owners and also to examine the risk management actions efficiency that are applied in the industry.

In order to achieve the objectives of the study a closed-ended questionnaire with interview was used to collect data from Construction professionals of the Palestine construction industry.

A draft questionnaire, with 36 risk factors was prepared from literature. Content validity was conducted by sending the draft questionnaire with covering letter to six experts to evaluate the content validity of questionnaire, to check readability, offensiveness of the language and to add more factors and information if needed. As a result, 12 additional factors were added and 4 were omitted to reflect the nature of construction industry in Gaza Strip. Thus, a total of 44 factors were included in the final questionnaire and distributed. The findings from the questionnaire indicated that the top 10 most significant risk factors that the construction contractors of Palestine are mostly concerned with are Financial failure of the contractor as the top most significant risk followed by Closure, Defective design (incorrect), Delayed payments on contract, Poor communication between involved parties, Unmanaged cash flow, Awarding the design to unqualified designers, Monopolizing of materials due to closure and other unexpected political conditions, Inflation and Supplies of defective materials as the 10^{th} most significant risk. The 10 risk factors in the order of priority that the construction contractors of Palestine are less concerned with are Design changes, Undefined scope of working, Inaccurate project program, Adverse weather conditions, Ambiguity of work legislations, Actual quantities differ from the contract quantities, Difficulty to get permits, Environmental factors, Rush bidding and finally New governmental acts or legislations as the least significant risk factor.

2.5.2 RISK AND ITS MANAGEMENT IN KUWAIT CONSTRUCTION INDUSTRY: A CONTRACTORS PERSPECTIVE (Kartam et al, 2001)

The objective of this paper was to identify the attitude of large Kuwaiti contractors towards construction risk. This paper was concerned with the assessment and allocation of risk and also investigated the most effective approaches towards preventing or minimizing construction risks.

The objectives were achieved by collecting the responses using questionnaire through guided interviews with major contractors in the Kuwaiti construction industry.

A total of 26 risk factors were included in the questionnaire without any particular order. These risk types were generated based on extensive literature review and consultation with the key local experts who participated in the survey. The results obtained from the questionnaire indicated that the 5 most significant risk factors in the order of priority that the contractors in Kuwait construction industry fear and are highly concerned with are financial failure either of the contractor or owner or sub-contractor as the moist significant risk followed by, Delayed payment on contract, Labor, equipment and material unavailability, defective design and finally Coordination with the sub-contractor as the 5^{th} most significant factor. The 5 risk factors in the order of priority that the contractors in Kuwait construction industry are less feared and concerned with are government's acts, Accidents/safety, Acts of God, Adverse weather condition and the least concerned risk is Labor disputes.

2.5.3 CONTRACT RISK ALLOCATION IN SAUDI ARABIAN CONSTRUCTION PROJECTS (Khaliluddin, 2010)

The objective of this study was firstly, to identify the potential construction risks in the Saudi Arabian Construction Industry and allocate the construction risks to the concerned party, which could be the contractor, owner or consequential sharing. Secondly, to assess the significance of these construction risks in the Saudi Arabian Construction industry.

The results to achieve the objective were obtained by sending questionnaire to the contractors of Saudi Arabia.

A total of 36 risk factors were identified through an extensive literature review and were included in the questionnaire. The results of this study indicated that the top 10 most significant risk factors that the contractors of Saudi Arabia are mostly concerned with are Poor quality of work at the top followed by Owners' unreasonably imposed tight schedule, Change of design required by owners, Quality problems of supplier material, Low productivity of labor and equipment, Accidents during construction, Delay of material supply by suppliers, Defective design, Deficiencies in drawings and specifications and finally Lack of scope of work definition by the owner as the 10^{th} most significant factor. The 10 risk factors in the order of priority that the contractors of Saudi Arabia are less with concerned are Owners' improper intervention, Owners' delayed payment to contractors, Unfairness in tendering, Difficulty in claiming insurance compensation, War threats and political instability, Changes in laws and regulations, Subcontractors' poor performance, Criminal acts, Conflicts due to differences in culture and the least concerned factor is Corruption and bribes.

2.5.4 ASSESSMENT OF RISK MANAGEMENT PERCEPTIONS AND PRACTICES OF CONSTRUCTION CONTRACTORS IN SAUDI ARABIA (Salman, 2004)

The objective of this study was to investigate the assessments and management of construction risks. In particular, to identify the perception and attitude of the construction contractors towards allocation of risks, risk importance and their effects on the project.

In order to achieve the objectives of the study a questionnaire was chosen as the principal survey method. The questionnaire was sent to the construction contractors of Saudi Arabia in order to get their responses.

A total of 25 risk factors were identified based on extensive literature review and were included in the questionnaire. The findings from the questionnaire indicated that the top 10 most significant risk factors that the construction contractors of Saudi Arabia are mostly concerned with are Quality of work as the top most significant risk followed by Delayed payment on contract, Financial failure, Scope limitation and work definition, Labor, material and equipment availability, safety / accidents, change order negotiations, Accuracy of project program, Contractors Competence and Site access as the 10^{th} most significant factor. The 10 risk factors in the order of priority that the construction contractors of Saudi Arabia are less concerned with are Delayed dispute resolution, labor and equipment productivity, Permits and regulations, Third party delays, Actual quantities of work, Changes in government regulations, Coordination with subcontractors, Acts of God, Labor disputes and finally Adverse weather conditions as the least important risk factor.

2.5.5 RISK MANAGEMENT PERCEPTIONS AND TRENDS OF U.S. CONSTRUCTION (Roozbeh, 1995)

The objective of this study was to present the perception of the typical large U.S. contractor towards construction risk by providing insight into the current attitudes of U.S. contractors for construction risk allocation and examining the importance of different risk factors.

In order to achieve the objectives of the study, a questionnaire was sent to collect data from large contractors of the US construction industry. The questionnaire utilized by this survey is based on the survey conducted by ASCE during a conference on construction risk and liability sharing held in Scottsdale, Ariz. in January 1979. The purpose of that survey was concerned with the identification and allocation of risk.

A total of 23 risk factors were included in the questionnaire and some of the questions in the ASCE survey were combined into one question. Most questions are similar to the ASCE questions, while a fraction are the consolidation of two or more questions. The only question that has no counterpart in the ASCE survey is Defensive Engineering. The findings from the questionnaire indicated that the top 7 most significant risk factors that the construction contractors of US are mostly concerned with are Defective design as the most significant risk followed by Safety, Quality of work, Delayed payment on contract, Contract-delay resolution, Changes in work and 7th most important risk factor as Change-order negotiations. The 7 risk factors in the order of priority that the construction contractors of US are less concerned with are Defensive engineering, Labor disputes, Site access / right of way, Defective materials, Acts of God, Permits and ordinances Changes in government regulations as the lest significant risk factor.

2.5.6 RISK ASSESSMENT AND ALLOCATION IN THE UAE CONSTRUCTION INDUSTRY (Sameh, 2008)

The main objective of this paper is to identify and assess the significant risks in the UAE construction industry based on their risk rating (impact and probability). The paper also compares the perspectives of local and international companies working in the UAE. Moreover, this research addresses the proper allocation of risks to the appropriate contracting party.

The objectives of the study were achieved by sending questionnaire to the construction professionals associated with the UAE construction industry. The completed responses were collected either personally, or received through regular postal mails, e-mails, and faxes.

A total of 42 risk factors were identified based on extensive literature review and were included in the questionnaire. The findings of the questionnaire indicated that the top 10 most significant risk factors that the construction professionals of UAE are mostly concerned with are Inflation and sudden changes in prices as the top followed by Owners' unreasonably imposed tight schedule, Subcontractors' poor performance, Delay of material supply by suppliers, Change of design required by owners, Owners' improper intervention, Shortage in manpower supply and availability, Delays in approvals, Lack or departure of qualified staff and the 10^{th} factor as Shortage in material supply and availability. The 10 risk factors in the order of priority that the construction professionals in UAE are less concerned with are Accidents during construction, Labor strikes and disputes, Changes in laws and regulations, Owners' sudden bankruptcy, Corruption and bribes, Conflicts due to

differences in culture, War threats and political instability, Unexpected inclement weather, Substance abuse and finally Criminal acts as the least important.

2.5.7 IDENTIFICATION OF RISK MANAGEMENT SYSTEM IN CONSTRUCTION INDUSTRY IN PAKISTAN (Rafiq, 2013)

The main objectives of this paper were to identify and prioritize common risks, management techniques to address those risks, the current status of the implementation of risk management systems in organizations, and barriers to effective risk management in the Pakistan construction industry.

The findings of the study were obtained using a questionnaire survey and interviews with key participants in the construction industry of Pakistan.

A total of 20 major risks were identified using extensive literature review and input of experts from the pilot survey which was conducted to check the applicability of the questionnaire in the local environment in Pakistan. The results show that the five most important project risks in order of priority are financial factors as most significant risk followed by economic factors, quality, premature failure of facility and finally the 5th most significant factor that the contractors in Pakistan are more concerned with is lack of planning and management. The 5 project risk which the contractors are least concerned with in the order of priority are feasibility of construction methods, insufficient technology / skills / techniques, poor coordination / cooperation / relationship among key stakeholders, non-implementation of standard bidding / contract documents and force majeure as the least concerned risk.

2.5.8 RISK MANAGEMENT IN THE CHINESE CONSTRUCTION INDUSTRY (Tang et al, 2007)

The main objectives of this study were to identify the importance of project risks, application of risk management techniques, status of the risk management system, and the barriers to risk management, which were perceived by the main project participants.

In order to achieve the objective a questionnaire was chosen as the principal survey method. The questionnaire survey was conducted through fieldwork, with the projects and respondents being chosen in advance. The questionnaire was completed face to face by each respondent.

A total of 32 risk factors were identified based on extensive literature review and were included in the questionnaire. The findings from the questionnaire indicated that the top 8 most significant risk factors that the Chinese construction professionals are mostly concerned with are poor quality of work as the top most significant followed by premature failure of the facility, safety, inadequate or incorrect design, financial risk, Failure to identify defects, Material or equipment quality and the 7^{th} significant factor as Force majeure. The 7 risk factors in the order of priority that the Chinese construction professionals are less concerned with are Shortage of labor, materials and equipment, Conflicts in documents, Poor relationship between parties, Organizational interface, Environmental, Site access and the least significant risk factor is Logistics.

2.5.9 NATURE OF THE CRITICAL RISK FACTORS AFFECTING PROJECT PERFORMANCE IN INDONESIAN BUILDING CONTRACTS (Wiguna et al, 2005)

The main objective of this study was to investigate the most critical risk factors causing project time and cost in Indonesian building projects under construction which were assessed using a risk assessment method similar to that proposed by Hastak and Shaked (2000).

In order to achieve the objective of the study, a questionnaire survey was used which predominantly based on a series of interviews with the project teams. The structured questionnaire was divided into two sections, the first section dealing with risks affecting time, while the second section asking similar questions about risk affecting cost. The intention of the subsequent interviews, was to identify the risk factors that had occurred in the previous month and to define the impacts of those risks on their project's performance. A total of 22 building projects under construction in East Java and Bali provinces were surveyed during the period from mid December 2003 to the end of June 2004.

A total of 30 risk factors were identified based on extensive literature review and were included in the preliminary questionnaire. Based on the responses the final questionnaire was prepared and was used to obtain the objective of the study. The findings from the interview indicated that the top 5 most significant risk factors that the Indonesian construction professionals are mostly concerned with in regard to time are High inflation/ increased price as the top most significant followed by Design change by owner, Defective design, Weather condition and the 5th significant factor as Delayed payments on contract.

The 5 risk factors in the order of priority that the Indonesian construction professionals are less concerned withy are Low labor and equipment productivity, inadequately compensated variation Order, High interest rate, Difficult in obtaining permits and Ordinances and the least significant risk factor as Changes in government actions.

2.5.10 SIGNIFICANT RISK FACTORS IN CONSTRUCTION PROJECTS: CONTRACTOR'S PERCEPTION IN MALAYSIA (Karim, 2012)

The main objective of this study is to identify risk factors from contractors' perspective as the contractors are key players in the success of a project.

In order to achieve the objective of the study, a questionnaire survey was used to understand the perception of the contractors to the risk factors. The target respondents were the contractor registered with Pusat Khidmat Kontraktor (PKK).

A total of 22 risk factors were identified based on extensive literature review and were included in the questionnaire. The findings from the questionnaire indicated that the top 8 most significant risk factors that the Malaysian construction contractors are mostly concerned with are Shortage of material as the top most significant followed by Late deliveries of material, Shortage of equipment, Poor quality of workmanship, Cash flow difficulties, Insolvency of subcontractors, Inadequate planning and the 8th significant factor as Insolvency of suppliers. The 8 risk factors in the order of priority that the Malaysian construction contractors are less concerned are Delay in project approval and permits, Land acquisition, Inconsistencies in government policies, Pollution, Excessive contract variation, Ecological damage, Compliance with law and regulation for environment issue and the least significant risk factor as Improper design.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The main aim of this study was to investigate how the contractors in the Eastern Province of Saudi Arabia manage risks in their organization. Specifically to determine the risk factors which contractors in Eastern Province of Saudi Arabia evaluate to manage risk in a project and also to determine the strategies which contractors in the Eastern province of Saudi Arabia design, implement and control to eliminate or mitigate risks in a project.

This chapter presents the steps that are followed to achieve the objectives of the study. A flow chart on the research methodology is shown to get a clear picture of the methodology that is be followed. It has the following steps beginning with literature review, identification of risk analysis technique, risk factors and risk management actions, development of survey questionnaire, data collection, data analysis, results and terminating with conclusions and recommendations.

3.2 RESEARCH STRATEGY

Research strategy can be defined as the way in which the research objectives can be questioned (Naoum, 1997). Research is a thorough, systematic investigation or inquiry to validate old knowledge and generate new knowledge (Burns & Grove, 1987).

In this study, a quantitative approach was used to determine the variables and factors that affect the risk management practices in Construction Industry in Eastern Province of Saudi Arabia and to identify if there is a systematic risk management practice among the contracting companies

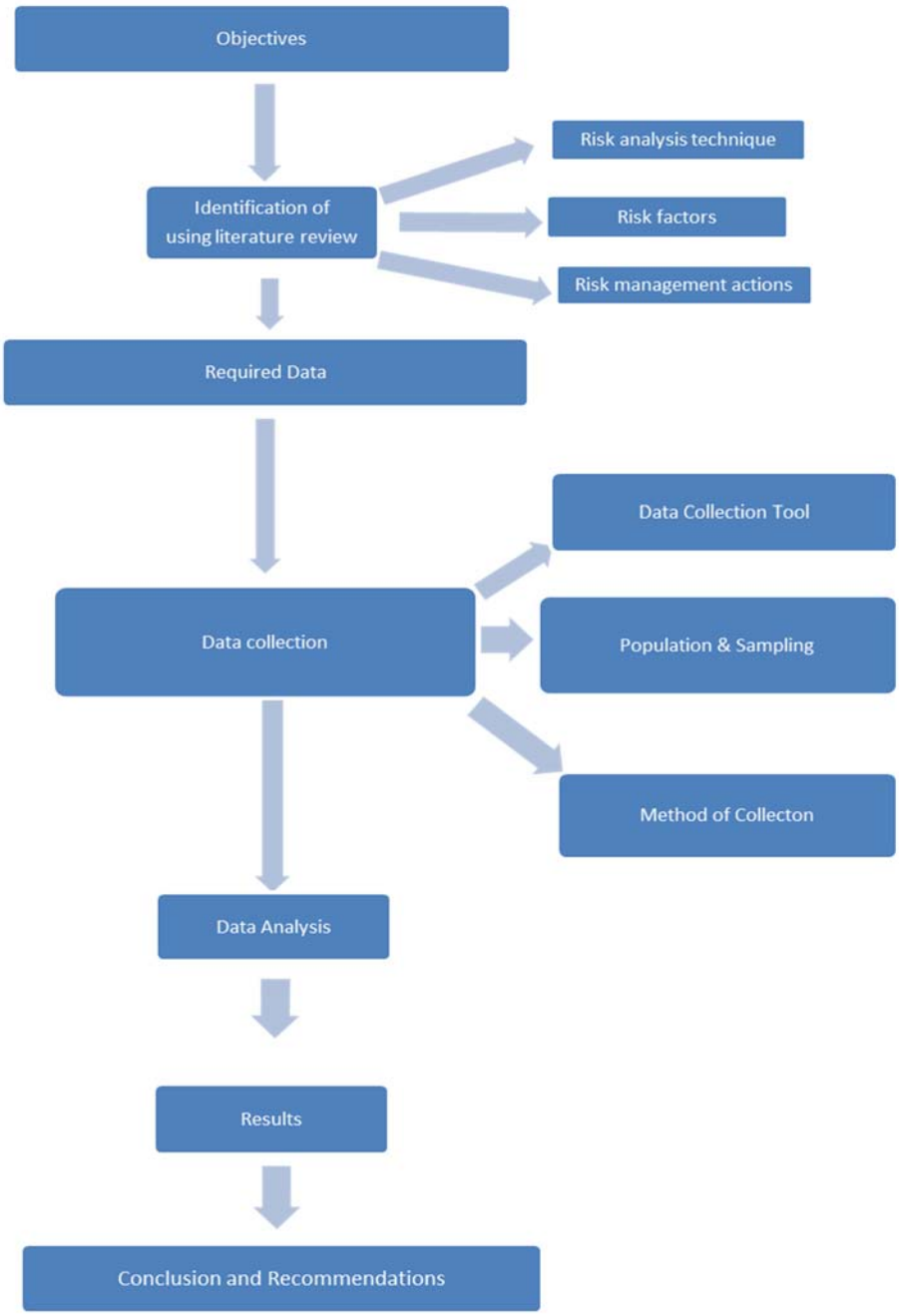

Figure 3.1 Flow Chart on Research Methodology

3.3 REQUIRED DATA

The objectives of this study mandates the collection of observations on the following variables:

