Perception eccentricities in risk time dimension of construction professionals in the state of Kuwait

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Perception Eccentricities in Risk Time Dimension of Construction Professionals in the state of Kuwait

BY

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Abstract

The role of risk management in construction has become increasingly important in recent decades. Risk management is often considered as a practice intended to identify and quantify all potential risks likely to affect a project or organisation, so that appropriate decisions can be made to mitigate any potential impact. Risk management in construction is currently practised on the basis that similar conditions to similar risk events faced by different professionals in different projects should have similar decisions. However, the identification and quantification of significant risks that require mitigation relies on the perception of the individual responsible for making decisions related to those risks. An important aspect of the individual's perception is the level of awareness for estimating the time within which an identified risk event should be mitigated; termed herein as *''the time dimension of risk''*. The time dimension of risk in construction is somehow considered to be subsumed within the assigned probability of risk events or/and project activities. There is ample evidence to support the view that current techniques and implementation methods of risk management in construction do not systematically take account of the risk time dimension. The nature, distribution, and influence of such perception attributes displayed among construction professionals is hardly known. Some schools of thought deem that attribute as reflecting a rather complex distribution among decision makers, with many construction professionals eccentrically located in the optimism-pessimism rationality axes. The research that underpins this thesis was aimed at investigating and establishing the eccentricities in the perceptions of construction professionals in relation to their time dimension of risk

A critical review of essential sources related to risk management within and beyond construction revealed that the different perceptions of individuals have a strong influence on the decisions that are made in the process of risk management. In responding to the differences in perception, two sets of investigations were conducted to establish their nature and scale. The first of these involved establishing the pre-existing concepts, current mitigation approaches, and responses predominantly practiced in construction. The second investigation contextualised and characterised the time dimension of risk for the professionals in construction. The findings from the investigations revealed that professionals utilise different sources of information and have different requirements in their estimation of the time dimension of risk, and therefore, their decisions vary accordingly. The findings also confirmed that the different risk attitudes of individuals play a dominant role in implementing decisions, especially when these are related to time dimension of risk. The analysis showed that 86 per cent of professionals do not systematically estimate the risk time dimension in their projects. The results from the analysis were employed in developing an assessment matrix to establish the scale of deviation (eccentricity) in the perceptions of professionals when estimating the time dimension of risk. The assessment matrix was validated as efficacious for determining the deviations exhibited by professional in their exercise of decisions on time dimension of risk. The significant contribution made by the development of the assessment matrix lies in its innovation and improvement in how risk timeframe should be defined with greater clarity. It also provides a new approach for augmenting current solutions employed for the management of risk.

Keywords: Risk management, risk time dimension, perception, timeframe, decision eccentricity, construction professionals.

Dedication

This thesis is dedicated to the soul of my beloved father, (Mohammad Aldaiyat), and to my precious mother (Haya Alazemi), brothers (Nayef, Hayef and Jassem), sisters, to my beloved wife and my children: Mohammad, Dhary, and Haya. None of this achievement would have been possible without your love and inspiration.

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Chapter 1: Introduction

1.1 Background

Recently the concept of risk has become more important to many organisations, and as a consequence, is attracting attention from research. The attention from research is throwing the searchlight on a practice that has hitherto been driven by 'rules-of-thumb', and leading to an evolution of theories aimed at improving risk management in many different fields. Risk management in construction is currently practised on the basis that similar conditions to similar risk events faced by different professionals in different projects should be addressed by similar decisions. Clearly, this is fundamentally flawed, and requires a fresh look at current approaches for addressing risk in construction. Furthermore, this is not a reflection of the real situation faced by professionals, as no formal attention is given to estimating the timeframe (time dimension) of risk, specifically when it is too late to mitigate an identified risk event.

Various scholars have defined risk in different ways, varying according to their specific viewpoint, experiences and attitudes. For example, professionals from different backgrounds, such as engineering, site construction, and architecture, as well as other designers, view risk from their own specific technical perspective. Reflecting on the differences in which risk is addressed, Baloi and Price, (2003) suggest that in the procurement of major project schemes, often lenders and developers view risk from an economic and financial point of view only, which is their technical background. Despite the differences in backgrounds, all risk management practitioners seek to implement proper identification of risk, in order to control, transfer, or otherwise manage the potential impact of events, so as to meet various organisational needs (Bajaj et al., 1997). When risk events are properly identified, risk management professionals then produce a plan to mitigate all possible risks that are likely to occur, according to their magnitude. In the current economic environment, it is necessary to have a formal risk management department within any worthwhile organisation. The successful delivery of any project depends largely on good management of associated risks, and the adoption of response strategies that are used to mitigate all identified risk events (Dikmen et al., 2007).