A). Risk Evaluating Techniques: The literature review revealed many risk evaluating techniques from which the most suitable technique that can be applicable to Saudi Arabian construction industry were identified and is as follows

1. Compare similar projects through similar conditions

2. Direct judgment using experience and personal skills and documented knowledge

3. Expert Systems (including software packages, decision support systems, computer-based analysis techniques such as @Risk

4. Analyzing historical data

5. Sensitivity analysis

6. Consulting experts

7. Project team brainstorming

8. Project documentation reviews

9. Joint evaluation by key participants

10. Checklist

B). Risk Factor: The literature review revealed many risk factors from which the most suitable factors that can be applicable to Saudi Arabian construction industry were identified and are as follows

1. Defective design (incorrect)

2. Inflation

3. New governmental acts or legislations

4. Unavailable labor

5. Unavailable materials

6. Unavailable equipment

7. Occurrence of accidents because of poor safety procedures

8. Design changes

9. Project size in term of cost

10. Project size in terms of size

11. Project size in terms of time

12. Quality of work

13. Difficulty to access the site

14. Adverse weather conditions

15. Unforeseen site conditions

16. Supplies of defective materials

17. Late deliveries of material

18. Financial failure of the Contractor

19. Financial failure of the owner

20. Financial failure of the sub-contractor

21. Delay in progress payments

22. Poor labor and equipment productivity

23. Actual quantities differ from the contract quantities

24. Breach of Contract by any of the involved parties

25. Legal disputes among the contract parties

26. Labor Disputes

27. Delayed disputes resolutions

28. Drawings and documents are not issued on time

29. Exchange rate fluctuation

30. Undefined scope of work

31. Difficulty to get permits

32. Change order negotiation

33. Third party delay

34. Environmental factors

35. Contractors Competence

36. Sub-Contractors Competence

37. Poor communication between involved parties

38. Lack of consistency between bill of quantities, drawings and specifications

39. Corruption and Bribes

40. Subcontractors Poor performance

41. Frequent changes of design by designers

42. Unpredicted Technical problems during Construction

43. Delays in approval

44. Departure of Qualified staff or labor

45. Awarding the design to unqualified designers

46. Lower work quality in presence of time constraints

47. Poor communication between home and field offices

48. Failure to identify defects

49. Delay in payment of claims

50. High interest rates

51. Poor cost control

52. Feasibility of construction methods

53. Insufficient technology/skills / technique available

C). Risk Preventing and Mitigating actions: The literature review revealed many risk preventing and mitigating actions from which the most suitable action that can be applicable to Saudi Arabian construction industry were identified and are as follows

Risk Preventing actions

1. Depend on subjective judgment to produce a proper program

2. Produce a proper schedule by getting updated project information

3. Refer to previous and ongoing similar projects for accurate program

4. Consciously adjust for bias and add risk premium to time estimation

5. Plan alternative methods as stand-by

6. Utilize quantitative risk analyses techniques for accurate time estimate

7. Transfer or share risk to/with other parties

Risk Mitigating actions

1. Increase manpower

2. Increase the working hours

3. Increase the equipment

4. Change the sequence of work by overlapping activities

5. Coordinate closely with subcontractors

6. Close supervision to subordinates for minimizing abortive work

3.4 METHOD OF DATA COLLECTION

This is a very important step as it explains the method of collecting the data which is required in order to achieve the objectives of the study. Method of data collection involves identification of the following:

3.4.1 KEY INFORMANT

It is very important to identify the key informant from which the data required for achieving the objectives can be acquired. Selection of the key informant is very significant as it determines the authenticity of the information acquired about a particular feature of the organization which is Risk management in this study. The required data for this study was obtained from the top management of the contractor's organization who is responsible for managing the risks coming from the projects to the contractor which helped to identify whether there is a separate risk management department in the organization which will study risks in projects. If there is no such department then it will be necessary to identify the responsible body; planners, cost estimators, or project managers, etc.; for risk management.

3.4.2 TOOLS

The tool which was used to obtain the required data to achieve the objectives of the study was identified after thorough consideration as it will affect the quality of the response. A tool which clearly shows the objectives of the study, the data required, the interest of the receiver and the importance of the informer should be used. In this study a close-ended questionnaire is used to collect the data. A close-ended questionnaire is used for its advantages as it is easy to ask and quick to answer, and does not require writing either by the respondents or interviewer.

Questionnaire design

A questionnaire accompanied with a covering letter was delivered to contracting companies. The letter indicated the objectives of the research and explained to the

participants that the results of the questionnaire will be used to improve the ability of contractors to identify, analyze and estimate the risk factors impact on the construction phase of building projects.

The questionnaire is composed of six sections to accomplish the aim of this research, which are as follows:

The Contractors Organization profile: This section contains questions seeking information related to contractors profile such as the size, annual revenue, number of employees, number of projects completed etc.

The Respondents profile: This section contains questions seeking information related to the respondents profile such as educational level, job title, experience etc.

Risk management in the organization: This section contains questions seeking information related to risk management in the organization such as whether it is done, since when it is being done, number of employees involved, when it is carried whom to report etc.

Risk analysis techniques: This section contains questions seeking information related to risk analysis techniques that the contractor believes to be suitable.

Risk factors: This section contains questions seeking information related to risk factors that the contractor believes to be significant.

Risk preventive and mitigative action: This section contains questions seeking information related to risk preventive and mitigative actions that the contractor believes to be suitable.

At the end of the last three sections an option was given to the respondent to add and rate any additional risk analysis technique, risk factor and risk management actions that he might think is significant in risk management studies.

Finally, full contact information of the surveyors was included in the covering letter for the respondents to contact if they needed any clarification or if they had any questions regarding the study. Appendix A presents the developed questionnaire.

3.4.3 METHOD

The questionnaire that is illustrated in appendix A was sent to collect the required data to achieve the objective of the study. It was sent through post mail and e-mails. Each respondent was followed up by e-mails, fax, phone etc.

3.5 POPULATION AND SAMPLING

A population consists of the total number of objects about which the study is concerned (Walpole & Myers, 1998). In this study, the population is the grade 1, 2 and 3 Construction contractors in the Eastern Province of Saudi Arabia as per the classification done by the Ministry of Municipality and Rural Affairs.

Since the total number of grade 1, 2, 3 construction contractors in the Eastern Province of Saudi Arabia are only 80. Therefore the questionnaire was sent to all of them.

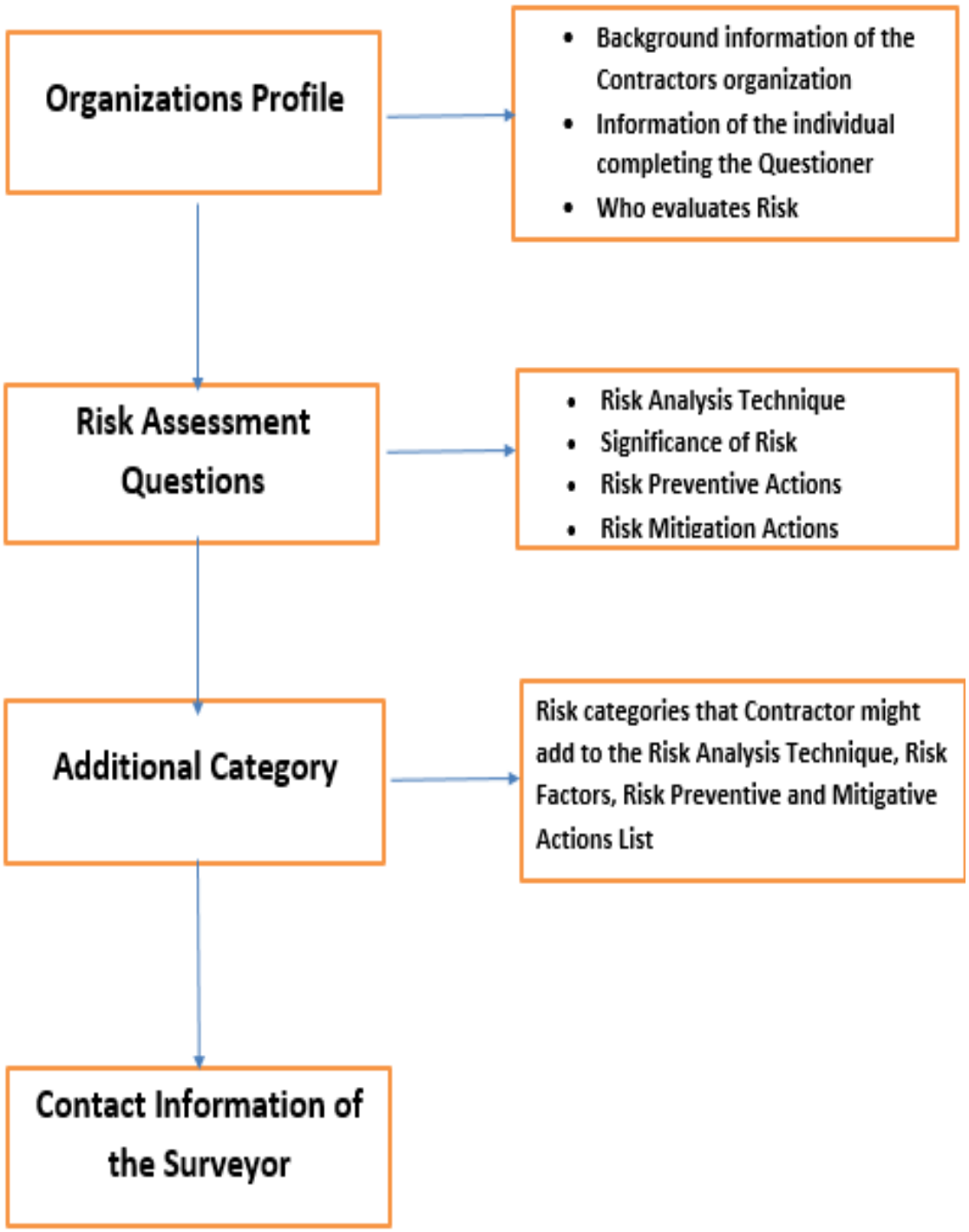

Figure 3.2 Layout of the questionnaire

3.6 SCORING SYSTEM

The initial section of the questionnaire doesn't really require any sort of scoring system as it is related to the profile of the organization and the respondent. Hence the usage of scoring system initiates at the level of calculation of weighted scores to determine the ranks.

3.6.1 SIGNIFICANCE OF RISK FACTORS

The degree of impact for each risk type is included in the questionnaire under the heading "Significance". The questionnaire is designed to examine practitioner's observations and judgments of the practitioner in determining the relative significance of each risk factor. Although the degree of impact varies from project to project, the questionnaire is expected to elicit a general assessment of the significance of risk. Each respondent is required to rank each risk on a scale from 1 to 9 by considering its contributions to the project. Scale 1 to 9 is selected to obtain a greater level of suppleness in choosing statistical procedures (Wood & Haber, 1998). Rank 1 is assigned to a risk that would give the lowest contributions to risk consequences while Rank 9 is allotted to a risk that would cause the highest contribution. At the same time ranks (1-3) means low importance risks, ranks (4-6) for medium risks and (7-9) for high risks. In order to quantitatively demonstrate the relative significance of risks to a project, a weighting approach is adopted. The principle is that the risk with the highest contribution rank would be assigned the largest weight. Weighted score of each individual risk was obtained by multiplying the number of respondents with the

corresponding weight for that particular risk. Then the total weight is divided by the number of responses to get a weighted mean value.

3.6.2 RISK ANALYSIS TECHNIQUES

Respondents were asked to rank the relative use of risk analysis techniques. Ten methods were included to highlight the construction industry practitioners concerns about risk analysis and its approaches. Each contractor was asked to rate each technique on a scale of 1 to 5 where 1 represents not suitable, 2 represents somewhat suitable, 3 represents suitable, 4 represents more suitable and 5 represents highly suitable. The same weighing policy as described above was used to measure the weighted score for each technique listed.

3.6.3 RISK PREVENTIVE ACTIONS

Preventive actions are used to avoid and reduce risks at the early stage of project construction, yet they may lead to submitting an excessive high bid for a project. Each of the contractor was asked to rate each technique on a scale of 1 to 5 where 1 represents not suitable, 2 represents somewhat suitable, 3 represents suitable, 4 represents more suitable and 5 represents highly suitable. The same weighing policy as described above was used to measure the weighted score for each technique listed.

3.6.4 RISK MITIGATIVE ACTIONS

While some project risks can be reduced though various preventive actions at early stages, the delay of progress still occurs in many projects during the construction process. A recent industry study has indicated that over 80% of projects exceed their scheduled time even with the employment of software techniques for project

development (Katram, 1992). When risk occurs, contractors can adopt various mitigative actions to minimize the effects of the risk. Each of the contractor were asked to rate each mitigative action on a scale of 1 to 5 where 1 represents not suitable, 2 represents somewhat suitable, 3 represents suitable, 4 represents more suitable and 5 represents highly suitable. The same weighing policy as described above was used to measure the weighted score for each technique listed.

3.7 DATA ANALYSIS

Data obtained from the questionnaire was analyzed and used to identify the significant risk factors that affect a project and also to identify the best risk analysis technique and risk management action that are considered by the construction contractors in the Eastern Province of Saudi Arabia

Statistical methods were used to interpret the results. The analyzed data is presented in tabulated format and Figures. Graphical representations have a tendency to make the comparisons clearer and thus were used for showing the risk importance levels for all the risks and the best risk evaluation technique and management actions from contractor's perspective. By carefully studying the results of the survey, a better understanding will be gained of the current situation of risk management in the construction industry from a local contractor's point of view. This will also help in recommending the next approach for further studies on the subject.

CHAPTER 4

RESULTS AND ANALYSIS

This chapter presents the data analysis of the results from the questionnaire survey so that the risk management practices in construction industry currently used by contractors in the Eastern Province of Saudi Arabia can be understood. Mainly, the respondents profile, risk management in organizations, risk analysis techniques, risk factors, risk preventive and mitigative action are discussed in detail in the following sections. Furthermore, the results would go through an analysis such that suggestions or recommendations can be put forward to overcome the problems faced in the current practice.

4.1 CHARACTERISTICS OF THE PARTICIPANT

The required information was obtained using a questionnaire. The questionnaire was sent to the entire population of construction contractors who are classified as grade I, 2 and 3 by the Ministry of Municipality and Rural Affairs in the Eastern Province of Saudi Arabia. The e-mails, telephone number and the postal mail address of these 80 contractors were also obtained from the Ministry. The questionnaire was sent to all the contractors 3 times by postal mail and then followed by telephone and e-mail twice a week. The responses were collected over a period of 8 months. Initially the response rate was very sluggish and later on gained momentum as personal meetings with project managers and construction

executives were done to get their responses. A total response rate of 28% was achieved in the due course of data collection.

4.1.1 CONTRACTORS PROFILE

Contractors profile such as the size, annual revenue, number of employees, number of projects completed etc, are used to describe the participating organizations.

- The results indicate that grade 2, majority of grade 1 (87.5%), and grade 3 (57.2%) participating contractors were established more than 15 years ago as shown below in Table 4.1. It is interesting to notice that 14.3% of grade 3 contractors were established in last 5 years. It seems that most of these contractors are foreign or joint venture with good experience and capabilities in the construction business. This indicates that a major ratio of the contractors have been established for a long time and have sufficient experience and knowledge in the Saudi construction industry.

Table 4.1 Organization age

Organization age	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Less than 5	4.7	0	0	14.3
5-less than 10	4.1	12.5	0	0
10-less than 15	9.1	0	0	28.6
15-less than 20	13.6	12.5	14.3	14.3
20 or more	68.2	75.0	85.7	42.9

- The results indicated that grade 1, and majority (85.7%) of grade 2 and 42.9% of grade 3 participating contractors have employed more than 1000 personnel in their organization as shown below in Table 4.2. This indicates that they are very well

equipped with large man power and are capable of carrying large projects. This is expected as the study target population is large contractors (grade 1, 2 and 3).

Table 4.2 Number of employees in organization

Number of Employees	All Contractors (%)	Grade 1 (%)	Grade 2 (%)	Grade 3 (%)
100-less than 500	9.1	0	0	28.6
500-less than 1000	13.6	0	14.3	28.6
1000-less than 1500	22.7	0	57.1	14.3
1500 or more	54.5	100	28.6	28.6

- The results show that the majority of grade 1 (87.5%), grade 2 (71.4%) and grade 3 (85.7%) participating contractors indicated that they provide their services to both government and private clients and are not inclined only to one sector as shown below in Table 4.3. The remaining participating contractors provide service to either government or private clients. This mix of experience add great value to the provided information which are related to risk.

Table 4.3 Clients distribution

Clients	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Government sector	82	12.5	14.3	0
Private Sector	9	0	14.3	14.3
Both	9	87.5	71.4	85.7

- The results indicated that majority (83.3%) of grade 1 contractors have financial capital more than 40 million while majority (71.5%) of grade 2 contractors have financial capital less than 20 million. It is interesting to note that grade 3 contractors are dispersed in regard to their financial strength as shown below in Table 4.4. This shows that almost half of the total participating contractors have the financial strength to undertake high cost projects.

Table 4.4 Financial capital in Saudi riyals

Saudi Riyals	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
less than 10 million	25	0	42.9	28.6
10-less than 20 million	20	16.7	28.6	14.3
20-less than 30 million	5	0	0	14.3
30-less than 40 million	5	0	0	14.3
40 million or more	45	83.3	28.6	28.6

- The results indicated that the participating contractors are varying with respect to the number of projects executed in the last 5 years regardless of the grade with overall 28.6% of the participating contractors undertaking 10 to less than 20 projects, 23.8% undertaking 20 to less than 30 projects and 28.6% undertaking more than 40 projects as shown below in Table 4.5. This may be because some of the participating contractors are more interested in big projects and are focusing on the project size rather than number of projects executed. Another reason may be due to the decrease in the number of projects due to recession as there are not many clients willing to invest in new project or due to favoritisms where the clients are more bent towards some contractors and are not focusing on all the contractors.

Table 4.5 Projects completed in last 5 years

Number of Projects	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
less than 10	14.3	12.5	14.3	16.7
10-less than 20	28.6	25.0	57.1	0
20-less than 30	23.8	25.0	14.3	33.3
30-less than 40	4.8	12.5	0	0
40 or more	28.6	25.0	14.3	50

- The results for grade 1 and majority (57.1%) of grade 2 participating contractors indicated that, the average cost of the project they undertake is more than 100 million while majority (57.1%) of grade 3 contractors indicated that they undertake projects that cost less than 20 million as shown below in Table 4.6. This shows that majority of the grade 1 and 2 contractors are performing only high cost projects and are not interested in small value projects.

Table 4.6 Average cost of each project in Saudi riyal

Cost	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Less than 20 million	18	0	0	57.1
40-less than 60 million	14	0	28.6	14.3
60-less than 100 million	4	0	14.3	0
100 million or more	64	100.0	57.1	28.6

- The results indicated that all the participating contractors are carrying out different types of projects regardless of the grade such as Infrastructure, Buildings, Utilities,

Industrial, and Residential and are not limiting themselves to a particular type of construction as shown below in Table 4.7. The participating contractors were asked to write any other type of projects which they perform. Two contractors said that they perform oil and gas projects and one said well sites. This indicates that only some of the contractors are specialized in performing oil related projects in Saudi Arabia, which is the largest oil producer in the world. This may be due to the complexities involved in such type of construction.

Table 4.7 Type of construction performed

Type of Construction	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Infrastructure	17	12.9	20.8	16.7
Buildings	23	25.8	20.8	22.2
Utilities	20	19.4	20.8	22.2
Industrial	19	22.6	16.7	16.7
Residential	21	19.4	20.8	22.2

4.1.2 THE RESPONDENTS PROFILE

Respondents profile such as the educational level, job title, experience etc, are discussed in detail below to determine the knowledge and experience of respondents thus ensuring the credibility of the results obtained.

- The questionnaire was completed by the top management of the organizations such as Business Development Manager, Chief Executive Officer, Chief Operations Officer, Projects Manager, Quality Management Representative, Division Manager, General

Manager, Risk Assessment Engineer and Senior Vice President etc. This shows that the answers that are obtained regarding risk management from the contractor are given by the personnel who are aware of the important decisions and practices that their organization undertakes thus ensuring that the required data on risk management was obtained from reliable and well experienced experts. The results indicated that majority (95.2%) of these experts have at least a bachelor degree. The participant's education distribution is presented below in Figure 4.1. This shows that the respondents have good academic knowledge and have understood the question properly.

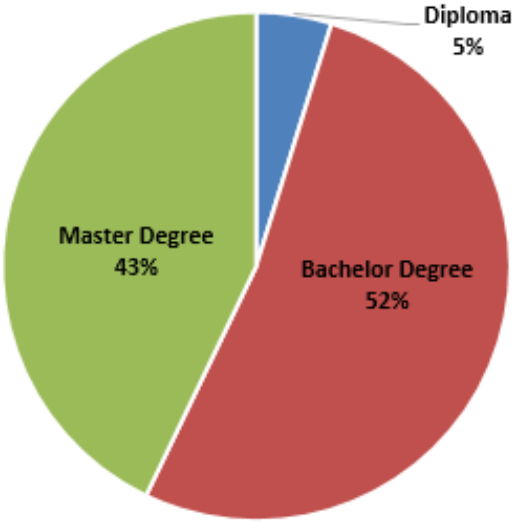

Figure 4.1 Participants educational level

- The results indicated that majority (60%) of the respondents are working with their present organization for more than 6 years as shown below in Figure 4.2. This shows that most of the respondents are working in their respective organization for sufficient time in order to be aware of the methods, procedures and practices their organization undertakes regarding risk management.

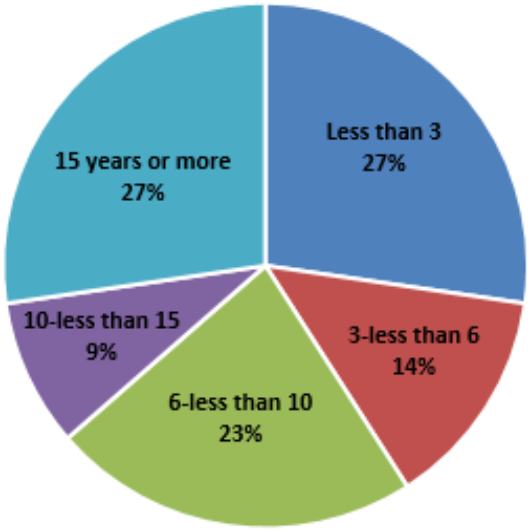

Figure 4.2 Experience in present organization

- The results indicated majority (73%) of the respondents are working in the construction industry for more than 15 years as shown below in Figure 4.3. This shows that the respondents had sufficient knowledge and experience of the questions that are asked in the questionnaire and have answered the questions accurately. Thus, ensuring the credibility of the results that are obtained from this study.

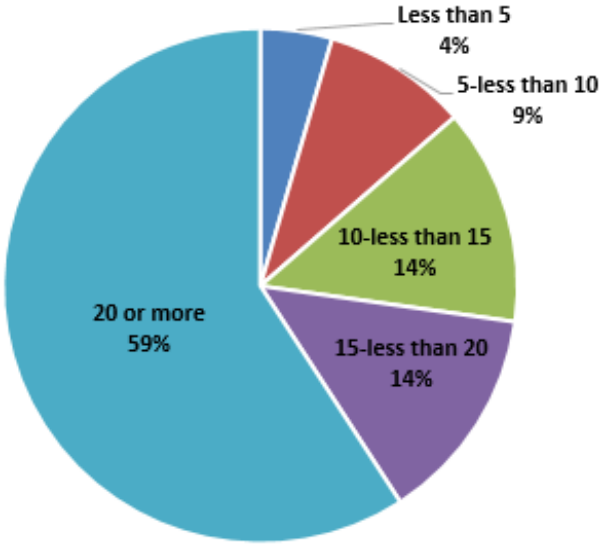

Figure 4.3 Total experience in construction industry

4.2 RISK MANAGEMENT IN THE ORGANIZATION

Risk management in the organization such as whether it is carried out, for how long it is being done, number of employees involved, when it is carried, at what stage it is carried out and whom to report etc, are discussed below to understand the current status of risk management in the participating contractors organization.

- The results indicated that grade 1, majority of grade 2 (83.7%) and grade 3 (71.4%) participating contractors do consider risk management in their business as shown below in Table 4.8. Surprisingly and unfortunately 13.6% (14.3% of grade 2 and 28.6% of grade 3) of the participants indicated that they do not consider risk management. The contractors were given a choice to proceed to the rest of the questions in this section if their organizations carry out risk management. Thus, the results obtained for the rest of this section are given by the 86.4% respondents.

Table 4.8 Risk Management on organization

Risk Management	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Yes	86.4	0	14.3	28.6
No	13.6	100.0	85.7	71.4

- The results indicated that the majority of participating contractors i.e. 50% of grade 1, 66.6% of grade 2 and 80% of grade 3 who consider risk management in their business operation have been performing risk management for more than 5 years as shown below in Table 4.9. The remaining participating contractors have realized the

importance of risk management less than 5 years ago and have started implementing it in their organizations.

Table 4.9 Start of risk management in organization

Number of years	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Less than 2 years	21	25.0	16.7	20
2 — less than5 years	16	25.0	16.7	0
5 — less than 10 years	21	12.5	33.3	20
10 years or more	42	37.5	33.3	60

- The results indicated that the participating contractors are varying in regard to the responsible person for performing risk management in their organization regardless of grade with 38.5% indicating the project manager, 19.2% the cost estimator and 15.4% as a separate risk management department. The remaining participating contractors are depending on the Planner, Senior Vice President of Estimation, Director of Cost and Planning and Tendering Team as shown below in Table 4.10 for performing risk management in their organizations. Very Less ratio of the grade 1 and 2 contractors have formed a separate risk management department in their organizations while none of the grade 3 contractors have established a risk management department which indicates that there is not a systematic approach taken by the contractor and there is a lack of risk management professionals in the construction industry in Saudi Arabia. The contractors were given a choice to proceed to next 4 questions in this section if they have a separate risk management department in their organization and skip them

if they do not have it. Thus, the results obtained for the next 4 questions in this section are given by the 15.4% respondents.

Table 4.10 Responsible personnel for Risk Management

Responsible Personnel	All Contractors (%)	Grade 1 (%)	Grade 2 (%)	Grade 3 (%)
Planner	15	10.0	22.2	14.3
Cost Estimator	19	10.0	11.1	42.9
Project Manager	39	40.0	33.3	42.9
Separate Risk Management department	15	30.0	11.1	0
Senior VP of estimation	4	0	11.1	0
Director of Cost and Planning	4	10.0	0	0
Tendering Team	4	0	11.1	0

- The results indicated that two participating contractors established risk management department in their organization for less than two years and two of them have established for more than two years as shown below in Figure 4.2.4. Two of the participating contractors have employed less than five personnel for the risk management department and two of them have employed more than ten as shown below in Figure 4.4. This indicates that the risk management department in these organizations are still in its early stages and the contractors have to make these department stronger to utilize them at full potential.

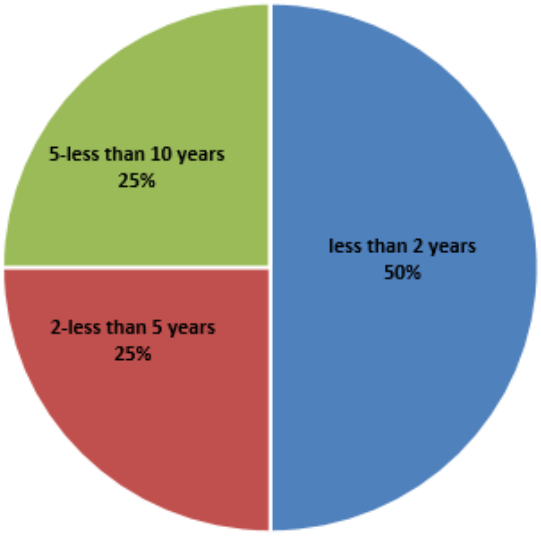

Figure 4.4 Formation of risk management department

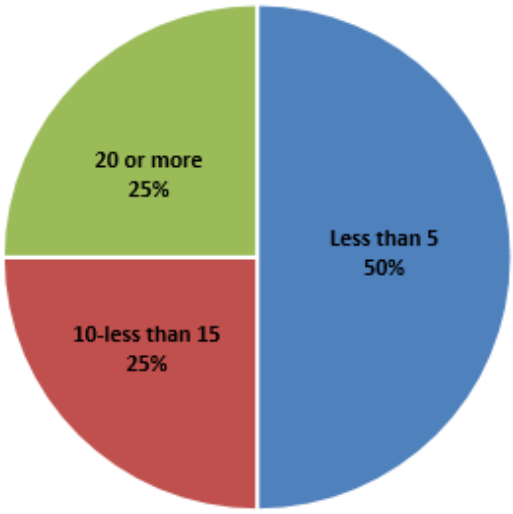

Figure 4.5 Number of employees in risk management department

- The results indicated that the personnel to whom the risk management department reports is varying among the participating contractors. This indicates that the risk management department are reporting to different personnel for each contractor but these personnel belong to the upper management of the contractors organization consisting of the president, CEO, operations manager etc as shown below in Figure 4.6.

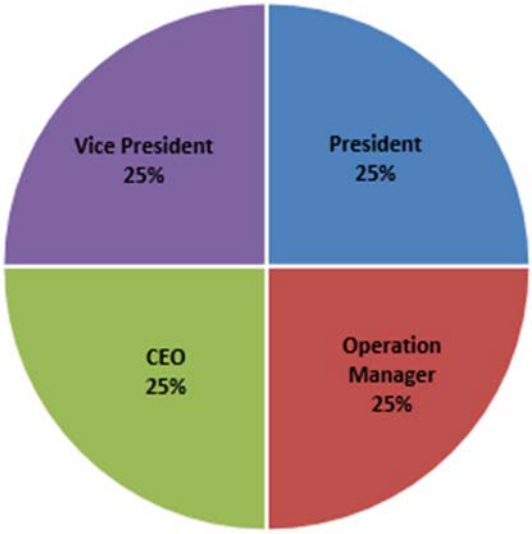

Figure 4.6 Personnel to report

- The results indicate that majority of grade 1 (66.7%) and grade 3 (75%) participating contractors have employed responsible person for risk management with an experience of more than 10 years in the area of risk, while the grade 2 contractors are varying in this regard as shown below in Table 4.11. The remaining grade 1 and 3 participants have employed less experienced personnel in the area of risk management. This result is in accordance with the result for start of risk management in the organization thus indicating that majority of the contractors have experienced risk management personnel and the remaining have started to realize the importance of risk management in construction industry.

Table 4.11 Number of year's responsible person involved in Risk management

Number of year	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Less than 2 years	25	16.7	33.3	25
2 — less than 5 years	19	16.7	33.3	0
10 years or more	56	66.7	33.3	75

- The participating contractors were asked on which project in terms of cost, size and time does their organization perform risk management and were given a choice to select more than one answer. The results indicate that in terms of cost, majority participating contractors i.e. 75% of grade 1, 42.9% of grade 2 and 60% of grade 3 perform risk management on every project while 35% (25% of grade 1, 42.9% of grade 2 and 40% of grade 3) participating contractors are performing risk management on only large projects as shown below in Table 4.12. In terms of time, majority of the participating contractors i.e. 75% of grade 1, 57.1% of grade 2 and 80% of grade 3 perform risk management on every project while 25% (25% of grade 1, 28.6% of grade 2 and 20% of grade 3) participating contractors are performing risk management on only large projects as shown below in Table 4.13. In terms of size, majority of the participating contractors i.e. 62.9% of grade 1, 42.9% of grade 2 and 66.7% of grade 3 perform risk management on every project while 33% (25% of grade 1, 42.9% of grade 2 and 33.3% of grade 3) participating contractors are performing risk management on only large projects as shown below in Table 4.14. This indicates that majority of the participating contractors consider risk management should be performed on every project irrespective of cost, time and size while the remaining consider it to be essential on only large projects.

Table 4.12 Risk Management on projects in terms of cost

Cost	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Medium Project	5	0	14.3	0
Large Project	35	25.0	42.9	40
Every Project	60	75.0	42.9	60

Table 4.13 Risk Management on projects in terms of time

Duration	All Contractor (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Medium Project	5	0	14.3	0
Large Project	25	25.0	28.6	20
Every Project	70	75.0	57.1	80

Table 4.14 Risk Management on projects in terms of size

Size	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Medium Project	10	12.5	14.3	0
Large Project	33	25	42.9	33.3
Every Project	57	62.5	42.9	66.7

- The results indicated that grade 3 and majority of grade 1 (87.5%) and grade 2 (66.7%) participating contractors consider that risk management should be performed throughout the life cycle of the project and not on any particular stage as shown below in Table 4.15. This indicates that the contractors are aware and have started accepting risk management as an important aspect for the success of the project in the construction industry. Thus the contractors are managing the risk at all stages starting from tendering till the handover of the project to the owner.