Risk management is recognised as a practice that is used to identify, analyse, and respond to various risks that are likely to occur in the process of managing a project. The rational of exploiting risk management is based on the notion that it is useful to enhance the probability of positive events occurring, and reducing the probability and consequences of adverse events within the project. For example project managers live with the view that no construction project can be completed without encountering risks. The effect of the risks rests on the judgment and mitigation decisions that are exercised by those in charge of the project and its delivery. Therefore, project managers, along with their team members, can reduce their risk exposure within a project through proper management, minimisation, sharing, transferring or accepting projects' risks.

Risks in projects cannot be ignored (Latham, 1994). Construction is recognised as high risk industry, within which no projects can be completed without encountering potential risks, due to the highly complex and strategic nature of the projects that construction businesses undertake. Construction projects are often associated with numerous stakeholders, and feature long production durations along with an open production system and a strong relationship between their internal and external environments (BSI, 2006).

Construction projects are also typically associated with technological complexity, and thus, often generate large amounts of risk (Zou et al., 2007). Unfortunately, there is the view held by some practitioners that construction has never been able to mitigate risks as effectively as other high-risk industries, such as financial and insurance businesses (Laryea and Hughes, 2008). This view on the risk management capability can be associated with the rule of thumb approach to addressing risk in construction. Although researchers in construction have paid much attention to risk management, their efforts have generally addressed at confirming the conventional approaches without extending the frontiers of knowledge in the subject or resolving controversial issues (Baloi and Price, 2003). Tah and Carr (2001) suggest that traditionally, attention has primarily focused on quantitative risk assessment despite the various difficulties involved in calculating objective probabilities and frequencies in the construction industry. Construction projects are often recognised as one-off endeavours by the project team (Flanagan and Norman, 1993). Project managers therefore, rely heavily on subjective probabilities in dealing risk levels (Winch, 2003). Others share this view of risk being associated with subjective probabilities and propose coping with the subjectiveness through adding approximate contingency sum to cover the potential impact (Kangari and Riggs, 1989). Typically, project managers and their team members utilise their individual knowledge, experiences, intuitive judgement and rules of thumb in a structured way to facilitate adequate risk assessment (Dikmen et al., 2007).

Risk assessment is directly associated with the modelling of risks, where construction companies encounter various risks under different conditions. The Probability-Impact (P-I) risk model is used to successfully assess risk events through the assessment of the probability of its occurrence during a construction project. However, the P-I risk model has been criticised by several different researchers including who have highlighted the need to make potential improvements in such risks (Taroun et al., 2011). Some researchers have consequently proposed alternative theories, tools and techniques that can be used to assess the risks are faced by various construction companies and organisations. These alternative theories appear to suggest that there is a clear distinction between the theory and practice of risk modelling and assessment (Taroun, 2014). The difference between theory and practice implies an opportunity for bridging the divide through research.

Kululanga and Kuotcha (2010) proposed a systematic approach to quantify the processes of risk management in order to assist construction contractors. In their work, Kululanga and Koutcha (2010) identified several factors that are deemed to influence the process of risk management. These factors were largely dependent on the size and experience of surveyed projects for which construction contractors had significant delivery influence. The study was based on the general notion that the success of any project relies heavily on its timely completion, within the desired budget, as well as satisfying the requisite performance and technical requirements. Project managers and team members will likely face several challenges during the project lifecycle, including changes in the project environments (Chapman, 2006). These problems can be further amplified by the size of the project, and uncertainties due to changes to the project outcomes (Zayed et al., 2008). Other considerations such as availability of various project resources, the climatic environment, the political and economic environment, and statutory regulations add further dimensions to the issues that require consideration (Dey and Ramcharan, 2008). In reality, risks can affect all types of projects, regardless of their size, resources deployed and other influencing factors and considerations (Dey, 2002). Some of the other risks considerations include the complexity of projects, along with conditions such as the need for rapid construction, the project location, and the degree of familiarity with such projects (Dey, 2001).