Table 4.15 Risk Management throughout the project life cycle

Project life cycle	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Yes	84	87.5	66.7	100
No	16	12.5	33.3	0

- The results indicate that 46.2% of grade 1, 50% of grade 2 and 28.6% of grade 3 participating contractors consider that risk management should be performed as it helps

in long term cost savings for the organization while 23.1% of grade 1, 40% of grade 2 and 28.6% of grade 3 participating contractors are performing risk management as they are quick and competent in handling risks as shown below in Table 4.16. This shows that majority of the contractors perform risk management as they are aware of the importance and benefits that are associated and also that they are capable of performing risk management effectively. 15.4% of grade 1 and 14.3% of grade 3 contractors consider that they are performing risk management due to unclear client's requirement. This may be because these contractors are dealing with different clients and there are ambiguities present in some of the contract. Thus, making it difficult for the contractors to understand the owner's requirements clearly. 15.4% of grade 1, 10% of grade 2 and 28.6% of grade 3 contractors consider that they are performing risk management due to complexities that occur in the projects. This may be because of the new technologies that is being introduced in the industry which are making the projects more complex. Thus, causing difficulties to the contractors in construction of such projects.

Table 4.16 Reasons for risk management

Reasons	All Contractors (%)	Grade 1(%)	Grade 2(%)	Grade 3(%)
Long term cost savings	43	46.2	50	28.6
Clients Requirement	10	15.4	0	14.3
Complex Projects	17	15.4	10	28.6
Quick and more competent in handling Risks	30	23.1	40	28.6

4.3 RISK ANALYSIS TECHNIQUE

In this section suitability of various risk analysis techniques by all the participating contractors and by each grade of contractor are separately analyzed and discussed. The results indicate that the participating contractors consider Consulting experts, Analyzing historical data, Joint evaluation by key participants, Project documentation reviews, Project team brainstorming, Checklist, Sensitivity analysis, Compare similar projects through similar conditions, Direct judgment using experience and personal skills and documented knowledge, and Expert software packages as the more suitable techniques for analysis of risk in Saudi Arabia and each technique is discussed in detail below.

Table 4.17 Risk Analysis Technique

Risk analysis technique	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Consulting experts	1.00	5.00	3.95	3.87	4.28	3.71
Analyzing historical data	2.00	5.00	3.77	3.75	3.71	3.85
Joint evaluation by key participants	2.00	5.00	3.77	3.75	4.00	3.57
Project documentation reviews	1.00	5.00	3.72	3.25	4.14	3.85
Project team brainstorming	1.00	5.00	3.68	3.25	4.28	3.57
Checklist	2.00	5.00	3.63	3.50	4.00	3.42
Sensitivity analysis	1.00	6.00	3.52	3.37	3.50	3.71

Table 4.17 Risk Analysis Technique continued…

Risk analysis technique	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Compare similar projects through similar conditions	2.00	5.00	3.40	3.37	3.57	3.28
Direct judgment using experience and personal skills and documented knowledge	1.00	5.00	3.31	3.00	3.71	3.28
Expert software packages (decision support systems, computer- based analysis techniques such as @Risk)	1.00	5.00	3.18	3.37	3.42	2.71

The results indicate that grade 1 and 3 participating contractors consider **Consulting experts** as a more suitable risk analysis technique and grade 2 contractors consider it as highly suitable. Thus, assigning consulting experts as overall a mostly suitable risk analysis technique as shown above in Table 4.17. This shows that the contractors consider consulting experts such as people who have through experience and knowledge of risk analysis as a suitable approach for dealing with risk. This may be due to lack of in-house expertise in the contractor's organization. Thus contractors in Saudi Arabia consider it is better to evaluate the risk by professional consultants. This result is supported by Rafiq (2013) where the contractors have preferred consulting experts for evaluating risks.

Analyzing historical data and **Joint evaluation by key participants** have also been considered as more suitable risk analysis technique by all the grade 1, 2 and 3 participating contractors, thus assigning analyzing historical data and joint evaluation by key participants as overall a mostly suitable risk analysis technique as shown above in Table 4.17 by the participating contractors in Saudi Arabia. The amount of historical data a contractor has depends on his experience in the construction industry. More the data, the better will be the analysis of risk. The contractor can use this data and compare it to the present project and can make necessary decisions that can help in overcoming risks. Thus, by analyzing historical data the contractor can identify the critical risks they have encountered in the past and can use them to determine necessary strategies to manage them in the current project. This result is supported by Jaser (2005) where the contractors have considered that analyzing historical data is an effective technique for the analysis of risk. In joint evaluation by key participants all the major players of the project i.e. owner, consultant and contractors come together to discuss about the project. In these meetings, the entire project will be evaluated and all the possible risk will be identified. Responsibilities of the risks can also be decided in such meetings. Thus, the contractors consider that such meetings are effective in analyzing the risks and will also determine the responsibilities of the identified risks. This result is supported by Rafiq (2013) where the contractors have considered that Joint evaluation by key participants is a more suitable technique for analyzing risks. **Project team brainstorming** has been considered as a more suitable risk analysis technique by grade 1 and 3 contractors and grade 2 contractors consider it as highly suitable. Thus, assigning project team brainstorming as overall a mostly suitable risk analysis technique as shown above in Table 4.17 by the participating

contractors in Saudi Arabia. Brainstorming is carried out by all the experts in risk in the contractor's organization and it involves defining all the potential problems that might occur, generating ideas, finding all possible solutions for each problem, developing selected feasible solutions and then conducting an evaluation. Thus, the contractors consider that by brainstorming they can identify all the possible risks that can occur and also determine their severity and accordingly make their decisions. However this result is in contradiction to the findings of Rafiq (2013) where the contractors have considered brainstorming as not an effective technique as it is not possible to identify all the possible risks just by using brainstorming technique and some risk might still be left out. **Checklist** has been considered as a more suitable risk analysis technique by grade 1 and 3 contractors and grade 2 contractors consider it as highly suitable. Thus, assigning checklist as overall a mostly suitable risk analysis technique as shown above in Table 4.17 by the participating contractors in Saudi Arabia. Checklist consists of a list of items that are marked as "yes" or "no", and can be used by an individual member or a project team. Checklist is prepared by the personnel who have expertise in the area of risk management and will be based on the previously executed projects and also on the knowledge of the personnel. Thus the contractors consider that using checklist for analyzing risk is a suitable technique as it may save time. However, this result is in contradiction to the findings of Akintoye (1997) where the contractors have considered that, although by using this method of risk analysis it is possible to make a long list that is reasonably comprehensive, this approach gives little confidence that all risks have been identified. **Sensitivity analysis** has been considered as a more suitable risk analysis technique by all the grade 1, 2 and 3 contractors. Thus, assigning sensitivity analysis as overall a mostly suitable risk analysis technique as shown

above in Table 4.17 by the participating contractors in Saudi Arabia. The contractors consider that by using sensitivity analysis, critical risks can be identified for the project. Sensitivity analysis provides answers to a whole range of what if questions. It is comparatively simple to use and has the ability to focus on a particular estimate. This technique provides information on the project risk variables which are considered to be of potentially causing a serious impact on project cost and time estimates. Thus, the contractors consider that using sensitivity analysis is a suitable technique for analyzing risks in projects. This result is supported by Jaser (2005) where the contractors consider sensitivity analysis as a more suitable technique for analyzing risks. **Compare similar projects through similar conditions** has been considered as a more suitable risk analysis technique by all the grade 1, 2 and 3 contractors. Thus, assigning compare similar projects through similar conditions as overall a mostly suitable risk analysis technique as shown above in Table 4.17 by the participating contractors in Saudi Arabia. In this the decision maker uses the experience gained from similar projects undertaken in the past, where decision-making is characterized by risk, to decide on the likelihood of risk exposure and the outcomes. Thus, the contractors consider that by comparing similar projects it is possible to evaluate and identify all the potential risks that can occur and according to which the project program can be prepared. This result is supported by Akintoye (1997) where the contractors have considered compare similar projects as a more suitable risk analysis technique. **Direct judgment using experience and personal skills and documented knowledge** has been considered as a more suitable risk analysis technique by all the grade 1, 2 and 3 contractors. Thus, assigning direct judgment using experience, personal skills and documented knowledge as overall a mostly suitable risk analysis

technique as shown above in Table 4.17 by the participating contractors in Saudi Arabia. Direct judgment approach to risk analysis is largely based on the experience and knowledge of the experts dealing with the risks in the organization, who try to think of all possible risks and take appropriate action. This result is supported by Jaser (2005) where the contractors have considered direct judgment using experience and personal skills as the most widely used risk analysis technique. **Expert software packages** has been considered as a more suitable risk analysis technique by grade 1 and 2 contractors while grade 3 contractors considering it as suitable. Thus, assigning expert software packages as overall a mostly suitable risk analysis technique as shown above in Table 4.17 by the participating contractors in Saudi Arabia, and it is interesting to note that grade 2 and 3 contractors do not prefer it over the other techniques. These software techniques obtain the probable outcome of the project by carrying out a number of iterations, depending on the degree of confidence required. These project management tools are designed to model interaction of time, resources, cost and revenue throughout the entire life of a project and have the capacity to evaluate the consequences of factors such as delay, inflation and changes to the market or to production rates. Such computer-based methods recognize the dynamic project environment. Thus, the contractors consider software approach as a suitable technique but do not prefer it, may be due to insufficient knowledge and experience of these analysis techniques and the incapability of applying them.

4.4 RISK FACTORS

In this section severity of the various risk factors by all the participating contractors and by each grade of contractor are separately analyzed and discussed. All the factors were categorized into 6 groups including on-site, construction, financial, design, legal and resources based on their nature and occurrence. The results obtained for each of the group are discussed in detail below.

4.4.1 ON SITE

This group consists of 5 risk factors. The result indicate that the participating contractors consider Occurrence of accidents because of poor safety procedures and unforeseen site conditions as highly severe risk factors while Adverse weather conditions, Difficulty to access the site, and Environmental factors are considered as risk factors of medium severity and each of these factors is discussed in detail below.

Table 4.18 On Site Risk Factors

Factors	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Occurrence of accidents because of poor safety procedures	1.00	9.00	7.47	6.50	8.00	8.28
Unforeseen site conditions	2.00	9.00	6.14	6.37	5.57	6.71
Adverse weather conditions	1.00	9.00	5.80	6.12	5.14	6.28
Difficulty to access the site	1.00	9.00	5.76	5.62	6.14	6.00
Environmental factors	2.00	9.00	5.71	5.75	5.14	6.28

Occurrence of accidents because of poor safety procedures has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning occurrence of accidents because of poor safety procedures as overall a highly significant risk factor as shown above in Table 4.18 by the participating contractors in Saudi Arabia. This shows that the contractors are highly concerned with the accidents which might occur on the site. This result is supported by the results of Khaliluddin (2010), Khartam et al (2001) and Jaser (2005) in which accidents on site have been ranked as one of the most significant risk that contractors face. **Unforeseen site conditions** has been considered as a highly severe risk factor by grade 1 and 3 contractors while grade 2 contractors consider it as of medium severity. Thus, assigning unforeseen site conditions as overall a highly significant risk factor as shown above in Table 4.18 by the participating contractors in Saudi Arabia. This shows that the contractors in Saudi Arabia are more afraid of site condition which mainly affects the progress of foundation construction. This situation can, in effect, reduce contractor productivity and delay the whole construction process. There are variations in the significance among other authors as Al Salman (2004) and Khartam et al (2001) have found it to be of high priority while Khaliluddin (2010) and Samir (2008) have found that the site condition are considered of low priority risk by the contractor.

Adverse weather conditions, Difficulty to access the site and Environmental factors have been considered as risk factors of high severity by grade 1 and 3 contractors while grade 2 contractors considering it as of medium severity. Thus, assigning Adverse weather conditions as overall a medium significance risk factor as shown above in Table 4.18 by the participating contractors in Saudi Arabia. For difficulty to access the site, grade 2 and 3 contractors have considered it a highly severe while grade 1 contractors consider it as of

medium severity. Thus, assigning difficulty to access the site as overall a medium significance risk factor as shown above in Table 4.18 by the participating contractors in Saudi Arabia. For environmental factors, grade 1 and 2 contractors have considered it of medium severity while grade 3 contractors considering it as highly severe. Thus, assigning environmental factors as overall a medium significance risk factor as shown above in Table 4.18 by the participating contractors in Saudi Arabia. These risks increase the probability of uncertain, unpredictable and even undesirable factors in the construction site. Jaser (2005) and Sameh (2007) have supported this result and ranked these three factors with medium priority. While, Khartam et al (2001) and Al Salman (2004) have said that the contractors consider these three risk factors as low priority.

4.4.2 CONSTRUCTION

This group consists of 13 risk factors. The result indicate that the participating contractors consider Subcontractors Poor performance, Project size in terms of time, Sub-Contractors Competence, Poor communication between involved parties, Quality of work, Insufficient technology/skills / technique available, Project size in term of cost, Project size in terms of size, Lower work quality in presence of time constraints, Third party delay, Poor communications between home and field offices, Unpredicted Technical problems during Construction, and Feasibility of construction methods all of high severity risk factors in Saudi Arabia and each of these factors are discussed in detail below.

Table 4.19 Construction Risk Factors

Factors	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Subcontractors Poor performance	5.00	9.00	7.71	7.50	7.00	8.57
Project size in terms of time	4.00	9.00	7.57	7.12	7.57	8.28
Sub-Contractors Competence	5.00	9.00	7.40	7.00	7.00	8.14
Poor communication between involved parties	3.00	9.00	7.33	7.12	6.57	8.28
Quality of work	5.00	9.00	7.28	6.87	7.57	7.71
Insufficient technology/skills / technique available	3.00	9.00	7.14	7.37	7.00	7.00
Project size in term of cost	2.00	9.00	6.85	6.37	7.14	7.42
Project size in terms of size	4.00	9.00	6.76	7.00	6.71	6.85
Lower work quality in presence of time constraints	4.00	9.00	6.66	6.25	6.71	7.28
Third party delay	4.00	9.00	6.61	6.12	6.14	7.71
Poor communications between home and field offices	4.00	9.00	6.61	6.00	6.85	7.28
Unpredicted Technical problems during Construction	3.00	9.00	6.61	6.62	6.28	7.28
Feasibility of construction methods	4.00	9.00	6.38	6.12	6.42	6.85

Subcontractor's poor performance has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning subcontractors poor performance as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This shows that the contractors in Saudi Arabia are highly concerned about the subcontractor's performance as they might cut corners to ensure their profitability while sacrificing the quality. This is especially true for local companies who have a number of small subcontractors that cannot cope with the size and complexity of new projects. This result is also supported by Sameh (2007) in which the contractors have considered subcontractors poor performance as one of the most significant risk. While Khaliluddin (2010) found out that contractors have considered subcontractor's poor performance as low priority risk. **Project size in terms of time** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning project size in terms of time as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This shows that the contractors are afraid of the time that may be allocated for a project. If the contractor has miscalculated the duration of the project or if delay occurs then the contractor might incur huge penalty which may reduce their estimated profit or sometimes might lead to losses. **Sub-Contractors Competence** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning sub-contractors competence as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This shows that contractors consider the ability of the subcontractor to perform their work as an important factor for the success of the project as the contractor will be responsible if the subcontractor is incompetent to perform his work as required and will be answerable to the

owner. **Poor communication between involved parties** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning poor communication between involved parties as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This shows that the contractors in Saudi Arabia consider poor communication between parties as a severe risk as this may lead to chaos in the management of construction team and programs. A general contractor or project manager who is skillful in team and program coordination should be engaged. On the other hand, strengthening the participant's perception of cooperation and communication is also of importance for improving construction quality and efficiency and to reduce the chance of ambiguities and misunderstanding which may result in conflicts and disputes. This result is supported by Jaser (2005) where the contractors have considered poor communication as the most important risk. **Quality of work** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning quality of work as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This result is supported by Al Salman (2004), Khaliluddin (2010) where the contractors have considered quality of work as the risk with highest severity and Khartam et al (2001) and Nur Alkaf (2012) said that the contractors have considered it as risk with high severity. **Insufficient technology/skills / technique available** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning insufficient technology/skills / technique available as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This shows that the contractors in Saudi Arabia consider that the technology, skills and techniques that is being employed during

construction of projects are not sufficient and the industry is relying on the traditional approaches for construction. Increase of modern and complex projects have made contractors to explore new ideas which include huge risk as the contractors are not familiar with such techniques. Both **project size in terms of cost and size** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning both project size in terms of cost and size as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. As the cost and size of the project increases the risks associated with it increases thus making the contractors take more precautions in order to avoid losses and delays. **Lower work quality in presence of time constraints** has been considered as highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning lower work quality in presence of time constraints as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This is supported by Jaser (2005) where contractors have agreed that they might get disturbed with the lower work quality, which means that contractors do their best to avoid abortive works due to limited time. Owners often impose tight construction schedule often makes it difficult and impractical for the contractor to complete the project with desired quality. This might be caused by the importance of time to the market but often is caused by political reasons. **Third party delay**, **Poor communications between home and field offices,** and **Unpredicted Technical problems** have been considered as highly severe risk by all the grade 1, 2 and 3 contractors. Thus, assigning all these factors as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia, and this is supported by Khartam et al (2001), Al Salman (2004), Jaser (2005), Sameh (2007),

Khaliluddin (2010). **Feasibility of construction methods** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning feasibility of construction methods as overall a highly significant risk factor as shown above in Table 4.19 by the participating contractors in Saudi Arabia. This indicates that the contractors consider construction methods of high importance as the method adopted during tendering stage might not become feasible during the actual construction resulting in project delays. Thus, the contractors consider feasibility of construction methods as high priority and should always be present with an alternate method if unexpected conditions creep out. This result is supported by Rafiq (2013) where the contractors consider feasibility of the construction method as a high risk factor.

4.4.3 FINANCIAL

This group consists of 9 risk factors. The result indicates that the participating contractors consider Delay in progress payments, Financial failure of the Contractor, Financial failure of the owner, Delay in payment of claims, Financial failure of the sub-contractor, and Poor cost control while Inflation, High interest rates, and Exchange rate fluctuation as risk factors of medium severity and each of these factors are discussed in detail below.

Delay in progress payments has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors, thus assigning delay in progress payments as overall a highly significant risk factor as shown below in Table 4.20 by the participating contractors in Saudi Arabia. This shows that the contractors in Saudi Arabia are more concerned about the payment which they receive during the execution of the project as any delay in the payment may cause disruption in the cash inflow as a result of delayed income. Contractors usually have limited capital for executing a project and when the capital available is

depleted, the contractors may postpone payments to subcontractors and suppliers. As a result, they will also reduce their performance. These multiple problems will eventually cause construction delays creating disputes and conflicts between the owner and contractor. This result is supported by Khartam et al (2001), Wiguna et al (2005), Jaser (2005), Al Salman (2004) and Khaliluddin (2010) where all of them have found out the contractors consider delayed payments as the most significant risk factor.

Table 4.20 Financial risk factors

Factors	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Delay in progress payments	3.00	9.00	6.90	7.12	6.28	7.57
Financial failure of the Contractor	3.00	.9.00	6.75	6.50	6.83	7.28
Financial failure of the owner	1.00	9.00	6.38	6.37	5.71	7.42
Delay in payment of claims	1.00	9.00	6.33	6.87	5.42	6.85
Financial failure of the sub-contractor	1.00	9.00	6.28	6.12	6.14	6.71
Poor cost control	1.00	9.00	6.22	6.25	6.28	6.14
Inflation	1.00	9.00	5.52	6.50	5.14	5.28
High interest rates	1.00	9.00	5.09	5.25	4.87	5.42
Exchange rate fluctuation	1.00	8.00	4.76	4.87	5.28	4.42

Financial failure of the Contractor has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors, thus assigning financial failure of the Contractor as overall a highly significant risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. Financial risks to contractors include whether the contractor has enough cash flow on time to enable him to progress with the work. One of the reasons for the failure may be the progress payment, and the contractors of Saudi Arabia have considered this to be the most critical financial risk as discussed above. This result is supported by Khartam et al (2001), Jaser (2005) and Rafiq (2013). According to Hallaq (2003), financial failure of the contractor can be due to:

· Lack of capital.

· Lack of experience in the line of work.

· Cash flow management.

· Low margin of profit due to competition.

· Lack of experience in contracts.

· Bidding contracts to lowest price.

Financial failure of the owner has been considered as a highly severe risk factor by grade 1 and 3 contractors while grade 2 contractors consider it as of medium severity. Thus, assigning financial failure of the owner as overall a highly significant risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. Owner's ability to pay to the contractor for the work he has done is the only driving force that keeps the contractor from progressing with the construction of the project. If the owner becomes bankrupt, then the entire project will fall in limbo as the contractor, subcontractor and everyone involved in the project will stop their work, thus leading to delays, disputes and

claims. This result is supported by Sameh (2007) and Khaliluddin (2010) where the contractors have considered the failure of the owner as a risk of high severity. Delay in payment of claims, Financial failure of the sub-contractor and Poor cost control have been considered as the fourth, fifth and sixth most important risk factor in the finance category by the contractors in Saudi Arabia. **Delay in payment of claims** has been considered as a highly severe risk factor by grade 1 and 3 contractors while grade 2 contractors considering it as of medium severity. Thus, assigning delay in payment of claims as overall a highly significant risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. In case of any change order, defective design or any problem caused by the owner that may lead to delay and additional work, the contractor is concerned that the payment claimed for the additional cost which he might incur would be delayed by the owner and it may adversely affect his cash flow management. **Financial failure of the sub-contractor** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors, thus assigning financial failure of the sub-contractor as overall a highly significant risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. The list of what can go wrong on a project is long, but one of the most common problems is subcontractor failure. Margins are so thin that one key subcontractor failure can be the difference between a successful and unsuccessful project. The contractor has to monitor the work done by each subcontractor carefully as any defects identified later would be the responsibility of the contractor and he will have to correct it on his expense. **Poor cost control** has been considered as a highly severe risk by all the grade 1, 2 and 3 contractors. Thus, assigning poor cost control as overall a highly significant risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. This indicates

that the contractors in Saudi Arabia consider cost control as high priority. Cost control is essential for contractors as the cost for construction of each activity will be decided earlier and if any activity incurs an additional cost then the budget allocated for other activities will get disturbed. Thus, if the contractor doesn't conduct cost control effectively then it may lead to failure of the contractor. This may be one of the reasons for financial failure of the contractors. The result is supported by Jaser (2005) where the contractors have considered cost control as a high significance risk factor. Inflation, High interest rates and Exchange rate fluctuation are the last three risk factors corresponding to seventh, eighth and ninth position in the financial category.

Inflation has been considered as a risk factor of medium severity by grade 2 and 3 contractors while grade 1 contractors consider it as highly severe. Thus, assigning Inflation as overall a highly significant risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. Contractors considered this risk factor as an oscillating one where its threat increases when inflation increases and vice versa. This result is supported by Khartam et al (2001) and Khaliluddin (2010), where the contractors have identified inflation of medium significance while according to Sameh (2007) and Andi (2006), the contractors have considered inflation of high significance. This may be due to what happened in 2005 when material prices sky-rocketed causing bankruptcy for contractors and delays in major projects for many countries. Saudi Arabia was one of the few countries which was able to control the inflation rate thus reducing its adverse effects. Thus the contractors in Saudi Arabia consider inflation as a moderate risk factor. **High interest rates** has been considered as risk factor of medium severity by all the grade 1, 2 and 3 contractors, thus assigning high interest rates as overall a medium significance risk factor

as shown above in Table 4.20 by the participating contractors in Saudi Arabia. Most of the contractors rely largely on banks to support their financial needs for carrying the construction works. Banks provides these loans on interest to the contractors and if the loan contributes to significant project value and if the bank interest rate is high, then the contractor has to pay relatively more amount thus reducing its profit coming from a project. The contractors of Saudi Arabia have considered it of medium priority as the contractors are aware of the interest rate that the bank charges which is moderate in this country with which they can calculate the loan amount accordingly so that it doesn't affect their profit while preparing their estimate. High interest rate can cause a major impact on the financial failure of the contractor which is the second most important risk factor in financial category. **Exchange rate fluctuation** has been considered as a risk factor of medium severity by all the grade 1, 2 and 3 contractors, thus assigning exchange rate fluctuation as overall a medium significance risk factor as shown above in Table 4.20 by the participating contractors in Saudi Arabia. This result is supported by Khaliluddin (2010) and Sameh (2007), where the contractors have considered it of medium priority. The strength of a national currency depends on its economy. The economy of Saudi Arabia has always been strong in recent years due to the boom in the oil industry and the increase of oil prices there by making the currency strong and constant and thus reducing the risk that the contractors might have to pay more to get any equipment or material from outside the Kingdom. It is important to note that most of the construction material and equipment is being imported to Saudi Arabia. Thus, any changes in the currency of other countries might have an impact on the cost that the contractor incur in purchasing them.

4.4.4 DESIGN

This group consists of 9 risk factors. The result indicates that the participating contractors consider Frequent changes of design, Awarding the design to unqualified designers, Delays in approval, Undefined scope of work, Lack of consistency between bill of quantities, drawings and specifications, Actual quantities differ from the contract quantities, Drawings and documents are not issued on time, Failure to identify defects, and Defective design (incorrect) all as high severity risk factors in Saudi Arabia and each of these factors are discussed in detail below.

Frequent changes of design has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors, thus assigning frequent changes of design as overall a highly significant risk factor as shown below in Table 4.21 by the participating contractors in Saudi Arabia. This shows that the contractors are more concerned about the changes in the design they receive during the construction phase of the project and consider it as a risk of high priority. This is a common risk as owners rush into projects without the necessary planning and design time and it results in changes in design as the construction progresses. Design changes causes loss of time in preparing amended drawings and waiting for shop drawing approval. These would consequently cause inefficiency in labor and equipment productivity and finally these multiple effects would lead to construction delays. These changes might also lead to changes in the sequence of works or even cause rework. As a result, these situations would cause project cost overrun. This result is supported by Sameh (2007), Wiguna et al (2005), and Rafiq (2013).

Table 4.21 Design risk factors

Factors	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Frequent changes of design	4.00	9.00	7.50	7.5	6.85	8.14
Awarding the design to unqualified designers	1.00	9.00	7.45	7.25	6.57	8.57
Delays in approval	4.00	9.00	7.40	7.25	7.57	7.42
Undefined scope of work	3.00	9.00	7.27	6.87	7.14	7.85
Lack of consistency between bill of quantities, drawings and specifications	2.00	9.00	7.13	6.75	6.57	8.14
Actual quantities differ from the contract quantities	4.00	9.00	7.09	6.20	7.57	7.28
Drawings and documents are not issued on time	2.00	9.00	7.09	6.62	7.28	7.42
Failure to identify defects	2.00	9.00	7.00	7.37	6.14	7.42
Defective design (incorrect)	1.00	9.00	6.81	6.75	6.00	7.71

Awarding the design to unqualified designers has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning awarding the design to unqualified designers as overall a highly significant risk factor as shown above in Table 4.21 by the participating contractors in Saudi Arabia. This shows that the contractors consider Awarding the design to unqualified designers as a risk of high significance. The outcome of award of design to unqualified designer will be incorrect or defective design. As many unforeseen factors encompass construction activities, incorrect or defect designs often deviates the estimated cost from the real cost. Choosing responsible and experienced designers and if possible getting the contractors/subcontractors involved early can help to eliminate the black box and minimize the inaccuracy. According to Ogunlana et al. (1996), unqualified or shortage of personnel involved in the project design due to work overload in the firm designing the project were recognized as the most important reasons causing defective construction drawings. Santoso *et al.* (2003) added that the limited design fee allocated by the owner would cause the designer to provide an incomplete design. To avoid defective designs, the design team not only needs to fully understand what the clients want as defined in the project brief, but also to establish an efficient communication scheme among the designers. Failure of the designer to accomplish any one of these aspects would lead to defective design resulting in project delays. **Delays in approval** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning delays in approval as overall a highly significant risk factor as shown above in Table 4.21 by the participating contractors in Saudi Arabia. This shows that the contractors consider Delays in approval as a risk of high significance. Delays in approval is related to obtaining governmental approvals and building permits that are essential for the contractor

to start the construction work. Delay in approval usually occurs due to management weakness of the project team or the bureaucracy of government. Clients need to establish a competent team to obtain the approval from government agencies and prepare project documents effectively and efficiently. This result is supported by Sameh (2007) and Khaliluddin (2010) where it is found that the contractors consider delay in approvals that are obtained by the owners as a risk of high significance as these delay may lead to delay in construction of the project which may cost the contractor due to unused resources and equipment's and will also result in project delay. **Undefined scope of work** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning undefined scope of work as overall a highly significant risk factor as shown above in Table 4.21 by the participating contractors in Saudi Arabia. This shows that the contractors consider undefined scope of work as a risk of high significance. Undefined scope of work can directly result in changes in the planning, design and construction. It may occur from two possible reasons, the change of mind by the clients or the misunderstanding /misinterpretation of the clients' needs in the project brief by the designer. For the former cause, the clients will bear the responsibility and for the latter one, a knowledgeable initial project team should be established as early as possible to define the project scope and functions precisely. This result is supported by Khartam et al (2001), Sameh (2007) and Nur Alkaf (2012) where the contractors have considered undefined scope of work as a risk of high severity as these will lead to design changes and the contractor may have to create a new project program in order to meet with the new requirements which may require rework and might cause additional cost. **Lack of consistency between bill of quantities, drawings and specifications** and **Actual**

quantities differ from the contract quantities has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning lack of consistency and actual quantities differ factors as overall a highly significant risk factor as shown above in Table 4.21 by the participating contractors in Saudi Arabia. These two risk factors are related to each other because if there is no consistency between bill of quantities, drawings and specifications then the actual amount of work that is required to be done will differ from the work as mentioned in the contract. Inconsistencies in dimensions and/or the position of the structural, architectural, mechanical, electrical, ventilation, air conditioning, plumbing and other systems commonly occur in the construction drawings leading to inconsistency between bill of quantities, drawings and specifications. They may arise probably because of lack of coordination between designers and lack of supervision among draftsmen in the design phase. This result is supported by Khaliluddin (2010), Sameh (2007) and Rafiq (2013) where the contractors have given these risk a high priority as based on these specification and drawing, contractors calculate their cost and participate in the bidding process. If there is inconsistency between the drawings and specification and the actual quantities differ then there is high probability of rework and change order which will result in delay of the project which not only costs to the owner but also to the contractor as most of the contractors utilize their resources on more than one project. **Drawings and documents are not issued on time** and **Failure to identify defects** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning drawings and documents are not issued on time and failure to identify defects as overall a highly significant risk factor as shown above in Table 4.21 by the participating contractors in Saudi Arabia. Delay in drawings and documents may be due to time pressure, work

overload, lack of co-ordination between design disciplines, and unclear and changing client information and requirements. This result is supported by Sameh (2007) and Khaliluddin (2010) where the contractors have considered delay in issue of drawings and documents as a risk of high priority. A recent study by Andi and Minato (2003) discussed that the design document related problems were considered to be critical in several countries, such as the US, Hong Kong, Australia and Japan. Therefore, it is recommended that the design company management, and more importantly the owners pay serious attention to these issues if they seek to reduce design related problems and minimize changes in the work in general because drawings and documents are very important as it the one which tells the contractors what he must do for the construction work. Any delay in these documents results in stoppage of work as the contractor doesn't know what to do which will cause significant loss to the contractor and also delay in completion of the project. **Defective (incorrect) design** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning defective design as overall a highly significant risk factor as shown above in Table 4.21 by the participating contractors in Saudi Arabia. Defective design may be result of design related problems such as incorrect and insufficient design information, inconsistent information among design documents, impractical designs (constructability problem) and co-ordination problems between design disciplines (e.g. between structural and architectural designs). Incorrect design may occur in the local industry mainly due to the short design time offered by the client or overload on the architect or competence of the designer or variations in the client's requirement. This result has been supported by Khartam et al (2001), Rafiq (2013) and Jaser (2005) where the contractors have considered it as a risk of medium importance. Defective design risk factor

depends on most of the factors that are explained in the design category. If the contractors found discrepancies between the various construction drawings and specifications or any defective design, they ask the designer to solve these problems. However, this procedure takes time as it requires waiting for responses from the designers. Thus defective design may cause delays, rework, and consequently these conditions could lead to cost overruns.

4.4.5 RESOURCES

This group consists of 8 risk factors. The results indicate that the participating contractors consider Poor labor productivity, Unavailable labor, Late deliveries of material, Departure of qualified staff or labor, Unavailable equipment, Unavailable materials, Poor equipment Productivity, and Supplies of defective materials all as high severity risk factors in Saudi Arabia and each of these factors are discussed in detail below.

Poor labor productivity has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning poor labor productivity as overall a highly significant risk factor as shown below in Table 4.22 by the participating contractors in Saudi Arabia. This shows that the contractors are highly concerned about the productivity of the labor. Construction industry is a labor intensive industry and almost all the construction work involves labor. If the productivity of the labor decreases then then there will be delay in the completion of the work which will affect the completion of subsequent activities. Thus, forcing the contractors to deploy more labor which will add additional cost in order to prevent delay in the construction of the project. This result is supported by Khaliluddin (2010) where the contractors have considered poor labor productivity as a high significance risk factor.