Although modern organisations recognise the importance of risk management in construction projects, formal risk management analysis and techniques are rarely used. According to Akintoye and Macleod (1997) this is due to a lack of knowledge on the part of various professionals regarding the tools and techniques used in construction activities. In the construction industry, risk management is recognised as one of the most important tasks that project managers should be familiar with in order to get the best outcome. It is therefore expected that project managers working on modern construction projects would display sufficient risk management capabilities by utilising the latest risk management tools and techniques. However, this is often not the case and many project managers indicate a preference for conventional risk management techniques such as checklist and unvalidated experience, which often prove rather insufficient for addressing complex projects. (Dey, 2001).

The major risk that most construction projects face is associated with a delay in the timely delivery of the project within a temporary organisation context. Das and Teng, (1997) suggest that individual perceptions regarding the flow of time has a considerable impact on the industrial risk behaviour, and therefore, any consideration of the importance of risk management in construction projects.

A careful examination of the perception of decision makers could provide a new direction with potential to impact on the management of risk in the modern construction industry. Becoming aware of the perception of construction professionals regarding the time dimension of risk, should pave the way to establish how an individual's perception of time can affect performance and prediction of project risks. Linley and Joseph (2004) argue that time is the most important concern that project managers face in relation to individual subjective experience. Time also has a considerable influence on individual choices and actions, which become dispositional characteristics when the time perspective of individual biased opinions plays a dominant role in their responses. Recent evidence on such perception appears to suggest that decision makers typically do not reflect a concentric alignment in the risk problems they address and the solution options they adopt. That alignment is often seen as being eccentric (Aldaiyat et al. 2014)

The construction industry in Kuwait, which is the focus of this research, is a significant contributor to the national economy and the development of that country. Recently, there has been considerable development in the construction industry. This was most noticeable following the announcement of Kuwait's Vision 2035, which aims at the development of the country. The timing of this study on risk management in construction projects in Kuwait coincides with the Kuwaiti Government's ambition to encourage more private sector participation. The current move towards privatisation would support the growth of construction industry, meaning less dependency on government funding. It would also mean a call for more effective tools to address the management of risk for large and complex development schemes. Many of the executives who would exercise critical decisions will be doing so often under time pressure. This makes any solutions on exploiting risk perception a useful tool for them.

The Kuwaiti Government's Five Year Development Plans outline its intention to continue strengthening private sector involvement in the construction industry. For example, the three models known as Build-Operate-Transfer (BOT), Build-Operate-Own (BOO), and Build-Transfer-Operate (BTO) encourage economic activity, increasing opportunities for the private sector.

They also have the additional benefit of providing employment opportunities and attracting foreign capital.

On the other hand, the lack of information in the published literature linking practitioners' time perceptions to the current practice of risk management could have a significant impact on the success of Kuwait's development plan. Therefore, there is a need to investigate and establish a link between individuals' perceptions of the time dimension of risk, and measure the extent to which it influences their decisions in terms of the estimation of the time dimension of risk events. In addition, there is a further need for data, information, and insight into the opportunities and challenges involved in risk management in construction projects, as only limited studies have been carried out on risk management in construction projects in Kuwait.

This study is intended to address the context of the construction professional in Kuwait, with the aspiration of exploring how assessment of practitioners' awareness and perceptions of the time dimension of risk in Kuwaiti construction projects can be harnessed to enhance current mitigation solutions.

1.2 Research questions

The above discourse on the nature of risk management and its practice, with particular reference to construction in the state of Kuwait raises an important research questions on the risk time dimension based on individual perception of professionals in construction. The dominant research question that drove the investigation is detailed below.

- What is the time dimension of risk, and how do practitioners in construction take account of this in decision-making?

In order to respond to this overarching question, the following supplementary lines of enquiry will be pursued:

- How do decision-makers perceive the time dimension of risk in project environments?
- How can the time dimension be characterised to support risk-related decisions?

- To what extent do practitioners take the time dimension of risk into account when making project decisions?
- What is the nature and current centre of gravity of the time dimension of risk for construction professionals ?

1.3 Aim and objectives of study

The aim of this study was to investigate and establish the eccentricities in the time dimension of risk of construction professionals , and to incorporate this knowledge into a new complementary tool for enhancing the management of risk in construction.

The following objectives were pursued in order to achieve the aim of the study.