Table 4.22 Resources risk factors

Factors	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Poor labor productivity	4.00	9.00	7.80	7.87	7.16	8.28
Unavailable labor	4.00	9.00	7.59	7.37	7.14	8.28
Late deliveries of material	2.00	9.00	7.54	7.25	7.00	8.42
Departure of qualified staff or labor	4.00	9.00	7.09	6.75	6.85	7.71
Unavailable equipment	3.00	9.00	7.00	6.50	6.71	7.85
Unavailable materials	3.00	9.00	7.00	6.87	6.71	7.42
Poor equipment productivity	4.00	9.00	6.90	6.87	6.00	7.85
Supplies of defective materials	2.00	9.00	6.72	6.87	5.42	7.85

Unavailable labor has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning unavailable labor as overall a highly significant risk factor as shown above in Table 4.22 by the participating contractors in Saudi Arabia. As discussed earlier construction is a labor intensive industry and there is an increase in demand of manpower in Saudi Arabia due to increase in project numbers, size and complexity. To add to this problem, the government imposed strict rules for importing manpower from foreign nations. This unavailability of labor will directly affect the contractor's ability to perform construction of projects. This result is supported by Jaser

(2005) where the contractors have considered unavailable labor as high significance risk factor. **Late deliveries of material** and **Unavailable materials** have been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning late deliveries of material and unavailable materials as overall a highly significant risk factor as shown above in Table 4.22 by the participating contractors in Saudi Arabia. Materials are essential in construction of any work and most of the materials in Saudi Arabia are imported from other countries. Any delay in procurement of materials will stop the construction work due to which other resources which are present on the site will remain unused which will cause additional cost to the contractor and will also delay the progress of the project. Thus, the contractors must ensure the adequate availability of the materials as scheduled. This result is supported by Karim (2012) where the contractors have considered late deliveries of material and unavailable materials as high significance risk factors. **Departure of qualified staff or labor** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning departure of qualified staff or labor as overall a highly significant risk factor as shown above in Table 4.22 by the participating contractors in Saudi Arabia. Qualified staff or labor is always essential to maintain the quality and productivity of the construction work. Departure of qualified staff is a major problem especially in the fields of construction and project management. Many talented staff keeps moving from one company to another as competition offers excellent opportunity for experienced staff. Also, Saudization has caused many qualified staff personnel to leave the country thus making empty spaces which the contractors may be forced to fill with unqualified personnel. This result is supported by Sameh (2007) where the contractors have considered Departure of qualified staff as a high significance risk

factors in construction industry. **Unavailable equipment** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors, thus assigning unavailable equipment as overall a highly significant risk factor as shown above in Table 4.22 by the participating contractors in Saudi Arabia. Shortage of equipment is another major risk factor that has significant impact on project productivity. This can result from poor planning and lack of experience among contractors in handling the projects. Usually, contractors handle more than one project at a time and they switch the equipment from one project to another. This would also affect the availability of equipment on a particular project. This result is supported by Karim (2012) where the contractors have considered Unavailable equipment as a high significance risk factor in the construction industry.

4.4.6 LEGAL

This group consists of 8 risk factors. The result indicated that the participating contractors consider Difficulty to get permits, Corruption and Bribes, Change order negotiation, Delayed disputes resolutions, Legal disputes among the contract parties, Labor Disputes, New governmental acts or legislations, and Breach of Contract by any of the involved parties all as high severity risk factors in Saudi Arabia and each of these factors are discussed in detail below.

Table 4.23 Legal Risk factors

Factors	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Difficulty to get permits	4.00	9.00	7.18	7.50	6.42	7.57
Corruption and Bribes	2.00	9.00	6.63	6.00	6.28	7.71
Change order negotiation	3.00	9.00	6.54	6.67	6.28	7.00
Delayed disputes resolutions	3.00	9.00	6.54	6.87	6.00	6.71
Legal disputes among the contract parties	3.00	9.00	6.54	6.87	5.71	7.00
Labor Disputes	4.00	9.00	6.50	6.50	6.00	7.00
New governmental acts or legislations	2.00	9.00	6.50	6.12	6.85	6.57
Breach of Contract by any of the involved parties	2.00	9.00	6.31	6.12	6.42	6.42

Corruption and Bribes has been considered as highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning corruption and bribes as overall a highly significant risk factor as shown above in Table 4.23 by the participating contractors in Saudi Arabia. Problem due to corruption and bribes may arise either from within the contractor's organization or outside. Corruption within the contractor's organization may lead to poor

quality of construction work for which the owner may disapprove and demand for rework. The contractors are also concerned that they might have to pay bribes to owner representatives to get their work approved and also to the government to get permits for construction work. This result is in contradiction with the findings of Khaliluddin (2010) and Sameh (2007) where the contractors have considered corruption and bribes as low significance risk factors in construction industry. This shows that there is lot of corruption in the construction industry in Saudi Arabia. **Change order negotiation** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning change order negotiation as overall a highly significant risk factor as shown above in Table 4.23 by the participating contractors in Saudi Arabia. Change orders issued by the owner will require the contractor to rethink his strategies and approach to complete the construction of the project. Negotiation for the cost of change order can only be achieved by mutual understanding between the owner and the contractor as the contractors will try to maximize their profit and the owner will try to maximize the cost. Thus the contractors consider that it is difficult to reach a negotiation for change orders in construction industry in Saudi Arabia and are concerned with it. This result is supported by Al Salman (2004) where the contractors have considered change order negotiation as a high significance risk factor. **Legal disputes among the contract parties** and **Delayed disputes resolutions** have been considered as highly severe risk factors by all the grade 1, 2 and 3 contractors, thus assigning legal disputes among the contract parties and delayed disputes resolutions factors as overall highly significant risk factors as shown above in Table 4.23 by the participating contractors in Saudi Arabia. Disputes during construction of project may arise due to failure of any of the project parties to meet their requirements.

Owner delayed payments, poor quality of contractor or subcontractor, delay in progress etc may be the reason for disputes. Rise of disputes between any project parties is harmful for the project as it will at the end effect the entire project. Disputes can be settled by mutual agreement or in worst cases may lead to arbitration or land in the court which will cost all the parties involved in the project and the longer the delay in resolving disputes the greater will be the cost. This result is supported by Jaser (2005), Ahmed et al (1999) where the contractors have considered legal disputes among the contract parties and delayed disputes resolutions as high significance risk factors. **Labor Disputes** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning labor disputes as overall a highly significant risk factor as shown above in Table 4.23 by the participating contractors in Saudi Arabia. Labor strikes and disputes can disrupt construction activity and may affect project objectives negatively. This result is in contradiction with the findings of Al Salman (2004), Khartam et al (2001) where the contractors have considered labor disputes of less significance risk factor. This shows that the contractors in Saudi Arabia are concerned with labor problem which may be due to the complex and unstable nature of Saudi labor industry. **New governmental acts or legislations** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning new governmental acts or legislations as overall a highly significant risk factor as shown above in Table 4.23 by the participating contractors in Saudi Arabia. Any changes in government procedures will require the contractor to change their approach for the construction work which will affect the contractor as he has to rethink his approach which will cause delay in the progress of the construction work. This result is in contradiction with the findings of Jaser (2005) and Sameh (2007) where the

contractors have considered new governmental acts or legislations as a low significance risk factor. This shows that the contractors in Saudi Arabia are concerned with the changes imposed by the government which may be due to the fact that many changes occurs in the government rules and regulation of Saudi Arabia and this is affecting the contractor adversely. **Breach of Contract by any of the involved parties** has been considered as a highly severe risk factor by all the grade 1, 2 and 3 contractors. Thus, assigning breach of contract as overall a highly significant risk factor as shown above in Table 4.23 by the participating contractors in Saudi Arabia. Contract breach may be caused by either of the project parties' i.e. contractor, owners or sub-contractors. Any breach of contract by one of the project party may lead to termination of the contract and will lead the fate of the project in limbo. Thus, breach of contract leads to disputes and claims which will cost heavily to all the parties. This result is in contradiction with findings of Sameh (2007) where the contractors consider breach of contract as a less significance risk factor.

4.5 RISK PREVENTIVE AND MITIGATIVE ACTIONS

In this section suitability of various Risk preventive and mitigative actions by all the participating contractors and by each grade of contractor are analyzed and discussed separately in detail below.

4.5.1 RISK PREVENTIVE ACTIONS

The results indicate that the participating contractors consider Utilize quantitative risk analyses techniques for accurate time estimate, Produce a proper schedule by getting updated project information, Plan alternative methods as stand-by, Consciously adjust for bias and add risk premium to time estimation, Refer to previous and ongoing similar projects for accurate program, Transfer or share risk to/with other parties as more suitable actions while Depend on subjective judgment to produce a proper program as a suitable action for prevention of risk in Saudi Arabia construction industry and each action is discussed in detail below.

Utilize quantitative risk analyses techniques for accurate time estimate has been considered as a highly suitable risk preventive action by grade 1 and 2 contractors and grade 3 contractors considering it as more suitable. Thus, assigning Utilize quantitative risk analyses techniques for accurate time estimate as overall a more suitable risk preventive action as shown below in Table 4.24. This shows that the contractors in Saudi Arabia consider use of quantitative risk analysis techniques for producing accurate time estimates as a highly effective technique to prevent risk. Quantitative risk analyses techniques may be Primavera, Monte Carlo simulation, @risk etc. There is a huge demand for professionals with optimizations software's such as Primavera in Saudi Arabia and the contractors are

adapting these techniques at the same time. Thus sufficient knowledge and experience of experts in analysis techniques, and the ease of finding the probability distribution for risk in practice could be the two main reasons for such a result. However this result contradicts the findings of Jaser (2005), where the approach of risk analysis is largely based on the use of checklists by managers, who try to think of all possible risks. **Produce a proper schedule by getting updated project information** has been considered as a more suitable risk preventive action by grade 1 and 3 contractors and grade 2 contractors considering it as highly suitable. Thus, assigning produce a proper schedule as overall a more suitable risk preventive action as shown below in Table 4.24 by the participating contractors in Saudi Arabia. Construction is subjected to a dynamic environment, which is why risk managers constantly strive to improve their estimates. Even with near perfect estimates, decision making about risk is a difficult task. Thus, depending only on experience and subjective judgment may not be enough, and updated project information should be obtained and applied. This result is supported by Khartam et al (2001) where the contractors have considered getting more updated project information at the project planning stage to be the most effective risk preventive method.

Table 4.24 Risk Preventive actions

Risk Preventive actions	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Utilize quantitative risk analyses techniques for accurate time estimate	1.0	5.0	3.95	4.37	4.00	3.42
Produce a proper schedule by getting updated project information	2.00	5.00	3.95	3.87	4.42	3.57
Plan alternative methods as stand-by	1.00	5.00	3.81	4.00	3.85	3.57
Consciously adjust for bias and add risk premium to time estimation	2.00	5.00	3.54	4.12	3.42	3.00
Refer to previous and ongoing similar projects for accurate program	1.00	5.00	3.45	3.62	3.71	3.00
Transfer or share risk to/with other parties	1.00	5.00	3.22	3.50	3.57	2.57
Depend on subjective judgment to produce a proper program	1.00	5.00	3.00	3.50	2.71	2.71

Plan alternative methods as stand-by has been considered as a more suitable risk preventive action by all the grade 1, 2 and 3 contractors. Thus, assigning plan alternative

methods as stand-by as overall a more suitable risk preventive action as shown above in Table 4.24 by the participating contractors in Saudi Arabia. This shows that the contractors consider planning by more than one method for a particular task to be very effective in order to overcome the aftermaths of any uncertainties. Planning alternative methods means that the contractors are evaluating the potential of risk from the planning stage for each method they will implement during construction phase which is highly recommended because the earlier the risk evaluation starts, more effective will be its management. However, this results is in contradiction with Khartam et al (2001) where the contractors have considered planning alternative method as a stand by as less effective risk preventive action. **Consciously adjust for bias and add risk premium to time estimation** has been considered as a more suitable risk preventive action by grade 2 and 3 contractors and grade 1 contractors considering it as highly suitable. Thus, assigning consciously adjust for bias and add risk premium to time estimation as overall a more suitable risk preventive action as shown above in Table 4.24. Risk premiums in construction projects take the form of contingencies or added margins to an estimate to cover unforeseen eventualities. The amount of the premium varies between projects and is mostly dependent upon the attendant risk and decision makers risk attitude. Thus, the contractors consider that adding risk premium to their estimates will ensure that they will be ready to face any potential risk that might occur during the construction phase. However this result is contradicting with the findings of Jaser (2005) where the contractors consider that taking into consideration such risks premiums would increase the priced bid and would consequently decrease the probability of gaining the bid due to the highly competitive construction industry market. **Refer to previous and ongoing similar projects for accurate program** has been

considered as a more suitable risk preventive action by all the grade 1, 2 and 3 contractors. Thus, assigning refer to previous and ongoing similar projects as overall a more suitable risk preventive action as shown above in Table 4.24 by the participating contractors in Saudi Arabia. This shows the contractors consider that by referring to previously executed and ongoing similar projects they can create much accurate construction program which will avoid any uncertainties to occur. The data obtained from previous and ongoing similar projects will help the contractors to identify the possible uncertainties that can occur during construction and thus enable them to adopt suitable methods, techniques and make necessary decisions while developing the project program. This result is supported by Jaser (2005) where it is found that the contractors consider using the data from previous and ongoing similar projects as a suitable risk preventive action which reduces the possibility of any risks occurring thereby creating a more accurate program. **Transfer or share risk to/with other parties** has been considered as a more suitable risk preventive action by grade 1 and 2 contractors and grade 3 contractors considering it as suitable. Thus, assigning transfer or share risk as overall a more suitable risk preventive action as shown above in Table 4.24. This shows that Transfer or share risk to/with other parties has been considered a suitable action for preventing all the effects of risk coming to the contractors. The contractor can share or transfer risk to owner, subcontractor, vendors etc either by including it in the contract or by mutual understanding. However, this result is contradicting with the findings of Khartam et al (2001) where the contractors consider that it is essential to establish a long-term working relationship with a particular subcontractor, owner and material vendor. Since the long-term transaction relationship between the parties should

prevail, very few general contractors could exercise the practice of shifting risk to other parties.

Depend on subjective judgment to produce a proper program has been considered as a suitable risk preventive action by grade 2 and 3 contractors and grade 1 contractors considering it as more suitable. Thus, assigning Depend on subjective judgment to produce a proper program as overall a suitable risk preventive action as shown above in Table 4.24. Judgment or subjective probability uses the experience gained from similar projects undertaken in the past by the decision maker to decide on the likelihood of risk exposures and the outcome. Judgment and experience gained from previous contracts may become the most valuable information source for the use when there is limited time for preparing the project program. The findings from Khartam et al (2001) show that contractors consider subjective judgment to produce a proper program as the most effective risk preventive action.

4.5.2 RISK MITIGATIVE ACTIONS

The results indicate that the participating contractors consider Close supervision to subordinates for minimizing abortive work, Change the sequence of work by overlapping activities, and Coordinate closely with subcontractors as highly suitable actions while Increase the working hours, Increase manpower, and Increase equipment as more suitable actions for mitigation of risk in Saudi Arabia construction industry and each action is discussed in detail below.

Table 4.25 Risk Mitigative actions

Risk Mitigative actions	Overall Minimum	Overall Maximum	Overall Mean	Grade 1 Mean	Grade 2 Mean	Grade 3 Mean
Close supervision to subordinates for minimizing abortive work	2.00	5.00	4.14	4.12	4.33	4.00
Change the sequence of work by overlapping activities	3.00	5.00	4.04	3.87	4.42	3.85
Coordinate closely with subcontractors	2.00	5.00	4.00	4.00	4.00	4.00
Increase the working hours	1.00	5.00	3.36	3.12	3.42	3.57
Increase manpower	1.00	5.00	3.27	3.12	3.14	3.57
Increase equipment	1.00	5.00	3.22	3.12	3.14	3.42

Close supervision to subordinates for minimizing abortive work has been considered a highly suitable risk mitigative action by all the grade 1, 2 and 3 contractors. Thus, assigning close supervision to subordinates as overall a highly suitable risk mitigative action as shown above in Table 4.25 by the participating contractors in Saudi Arabia. This shows the contractors in Saudi Arabia consider that by close and continues supervision during the construction phase abortive work can be minimized and any potential risk can be mitigated. Abortive work is a big risk for the contactors as it may require rework due to rejection by the owner, resulting in significant cost overrun and delay to the contractor. Thus the contractor consider that close supervision is a highly suitable risk mitigative action to avoid abortive work. This result is supported by Jaser (2005) where the contractors consider that close supervision to subordinates for minimizing abortive work is the most effective

mitigative method to be followed for minimizing losses. **Change the sequence of work by overlapping activities** has been considered as a more suitable risk mitigative action by grade 1 and 3 contractors and grade 2 contractors considering it as highly suitable. Thus, assigning change the sequence of work by overlapping activities as overall a highly suitable risk mitigative action as shown above in Table 4.25. This shows that the contractors consider that changing the sequence of work by overlapping activities is more suitable in case of project delays. In case a delay occurs in one of the project activities then the upcoming activities can be re arranged and all the possible activities can be overlapped to make the schedule as feasible as possible. Such approach doesn't involve any cost to the contractors but care should be taken such that no uncertainties should arise later due to overlapping of the activities. This result is supported by Jaser (2005) where that contractors consider that Changing the sequence of work by overlapping activities is more suitable approach to mitigate project risk due to delays. **Coordinate closely with subcontractors** has been considered as a highly suitable risk mitigative action by all the grade 1, 2 and 3 contractors. Thus, assigning coordinate closely with subcontractors as overall a highly suitable risk mitigative action as shown above in Table 4.25 by the participating contractors in Saudi Arabia. This shows that contractors consider that close coordination with the subcontractors is more suitable and effective to mitigate the effects of risk. Contractors know that subcontractors bring additional risks to them. These risks include uncertainties related to a subcontractor's technical qualifications, timeliness, reliability, and financial stability, causing time and/or cost increase during construction. Thus, the contractors consider that coordinating with the subcontractor will help to identify any defects caused by them and to reduce its effects on the project. This result is supported by Khartam et al

(2001) where the contractors consider close coordination with the subcontractors as the most effective risk mitigative action.

Increase the working hours has been considered a more suitable risk mitigative action by all the grade 1, 2 and 3 contractors. Thus, assigning increase the working hours as overall a more suitable risk mitigative action as shown above in Table 4.25 by the participating contractors in Saudi Arabia. The contractors consider that by increasing the working hours for the project the risk of delay can be mitigated. Increasing the working hours can be done by paying overtime for the labor and equipment and completing the task without any additional work force. Such an approach will increase the cost of the project for the contractor but it will be less when compared to the penalties and losses that the owner may impose on him due to delay in completion of the project. The contractor should be aware that overtime may reduce the productivity of the work force and he should limit it to an acceptable value. Thus, contractors consider that increasing working hours is a suitable approach to mitigate the effects of risks due to delay. This result is supported by Jaser (2005) where the contractors consider increasing the working hours as an effective risk mitigative action. **Increase manpower** and **Increase equipment** have been considered more suitable risk mitigative actions by all the grade 1, 2 and 3 contractors. Thus, assigning Increase manpower and Increase equipment as overall more suitable risk mitigative action as shown above in Table 4.25 by the participating contractors in Saudi Arabia. This shows the contractors consider increasing the manpower and equipment's to mitigate the affects of risk is a suitable approach. Work force available on the site is one of the important variables to project progress, since construction projects generally include many labor-intensive operations. Therefore, increasing the work force normally speeds up progress,

subject to physical constraints of the site and construction sequence. It is important that the contractors should consider that it is not easy to procure labor and equipment on a short notice and the contractor will incur additional costs in order to pay those additional force. This result is supported by Jaser (2005) where the contractors have considered increasing manpower and equipment's as a reasonably suitable risk mitigative action.

The contractors were asked to identify any additional risk preventive and mitigative actions that they consider to be suitable. **Involve all stakeholders** and **Create corporate Risk memory Bank** were suggested as more suitable risk mitigative actions with a suitability of 4 by one of the participating contractor.

CHAPTER 5

SUMMARY OF THE STUDY, CONCLUSIONS, and RECOMMENDATIONS

This chapter presents the summary of the study, findings, conclusions and recommendations that arise from the study. Furthermore, the direction of future studies in the same field are also presented.

5.1 SUMMARY OF THE STUDY

Risk management can be generally described as a management tool which aims at determining the causes of risk and uncertainty, evaluating their impact, and creating appropriate risk management responses. An effective risk management method can not only help contractors to understand the kinds of risks they might incur in different phases of a project, but will also help them in manage those risks. Due to its growing significance, today risk management has been accepted as an essential requirement in construction industry and for which a set of techniques have been created to manage the impacts that might be brought by the potential risks. Risk management therefore is an integral part of any construction industry particularly in a developing country like Saudi Arabia where there are massive construction projects to be handled in the future.

The main objectives of this study are to investigate whether contractors in Saudi Arabia consider risks in their organization and if yes then how are they managed. Also, to determine risk evaluation techniques and risk factors which contractors consider and the strategies which they design, implement and control to eliminate or mitigate the impact of risks in projects.

An intense literature review was conducted to determine the risk techniques, risk factors and risk management actions that are suitable for the construction industry in Saudi Arabia. A questionnaire was developed to collect the required data from grade 1, 2 and 3 building contractors in the Eastern Province of Saudi Arabia classified by the Ministry of Municipality and Rural Affairs. The questionnaire was sent to all the contractors' population and 28% of them completed and returned the questionnaire.

5.2 FINDINGS

The following are the major findings towards the objectives of this study:

5.2.1 RISK MANAGEMENT IN THE ORGANIZATION

- Majority of the contractors regardless of grades are considering risk management in their business operation and have been conducting risk management for more than 5 years.
- Different personnel are responsible for risk management in the organization among contractors regardless of grades in Saudi Arabia varying from project manager, cost estimator, planner etc with majority of personnel in grade 1 and grade 3 contractors

involved in risk management for more than 5 years while the personnel for grade 2 are varying in regard to their experience in the area of risk.

- Very few grade 1 and grade 2 contractors have a separate risk management department established in their organization for dealing with project risk with very few personnel employed while none of the grade 3 contractors have considered this department.
- Majority of contractors regardless of their grades are carrying out risk management on all projects irrespective of the cost, time and size throughout the life cycle of the project due to long term cost savings and they are quick and more competent in handling risk with grade 3 contractors also considering risk management due to complexities of the projects.

5.2.2 RISK ANALYSIS TECHNIQUES

- Analyzing historical data and Joint evaluation by key participants, Sensitivity analysis, Compare similar projects through similar conditions, direct judgment using experience and personal skills and documented knowledge have been consider as more suitable risk analysis techniques by all the grade 1, 2 and 3 participating contractors in Saudi Arabia.
- Consulting experts, Project team brainstorming, Checklist have been considered as more suitable risk analysis techniques by grade 1 and 3 participating contractors while grade 2 contractors considering it as highly suitable. Expert software packages has been considered as a more suitable risk analysis technique by grade 1 and 2 contractors while grade 3 contractors considering it as suitable.

5.2.3 RISK FACTORS

- Regarding the significance of various risk factors occurring in construction projects for the On-site category; Occurrence of accidents because of poor safety procedures has been considered as highly severe by all the grade 1, 2 and 3 contractors. Unforeseen site conditions and adverse weather conditions has been consider as highly severe by grade 1 and grade 3 contractors while grade 2 contractors consider it of medium severity. Difficulty to access the site has been considered as highly severe by grade 2 and grade 3 contractors while grade 1 contractors consider it of medium severity. Environmental factors has been considered as a medium severity factor by all the grade 1, 2 and 3 contractors.
- In the Construction category, contractors regardless of grades consider Subcontractors Poor performance, Project size in terms of time, Sub-Contractors Competence, Poor communication between involved parties, Quality of work, Insufficient technology/skills / technique available, Project size in term of cost, Project size in terms of size, Lower work quality in presence of time constraints, Third party delay, Poor communications between home and field offices, Unpredicted Technical problems during Construction, and Feasibility of construction methods all as high severity risk factors.
- In the Financial category, Delay in progress payments, Financial failure of the Contractor, Financial failure of the sub-contractor, and Poor cost control have been considered as highly severe by all grade 1, 2 and 3 contractors. Financial failure of the owner and Delay in payment of claims has been consider as highly severe by grade 1 and grade 3 contractors while grade 2 contractors consider it of medium severity.

Inflation has been considered as a medium severity factor by grade 2 and grade 3 contractors while grade 1 contractors consider it of high severity. High interest rates and Exchange rate fluctuation have been considered as medium severity factor by all the grade 1, 2 and 3 contractors.

- In the Design category, contractors regardless of grades consider Frequent changes of design, Awarding the design to unqualified designers, Delays in approval, Undefined scope of work, Lack of consistency between bill of quantities, drawings and specifications, Actual quantities differ from the contract quantities, Drawings and documents are not issued on time, Failure to identify defects, and Defective design (incorrect) all as high severity risk factors.
- In the Legal category, contractors regardless of grades consider Difficulty to get permits, Corruption and Bribes, Change order negotiation, Delayed disputes resolutions, Labor Disputes, New governmental acts or legislations, and Breach of Contract by any of the involved parties all as high severity risk factors. Legal disputes among the contract parties has been consider as a highly severe by grade 1 and grade 3 contractors while grade 2 contractors consider it of medium severity.
- In the Resource category, contractors regardless of grades consider Poor labor productivity, Unavailable labor, Late deliveries of material, Departure of qualified staff or labor, Unavailable equipment, Unavailable materials, Poor equipment productivity, and Supplies of defective materials all as high severity risk factors

5.2.4 RISK MANAGEMENT ACTIONS

- In regard to the suitability of various risk preventive actions, Utilize quantitative risk analyses techniques for accurate time estimate has been considered as a highly suitable risk preventive action by grade 1 and 2 participating contractors while grade 3 contractors consider it as more suitable. Produce a proper schedule by getting updated project information has been considered as a more suitable risk preventive action by grade 1 and 3 participating contractors while grade 2 contractors consider it as highly suitable. Plan alternative methods as stand-by and Consciously adjust for bias and add risk premium to time estimation have been considered as more suitable risk preventive action by grade 2 and 3 participating contractors while grade 1 contractors consider it as highly suitable. Refer to previous and ongoing similar projects for accurate program has been considered as a more suitable risk preventive action by all grade 1, 2 and 3 participating contractors. Transfer or share risk to/with other parties has been considered as a more suitable risk preventive action by grade 1 and 2 participating contractors while grade 3 contractors consider it as suitable. Depend on subjective judgment to produce a proper program has been considered as a suitable risk preventive action by grade 2 and 3 participating contractors while grade 1 contractors consider it as mostly suitable.
- For the suitability of risk mitigative actions, close supervision to subordinates for minimizing abortive work and coordinate closely with subcontractors have been considered as highly suitable risk mitigative action by all grade 1, 2 and 3 participating contractors. Change the sequence of work by overlapping activities has been considered as a more suitable risk mitigative action by grade 1 and 3 participating

contractors while grade 2 contractors consider it as highly suitable. Increase the working hours, Increase manpower and Increase equipment have been considered as more suitable risk mitigative action by all grade 1, 2 and 3 participating contractors.

5.3 CONCLUSION

Most of the contractors in Saudi Arabia are practicing risk management in their business operation but there is a lack of risk professionals in the contractor's organization and the contractors are not following a systematic approach for dealing with risks. The contractors are using proper techniques for evaluating risks which have proven acceptable and effective in the construction industry. The contractors are considering lot of risk factors both internal and external to the project in their business operations. The contractors are using suitable risk preventive and mitigative actions which are acceptable in the construction industry to reduce the aftermaths of the occurrence of risks.

5.4 RECOMMENDATION

In this section recommendation will be made to the contractors which may help them to improve their risk management practices in their organization. Recommendation for further studies will also be given which are required in the construction industry in Saudi Arabia.

5.4.1 RECOMMENDATION TO THE CONTRACTORS

- Contractors who are not considering risk management are advised to understand its importance and start implement it for construction of projects.
- Contractors are advised to start following a more systematic approach for risk management process and should employ risk professionals and experts in their organization instead of relying on consulting experts.
- Contractors are advised to work on training their personnel to properly apply risk management principles by organizing workshops or providing education in risk management institutes.
- Contracting firms are advised to utilize computerized approaches used for risk analysis and evaluation such as @Risk package which integrates with widely used programs like Microsoft Project and Microsoft Excel. These project management tools are designed to model interaction of time, resources, cost and revenue throughout the entire life of a project and have the capacity to evaluate the consequences of factors such as delay, inflation and changes to the market or to production rates. Such computer-based methods recognize the dynamic project environment.
- Contractors are advised to learn how to share and shift different possible risks that will occur in the project. This will reduce the amount allocated for contingencies thereby maximizing the profit and chance of winning the bid simultaneously.
- Contractors are advised to maintain a satisfactory level of communications not only between the home and field office but also with the sub-contractors and owners representatives to convey the needed information fluently and effectively.

5.4.2 RECOMMENDATION FOR FURTHER STUDIES

- It can be recommended that a study could be carried out in future to determine the barriers which the contractors consider and face in implementing risk management practices in their business operation in Saudi Arabian construction industry.
- It is recommended that this study should be once again carried out after 5 years to identify the status of risk management in the construction industry in Saudi Arabia and compare it with the present results.

REFERENCE

[1] Patrick. X.W, Zou Guomin Zhang and Jia-Yuan Wang "**Identifying Key Risks in Construction Projects: Life Cycle and Stakeholder Perspectives**" www.prres.net/papers/zou_risks_in_construction_projects.pdf

[2] Ewelina Gajewska, Mikaela Ropel "**Risk Management Practices in a Construction Project–a case study**" Chalmers, Civil and Environmental Engineering ,Master's Thesis, 2011:47.

[3] PMI (Project Management Institute),"**A guide to the project management body of knowledge**": PMBOK. 3rd edition, Pennsylvania: Project Management Institute, 2004.

[4] Keith Potts, Taylor & Francis, "**Construction cost management, learning from case studies**", Construction Management and Economics Volume 28, Issue 5, 2010.

[5] Klemetti A., "**Risk Management in Construction Project Networks**", Helsinki University of Technology, Laboratory of Industrial Management Report. Espoo, 2006.

[6] Gould, F.E, and Joyce, "**Construction project management**" Upper Saddle River: Prentice Hall, N.E, 2002.

[7] Smith. N.J., Merna, T. and Jobbling P., "**Managing Risk in Construction Projects"** 2nd edition Oxford: Blackwell Publishing, 2006.

[8] Carr V, Tah J.H.M, "**A fuzzy approach to construction project risk assessment and analysis: construction project risk management system**", Advances in Engineering Software, Volume 32, Issues 10–11, Pages 847–857, October–November 2001,

[9] Akintoye. A.S., MacLeod. M.J, "**Risk analysis and management in construction**", International Journal of Project Management, Volume 15, Number 1 pp. 31-38(8), February 1997.

[10] Ceric A, "**A framework for process-driven risk management in construction projects**", PhD thesis, University of Salford, UK, 2003.

[11] Roozbeh Kangari, "**Risk Management Perceptions and Trends of US Construction"**, Journal of Construction Engineering and Management, vol. 121, no. 4, pp. 422-429, 1995, December 1995.

[12] Yoe C., "**Risk Analysis Frame Work for Cost Estimation**", in association with Planning and Management Consultants for U.S. Army Corps of Engineers, Institute of Water Resources, 2000.

[13] Zayed T. and Chang L., "**Prototype model for build-operate-transfer risk assessment**", Journal of Management in Engineering 18, pp7-16, 2002.

[14] Jaafari A., "**Management of risks, uncertainties and opportunities on projects: time for a fundamental shift**", International Journal of Project Management 19, pp 89-101, 2001.

[15] Greene A**.," A process approach to project risk management**", Department of Civil and Building Engineering, Loughborough University, 2001.

[16] Erikson, C. A, "**Risk Sharing in Construction Contracts**" PhD thesis, Civil. Engineering. Dept., University. Of Illinois. Urbane, III, 1979.

[17] Al-Bahor, J, Crandall K, "**Systematic Risk Management Approach for Construction Projects**", Journal of Construction Engineering and Management, ASCE, Vol. 116, No. 3, pp 533-547, 1990.

[18] Chapman C. B. and Cooper D. F, "**Risk analysis: testing some prejudices**", European Journal of Operational Research, Volume 14, pp. 238-247, 1983.

[19] Wideman R. M, "**Risk Management**", Project Management Journal, pp 21-26, 1986.

[20] Kliern R. L, Ludin I. S," **Reducing project risk**", Gower, 1997.

[21] Smith N .J, "**Managing Risk in Construction Project**", Blackwell Science Ltd, 1999.

[22] Flanagan, R. and Norman, G, "**Risk Management and Construction**", Blackwell Science Ltd, 1993.

[23] Clark, R. C., Pledger and Needler, H. M. J, " **Risk analysis in the evaluation of non-aerospace projects**", Risk management, Vol. 8, No. 1, pp. 17-23, 1990.

[24] Grier, B, "**The early history of the theory and management of risk**." Proc., judgment and Decision Making Group Meeting, 1981.

[25] Kahkonen, K. & Huovila, P, "**Systematic Risk Management in Construction Projects**", VTT Building Technology, P. O. Box 1801, SF-02044 VTT, Finland, 1999.

[26] Zack, J. G. Jr, "**Risk-Sharing- Good Concept, Bad Name**", Cost Engineering, Vol. 38, No. 7, pp. 26- 31, 1996.

[27] Godfrey, P, "**Control of Risk: A Guide to the Systematic Management of Risk from Construction**", Construction Industry Research and Information Association, London, 1996.

[28] Miller. A, "**A systematic Approach to Risk Management for Construction**" Structural Survey, Vol. 19, No. 5-2001, pp 245-252, 2001.

[29] Flangan, Roger and Norman, G, "**Risk Management in Engineering Construction**", BSP Professional Boos, Oxford, 1999.

[30] Baker, S, Ponniah, D., and Smith, S, "**Risk response techniques employed currently tor major projects**", Construction Engineering and Economics, 17, pp. 205-213., 1999.

[31] Hayes, R., Perry, J. and Thompson, J, "**Risk Management in Engineering Construction: A Guide for Project Analysis and Risk management**", Thomas Telford, London, 1986.

[32] Bing, L., Tingo, R. L., and Chew, D., "**Risk Management in International Construction Joint Venture**" Journal of Construction Engineering and Management, ASCE, July/August 1999, pp 277-284, 1999.

[33] Perry, J," **Risk management an approach for project managers**", Butterworth & Co, Vol. 4, pp. 211-216, 1986.

[34] Cooper, D., Grey, S., Raymond, G., and Walker, P., "**Project Risk Management Guidelines: Managing Risk in Large Projects and Complex Procurements**", Chichester: John Wiley & Sons, Ltd, 2005.

[35] Webb, A., "**The project manager's guide to handling risk**", Aldershot: Gower Publishing Limited, 2003.

[36] Winch, G, "**Managing construction projects, an information processing approach**", Oxford: Blackwell Publishing, 2002.

[37] Raz T, Michael E, "**Use and benefits of tools for project risk management**", International Journal of Project Management 19, pp 9-17, 2001.