- To describe the nature and context of project delivery in the State of Kuwait, along with the key capabilities for managing risk in construction.
- To identify the essential theories and fundamental principles associated with the current and established notions of risk and its management in/outside construction.
- To identify the different perceptions of time and risk within various disciplines and industries.
- To investigate and establish the scale of awareness and eccentricities on the part of key decision-makers in construction industry of the time dimension of risk, in order to develop a common risk perception classification.
- To develop an assessment tool that identifies polarity in practitioners' decisions regarding the time dimension of risk in accordance with the common risk perception classification.
- To test and validate the developed assessment tool for risk management in construction.

1.4 Research methodology

Due to the nature and type of this study, a pragmatic research philosophy was adopted to guide the process of the investigation at the data collection stage. The adoption of a pragmatic perspective requires a combination of qualitative and quantitative approaches. In this research, a qualitative approach was applied in the form of exploratory semi-structured interviews as the preliminary data collection tool, to investigate and identify whether the concept of a time dimension of risk exists in this context, and explore its current implementation. A quantitative approach was then used in the design and implementation of a semi-structured questionnaire survey, as the main data collection instrument of this research, to enable a deeper investigation of the nature and characteristics of the time dimension of risk.

All of the stages of this research, and the way in which together they meet the objectives of the study, are presented in Table 1.1. The methods employed to achieve the research objectives are also indicated.

Table 1.1 Research objectives and the methods of their achievement

OBJECTIVES	METHOD OF ACHIEVEMENT
To describe the nature and context of project delivery in the State of Kuwait, along with the key capabilities for managing risk in construction	Literature review
To identify the essential theories and fundamental principles associated with the current notions of risk and its management in/outside construction	Literature review
To identify different perceptions of time within various disciplines and industries	Literature review
To investigate and establish the scale of awareness and eccentricities on the part of key decision-makers in the construction industry of the time dimension of risk, in order to develop a common risk perception classification	Mixed method: • Semi-structured interviews • Questionnaires
To develop an assessment matrix that classifies practitioners' decisions in terms of the risk perception as well as measuring practitioners' awareness of the time dimension of risk	In reference to the analysis outcome
To test and validate the assessment matrix for risk management in construction, and make recommendations for its use	Interviews with professionals

1.5 Scope of the study

This research investigates the eccentricities or deviations in the perceptions of professionals' in relation to the time dimension of risk during the delivery of construction projects in the State of Kuwait. There are currently no records of a systematic or formal process relating to the timeframe of risks in the current concept and implementation of risk management in the construction industry. This goes against the grain of a substantial effort focused on improving other aspects of the practice and effectiveness of risk management in construction projects. This study is concerned with establishing perception eccentricities of professionals in the decisions they make with regard to the time dimension of risk in construction projects in Kuwait. Therefore, it is focused on construction projects, at the individual level; essentially professionals, who work in these projects across different organisations, such as consultants, clients and contractors within both the public and private sectors.

1.6 Principal findings

The principal findings of the study derive from data collected in two stages from professionals working on construction projects in Kuwait. First, 34 exploratory interviews were conducted, followed by 115 questionnaire survey. In both stages, data were collected.

The findings from the exploratory interviews indicated the following.

1. There are different predictive capabilities of time dimension displayed among practitioners
2. Current approaches for mitigation do not formally account explicitly for the time dimension risk. Rather, it is subsumed in the definition of likelihood. This situation often leads to sub-optimal decisions.
3. There exists a clear misalignment between when risk should be mitigated and its time dimension
4. The current status of risk time dimension in construction can be considered as an area holding potential for enhancing how risk is managed by professionals.

The findings from the survey (questionnaires) indicate the following.

1- The findings revealed that 86 per cent of professionals do not systematically estimate the risk time dimension in their projects.

2- The findings revealed that only 15 per cent of professionals' estimations reliability is above 90 per cent.

3- The findings also revealed that 78 per cent of professionals do not formally prioritise their mitigation responses to risk events according to their time dimension.

4- The findings further revealed that 72 per cent of professionals are significantly influenced by the time dimension of risk; between 70-100% on performing decisions related to prioritising their mitigation responses.

5- The analysis showed that the risk level of any identified risk event has a considerable influence ranging between 50- 100% of professionals estimations for the time dimension of risk.

6- The findings revealed that different professionals in construction projects rely on different sources of information in establishing their estimation for the time dimension or risk, and that there is a clear eccentricity in the risk perception of construction professionals. The magnitude of this eccentricity can be established using objective methods and rationalised to enhance risk mitigation.

1.7 Structure of the thesis

Chapter 1 – Introduction

The introductory chapter discusses the background to the study and the research motivation, the scope of the study and the research questions, states the aim and objectives of the study, explains the adopted methodology and presents a short summary of each chapter.

Chapter 2 – Kuwait construction industry

This chapter presents an overview of general information relating to Kuwait, and in particular explores the economy and oil industries. The nature and context of the construction industry in the State of Kuwait are discussed, along with the key capabilities necessary for managing risk in construction. This chapter will also describe the current status of the construction industry in Kuwait.

Chapter 3 – Review of the current notion of risk management

This chapter reviews the current literature relating to risk management in general and risk management in construction projects. Definitions and explanations of fundamental principles associated with risk management are provided, including risks, certainty, uncertainty, risk exposure and acceptance of risks. These principles are not only associated with managing risks within the construction industry, but also relate to the conditions and circumstances in the course of decision-making. This chapter also discusses how risks are managed within the construction industry, and seeks to explain the processes involved in managing risks associated with construction works. This includes: a discussion of the nature of construction projects; the challenges that are faced; project success; the causes of risks, how to recognise, classify, and analyse risks, qualitatively and quantitatively; how to reduce risk through optimisation, and responses to risk.

Risk management has been widely discussed in past studies; however, the review in this research will focus on the processes of risk management in construction projects specifically.

Chapter 4 – Review of risk and time perceptions

This chapter reviews existing literature related to the importance of time in risk management, and the different individual perceptions of time across various disciplines. It will also introduce, defines and explains the concept of the time dimension of risk.

Chapter 5 – Research methodology

This chapter explains the research methodology used to pursue the research objectives, and the philosophical position taken. The data collection methods, approaches and data analysis methods used are also discussed.

Chapter 6 – Data analysis

This chapter presents a descriptive and statistical analysis of the data gathered from the exploratory interviews.

Chapter 7 – Data analysis

This chapter presents a descriptive analysis and statistical test of the data gathered from the main survey (questionnaires).

Chapter 8 – Results and validation

This chapter explains the purpose for developing the assessment matrix and the process used, as well as the outcomes and validation of the quantitative data collection. The outcomes of the questionnaire form the main contribution of this research. It should explain how to assess professionals' awareness as well as to classify professionals' decisions relating to the time dimension of risk in accordance with the common risk attitude classifications (risk adverse, risk neutral and risk seeker). In addition, the outcomes and contribution of this research would also fill an identified research gap.

Chapter 9 – Discussion

This chapter presents a general discussion of the research findings, places the results in context and addresses the significance of the contribution made by the study.

Chapter 10 – Conclusion and recommendations

This chapter brings together the findings of the research and draw conclusions with specific reference to the research objectives. It also highlights the contribution this research makes to the existing body of knowledge, as well as the limitations of the research, and makes recommendations for further avenues of study.

Chapter 2: State of Kuwait

2.1 Overview

The chapter presents a background and general information about the state of Kuwait, the region where the research has been conducted. Information such as Kuwait's geography and climate, and natural resources, government type and brief historical overview are covered within this chapter. Further information in this chapter relates to Kuwait prices inflation and industry shares of gross domestic product (GDP). A discussion of the oil industry is provided, as this is the core revenue producer for Kuwait. The chapter also discusses in details the construction in Kuwait, which is the core of this research. Details of the Kuwait construction industry structures and some of the on-going and planed major projects are presented. Kuwait national development plan and Kuwait future vision are also highlighted in this chapter.

2.2 Kuwait background

The Gulf that is taken as the biggest source of crude oil in the whole world is an internal sea, covering an area of 251,000 km^2. The Central Intelligence Agency's record shows its length almost 989 km (CIA, 2016). The area is the centre of oil industry. The coastal countries of Gulf region are united and known as the Gulf Cooperation Countries States (GCC) or simply as Gulf States. The countries that make up GCC are the Kingdom of Saudi Arabia (KSA) the United Arab Emirates (UAE), the Sultanate of Oman, Qatar, the Kingdom of Bahrain and the State of Kuwait.

2.2.1 State of Kuwait

Kuwait is amongst one of the six, Gulf Cooperation Countries (GCC). It is situated on the northerly bank of the Gulf. The map shown in Figure 2.1 demonstrates the State of Kuwait along with its neighbouring countries.