[38] Syed M. Ahmed, Riaz Ahmad & D Darshi De Saram, "**Risk management trends in the Hong Kong construction industry: a comparison of contractors and owners perception**", Engineering, Construction and Architectural Management 6/3, pp 225-234, 1999.

[39] Project Management Institute PMI, "**Project Management Body of Knowledge**", PMI, 1996.

[40] Shen LY, "**Project risk management in Hong Kong**", International Journal of Project Management 15, pp 101-105, 1997.

[41] Dembo R. & Freeman A, "**The rules of risk: A guide for investors**", John Wiley & Sons inc, 1998.

[42] Chapman C. & Ward S, "**Project Risk Management: Processes, Techniques and Insights**". John Wiley, 1997.

[43] Carter, B., Hancoc, T., Morin, J-M and Robins, N, "**Introducing Risk man -The European Project Risk Management Methodology**", NCC Blackwell, 1994.

[44] Grammer, J, Trollope, S, "**Lifecycle Management: Managing Risk**", GPT Limited, 1993.

[45] Bajaber M. A and Taha. M. A, "**Contractor Selection in Saudi Arabia** ", World Academy of Science, Engineering and Technology 71, 2012.

[46] http://www.zawya.com/story/Failing_Saudi_projects_feared_to_double_in_2013-ZAWYA20131126101943/, Nov 26 2013.

[47] http://www.arabnews.com/news/464904, 17 September 2013 5:36 am

[48] Grant Kululanga and Witness Kuotcha, "**Measuring project risk management process for construction contractors with statement indicators linked to numerical scores**", Engineering, Construction and Architectural Management Vol. 17 No. 4, pp. 336-351, 2010.

[49] Stephen O Ogunlana, Krit Promkuntong, Vithool Jearkjirm. "**Construction delays in a fast-growing economy: Comparing Thailand with other economies**", International Journal of Project Management, 14(1), 37-45, 1996.

[50] Djoen San Santoso, Stephen O. Ogunlana, Takayuki Minato "**Assessment of risk in high risk building construction in Jakarta**", Engineering Construction and Architectural Management, 10(1), 43-55, 2003.

[51] Darnall, R. and Preston, J.M., "**Project Management from Simple to Complex**", Flat World Knowledge, Inc, 2010.

[52] Potts Keith, "**Construction cost management, learning from case studies**", Abingdon: Taylor Francis, 2008.

[53] Thomas P., "**Strategic Management**", Course at Chalmers University of Technology, 2009.

[54] Wiguna, I P A and Scott, S, "**Nature of the critical risk factors affecting project performance in Indonesian building contracts**", Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, SOAS, University of London. Association of Researchers in Construction, Management, Vol. 1, 225-35, 2005.

[55] Ali Abdullah Al Salman, "**Assessment of Risk Management Perceptions a n d Practices OF construction contractors in Saudi Arabia**", M.S. Thesis, King Fahd University of Petroleum and Minerals, Saudi Arabia, 2004.

[56] Nur Alkaf Abd Karim, Ismail Abd. Rahman Aftab Hameed Memmon, Nurhidayah Jamil, "**Significant Risk Factors in Construction Projects: Contractor's Perception**", Humanities, Science and Engineering (CHUSER), IEEE Colloquium, 2012.

[57] Rafiq M. Choudhry and Khurram Iqbal, "**Identification of Risk Management System in Construction Industry in Pakistan**", Journal of Management in Engineering, Vol. 29, No. 1, January 1, 2013.

[58] Nabil A. Kartam, Saied A. Kartam, "**Risk and its management in the Kuwaiti construction industry: a contractors' perspective**", International Journal of Project Management 19 325-335, 2001.

[59] Eng. Jaser Hmaid Abu Mousa, "**Risk Management in Construction Projects from Contractors and Owners" perspectives**", M.S. Thesis, The Islamic University of Gaza, Palestine, 2005.

[60] Sameh Monir El-Sayegh, "**Risk assessment and allocation in the UAE construction industry**", International Journal of Project Management 26 431–438, 2008

[61] Mohammed Khaliluddin, "**Contract Risk Allocation in Saudi Arabian Construction Projects**", M.S. Thesis, King Fahd University of Petroleum and Minerals, Saudi Arabia, 2010.

[62] Tang W., Qiang M., Duffield C., Young D., and Lu Y.," **Risk Management in the Chinese Construction Industry**" J. Constr. Eng. Manage., 133(12), 944–956, 2007.

APPENDIX

Risk Management in Construction Industry in Saudi Arabia: a Contractor's Perspective

QUESTIONNAIRE

It is greatly appreciated if this questionnaire is completed by a person who is involved in the management of risk for the organization to obtain valuable and reliable information on the subject of this study.

بسم الله الرحمن الرحيم

Ministry of Higher Education
King Fahd University of Petroleum & Minerals
COLLEGE OF ENVIRONMENTAL DESIGN
Dept. of Construction Engineering & Management

وزارة التعليم العالي
جامعة الملك فهد للبترول و المعادن
كلية تصاميم البيئة
قسم هندسة وإدارة التشييد

Dear General Manager,

24-August-2014

The department of Construction Engineering and Management is conducting a research on **Risk Management in the Construction Industry in Saudi Arabia: a Contractors perspective** and the participants of this research are Grade 1, 2 and 3 construction contractors.

Risks are imminent in construction industry and plays a vital role in success or failure of projects. Among all the stakeholders contractors are one who are most vulnerable to risks. Risk management if not carried effectively may lead to evident case of project delay, cost overrun, confusion, ultimately causing substantial financial losses to the contractor.

This research tries to investigate how contractors in Saudi Arabia manage risks in their organization. Specifically, to determine the risk evaluation techniques used to identify potential risks, significance of the risk factors which contractors evaluate to manage risk in projects and also to determine the strategies which contractors design, implement and control to eliminate or mitigate risks in projects.

This research will help to identify the current risk management practices of construction contractors in Saudi Arabia and will help contractors to minimize losses and save extra costs which they might incur by better understanding how these risks are allocated and dealt with. It will also help the contractor's to identify the best approach to deal with the risks not only coming from the project but also the risks coming from within his organization, subcontractors, man power, vendors, government etc.

This research has been formally approved and will be published in International journals and all the participants will receive the results. No personal information about individuals involved will appear in the findings.

An enclosed questionnaire is attached and it's crucial for the research that it is completed by the person dealing with risk management. It will be grateful that the completed questionnaire is returned as early as possible. It shall be appreciated that the completed questionnaire is send by post, fax and/or e-mail to the address of Dr. Ali Shash as listed below and should you have any question or clarification regarding the research, please contact the undersigned.

Thank You

Mohammed Shoeb,
Research Assistant & Graduate Student,
CEM Department, K.F.U.P.M,
Dhahran 31261,
Mob # 0535729597,
E-mail: mdshoeb@kfupm.edu.sa

Dr. Ali Ali Hassen Shash,
Director, Construction Industry Institute,
Professor, CEM Department, K.F.U.P.M,
P.O. Box # 1627, Dhahran 31261,
Fax # 013 860 7889,
E-mail: aashash@kfupm.edu.sa

Section-1: Organization

This section contains questions seeking information about your organization. You are kindly requested to provide the needed information by placing a tic (√) in the box next to your answer or by writing in the space next to the questions.

Q1). Name of the Organization: (Optional) .....

Q2). Number of Employees:

☐ Less than 100 ☐ 100-less than 500 ☐ 500-less than 1000
☐ 1000-less than 1500 ☐ 1500 or more

Q3). How many years since your organization was established?

☐ Less than 5 ☐ 5-less than 10 ☐ 10-less than 15
☐ 15-less than 20 ☐ 20 or more

Q4). What is your organization financial capital in Saudi Riyals?

☐ Less than 10 million ☐ 10-less than 20 million ☐ 20-less than 30 million
☐ 30-less than 40 million ☐ 40 million or more

Q5). Number of executed projects in the last 5 years

☐ Less than 10 ☐ 10-less than 20 ☐ 20-less than 30
☐ 30- less than 40 ☐ 40 or more

Q6). What are the type(s) of facilities which your organization builds? (You may select more than one answer)

☐ Infrastructure ☐ Buildings ☐ Utilities ☐Industrial
☐ Residential ☐ Others, please specify .....

Q7). What is the average size, in terms of Saudi riyals of projects which your organization performs?

☐ Less than 20 million ☐ 20-less than 40 million ☐ 40-less than 60 million
☐ 60-less than 100 million ☐ 100 million or more

Q8). Who are your organization's clients? (you may select one or more than one answer)

☐ Government sector ☐ Private sector ☐ Both
☐ Others, please specify .....

END OF SECTION 1

Section 2: Respondent

This section contains questions seeking information about the respondent to this questionnaire. You are kindly requested to provide the needed information by placing a tic (√) in the box next to your answer or by writing in the space next to the questions.

Q1). Name: (Optional)…….

Q2). Job Title in present organization: ……..

Q3). What is your education level?

☐ Diploma ☐ Bachelor Degree ☐ Master Degree
☐ Doctor of Philosophy (Ph.D.) ☐ Others, please specify ……..

Q4). How many years you have been working with the present organization?

☐ Less than 3 ☐ 3-less than 6 ☐ 6-less than 10
☐ 10-less than 15 ☐ 15 years or more

Q5). Total experience in years in construction Industry?

☐ Less than 5 ☐ 5-less than 10 ☐ 10-less than 15
☐ 15-less than 20 ☐ 20 or more

End of Section 2

Section 3: Risk Management in the organization

This section contains questions seeking information about who is responsible for carrying out risk management in the contractor's organization. You are kindly requested to provide the needed information by placing a tic (√) in the box next to your answer or by writing in the space next to the questions.

Q1). Does your organization carry out Risk Management?

☐ Yes, if yes please continue ☐ No, if no please go to **section 4**

Q2). How long has your organisation been carrying out Risk Management?

☐ Less than 2 years ☐ 2 — less than5 years ☐ 5 — less than 10 years ☐ 10 years or more

Q3). Who in your organization carries out risk management?

☐ Planner ☐ Cost Estimator ☐ Project Manager
☐ A separate risk management department (If selected, continue if not selected please go to question 7) ☐ Others, please specify .....

Q4). When was risk management department formed?

☐ from the start of the Organization ☐ Less than 2 years ☐ 2 —less than 5 years
☐ 5 —less than 10 years ☐ 10 years or more

Q5). Number of employees in risk management department?

☐ Less than 5 ☐ 5-less than 10 ☐ 10-less than 15
☐ 15-less than 20 ☐ 20 or more

Q6). To whom does this department report to?

☐ President ☐ Operation Manager ☐ Others, please specify .....

Q7). For how long has the responsible person been involved in Risk management?

☐ Less than 2 years ☐ 2 — less than 5 years ☐ 5 — less than 10 years ☐ 10 years or more

Q8). On which project(s) In terms of Cost do your organization carry Risk Management? (You may select more than one answer)

☐ Small projects ☐ Medium Projects ☐ Large Projects ☐ Every project

Q9). On which project(s) In terms of Time do your organization carry Risk Management? (You may select more than one answer)

☐ Small projects ☐ Medium Projects ☐ Large Projects ☐ Every project

Q10). On which project(s) In terms of Size do your organization carry Risk Management? (You may select more than one answer)

☐ Small projects ☐ Medium Projects ☐ Large Projects ☐ Every project

Q11). At what stage of the project do you usually launch Risk Management?

☐Conceptual ☐ Preliminary design ☐ Detail design
☐ Tendering ☐ Construction ☐ Operation of building

Q12). In your opinion, what other stage(s) should Risk Management be launched at? (You may select more than one answer)

☐Conceptual ☐ Preliminary design ☐ Detail design
☐ Tendering ☐ Construction ☐ Operation of building

Q13). Do you follow up or maintain Risk Management throughout the project life cycle?

☐ Yes ☐ No

Q14). What are the reason(s) for using Risk Management? (You may select more than one answer)

☐ Long Term Cost Savings ☐ Client's requirements ☐ Complex projects
☐ Quick and more competent in handling risks ☐ Others.....

End of Section 3

Section 4: Risk Analysis Techniques

The following are potential Risk Analysis Techniques, you are kindly requested to evaluate the suitability of these techniques by placing a tick (√) in the appropriate box next to each technique, where 1 corresponds to Not suitable, 2 - Somewhat suitable, 3 – Suitable, 4 - Very suitable and 5 - Very much suitable respectively.

	Risk Analysis Technique	Suitability				
		1	2	3	4	5
1	Compare similar projects through similar conditions					
2	Direct judgment using experience and personal skills and documented knowledge					
3	Expert Systems (including software packages, decision support systems, computer- based analysis techniques such as @Risk					
4	Analyzing historical data					
5	Using computer simulation packages					
6	Sensitivity analysis					
7	Consulting experts					
8	Project team brainstorming					
9	Project documentation reviews					
10	Joint evaluation by key participants					
11	Checklist					
12	Others, please specify and rate: a. _____ b. _____ c. _____					

End of section 4

Section 5: Risk Factors

The following are potential risk factors which a contractor should consider while evaluating the risks for project. Please rate the following factors that you think most appropriate by placing a **tick** ($\surd$) in the appropriate box for a scale of 1 to 9 where 9 represents extremely significant and 1 represents the not a significant risk factor.

	Risk Factors	Significance								
		1	2	3	4	5	6	7	8	9
A	**On site**									
1	Occurrence of accidents because of poor safety procedures									
2	Difficulty to access the site									
3	Adverse weather conditions									
4	Unforeseen site conditions									
5	Environmental factors									
6	Others, please specify and rate a. _____ b. _____									
B	**Construction**									
1	Project size in term of cost									
2	Project size in terms of size									
3	Project size in terms of time									
4	Unpredicted Technical problems during Construction									
5	Lower work quality in presence of time constraints									
6	Feasibility of construction methods									
7	Insufficient technology/skills / technique available									
8	Quality of work									
9	Poor communications between home and field offices									
10	Third party delay									
11	Sub-Contractors Competence									
12	Poor communication between involved parties									
13	Subcontractors Poor performance									
14	Others, please specify and rate a. _____ b. _____									
C	**Financial**									
1	Inflation									
2	Financial failure of the Contractor									
3	Financial failure of the owner									
4	Financial failure of the sub-contractor									
5	Delay in progress payments									
6	Exchange rate fluctuation									
7	Delay in payment of claims									
8	High interest rates									
9	Poor cost control									

	Risk Factors	Significance								
		1	2	3	4	5	6	7	8	9
10	Others, please specify and rate a. _____ b. _____									
D	**Design**									
1	Defective design (incorrect)									
2	Design changes									
3	Actual quantities differ from the contract quantities									
4	Drawings and documents are not issued on time									
5	Undefined scope of work									
6	Lack of consistency between bill of quantities, drawings and specifications									
7	Frequent changes of design by designers									
8	Awarding the design to unqualified designers									
9	Failure to identify defects									
10	Delays in approval									
11	Others, please specify and rate a. _____ b. _____									
E	**Legal**									
1	New governmental acts or legislations									
2	Breach of Contract by any of the involved parties									
3	Legal disputes among the contract parties									
4	Labor Disputes									
5	Delayed disputes resolutions									
6	Difficulty to get permits									
7	Change order negotiation									
8	Corruption and Bribes									
9	Others, please specify and rate a. _____ b. _____									
F	**Resources**									
1	Unavailable labor									
2	Unavailable materials									
3	Unavailable equipment									
4	Supplies of defective materials									
5	Late deliveries of material									
6	Poor labor productivity									
7	Poor equipment productivity									
8	Departure of qualified staff or labor									
9	Others, please specify and rate a. _____ b. _____									

End of Section 5

Section 6: Risk Preventive and Mitgative Actions

The following are potential Risk Preventive and Mitigative Actions, you are kindly requested to express your level of agreement with the listed preventive and mitigative actions by placing a **tick** (√) in the appropriate box next to each action where 1 corresponds to Not suitable, 2 - Somewhat suitable, 3 – Suitable, 4 - Very suitable and 5 - Very much suitable respectively.

	Risk Preventive Actions	Level of Agreement				
		1	2	3	4	5
1	Depend on subjective judgment to produce a proper program					
2	Produce a proper schedule by getting updated project information					
3	Refer to previous and ongoing similar projects for accurate program					
4	Consciously adjust for bias and add risk premium to time estimation					
5	Plan alternative methods as stand-by					
6	Utilize quantitative risk analyses techniques for accurate time estimate					
7	Transfer or share risk to/with other parties					
8	Others, please rate and specify a. _____ b. _____ c. _____ d. _____					

	Risk Mitigating Actions	Level of agreement				
		1	2	3	4	5
1	Increase manpower					
2	Increase equipment					
3	Increase the working hours					
4	Change the sequence of work by overlapping activities					
5	Coordinate closely with subcontractors					
6	Close supervision to subordinates for minimizing abortive work					
7	Others, please rate and specify a. _____ b. _____ c. _____ d. _____					

END OF QUESTIONNAIRE

VITAE

Name	: Mohammed Shoeb
Nationality	: Indian
Date of Birth	:6/6/1991
Email	: mrshoeb91@gmail.com
Address	: 20-4-1112/18, Beside Julukhana Masjid, Moti Galli, Lad Bazar, Charminar, Hyderabad, 50002, India
Academic Background	: B.E., Civil Engineering, Osmania University, India, 2012