Figure 2.1 State of Kuwait (Source: Google map)

Kuwait is an important country of the Gulf region that was under British shelter till 19th June 1961. Its official name is the State of Kuwait and its official language is Arabic but English is considered as the second language and is commonly spoken and understood. Its capital is known as Kuwait City. For administrative purpose the country has been divided in five provinces named as; the Capital, Al-Ahmadi, Al-Jahra, Al-Farwaniya and Hawalli (CSO, 2008). Iraq attacked and overrun Kuwait on the 2nd of August 1990 that resulted in a UN coalition's counter attack that was led by US. It started with aerial bombing and after many weeks, a ground attack was started on 23rd February 1991 that was extremely successful and freed Kuwait from Iraqi occupation in a short duration of only four days. Kuwait had to spend almost 5 billion dollars in order to overhaul the damaged structure of oil wells during the time period of 1990-1999 (The World Factbook, 2016). Figure 2.2 demonstrates the destruction of some oil wells during 1990-1991.

Figure 2.2 The invasion and destruction of oil wells and facilities 1990 (Kuwait oil company)

Interestingly, only five to six per cent of the total area of Kuwait is populous and as a result most of Kuwait population inhabited in and around Kuwait City and Al Ahmadi City so these are considered very thickly populated areas throughout the world (Worldpopulationreview.com. 2017). This trend results in absence of countryside. Table 2.1 presents transitory figures and facts related to State of Kuwait (The World Factbook, 2016).

Table 2.1 General information about the state of Kuwait

Kuwait	
Location	Middle East, bordering the Persian Gulf, between Iraq and Saudi Arabia
Area	Total: 17,818 sq. km Country comparison to the world: 158
Government type	Constitutional monarchy
Land Boundaries	Total: 462 km Border countries: Iraq 240 km, Saudi Arabia 222 km
Coastline	499 km
Climate	Dry desert; intensely hot summers; short, cool winters
Terrain	Flat to slightly undulating desert plain
Natural resources	Petroleum, fish, shrimp, natural gas
Land use	Arable land 0.6 per cent; permanent crops 0.3 per cent; permanent pasture 7.6 per cent Other 91.1 per cent (2011 est.)
Elevation extremes	Lowest point: Persian Gulf 0 m Highest point: unnamed elevation 306 m
Natural hazards	Sudden cloudbursts are common from October to April and bring heavy rain, which can damage roads and houses; sandstorms and dust storms occur throughout the year but are most common between March and August
Environment	Limited natural freshwater resources; some of world's

current issues	largest and most sophisticated desalination facilities provide much of the water; air and water pollution; desertification
Population	4,380,286 (2016) Country comparison to the world: 141 Note: includes 3,048,770 non-nationals
Population growth rate	1.53 per cent (2016 est.)
Exports commodities	Oil and refined products, fertilizers

2.3 Overview of Kuwait economy

Though Kuwait is a main, international oil producer, there is a continuous effort for financial variation with a purpose of reduction in dependency on revenues generated by oil industry. There has been an amplified drive for big foundational ventures that can help the country to get into the international economy. As a leading oil producer in the region, Kuwait is an important member of GCC and OPEC (Organisation of the Petroleum Exporting Countries). This distinguishing position helped Kuwait to deal with many problems such as legislative elections and liability related issues.

Oil production has been the greatest strength for Kuwaiti economy that has played a major role in national growth and development after the end of Second World War. Oil production has been the back bone of Kuwaiti economy since the nationalisation of oil industry in 1975. Kuwait's' oil proceeds have been the source of solid communal finance, provision of a substantial welfare scheme and continuous budgetary overages. These oil proceeds make up almost 95 per cent of external trade and nearly 60 per cent of country's GDP. Despite the inadequate role of private sector in past 40 years, Kuwait has successfully developed international business organisations for example, telecom firm Zain and Jazeera Airways.. As the fiscal power of the country is based on its oil deposits that are exceeding 100 billion barrels, the government aims to produce almost four million barrels every day till 2020. That is more than 2014 level of 2,93 million barrels every day.

Historically the private sector has been quite ineffective in the economic field but the Kuwait government has been following a progressive fiscal divergence program that aims at activating and energising this sector. A 30 billion KD National Development Plan (NDP) was sanctioned by the Kuwaiti parliament in February 2010 that is basically an outline for making the country a business, finance and services centre for the Gulf region till 2030.

In order to support the financial growth and to develop a balance between the private and public sectors, the Kuwaiti government has scheduled more than 800 developmental plans under the NDP (National Development plan) with the purpose of upgrading the transport system, infrastructure, oil production and provision of better services to satisfy the demands of general public. Several projects are in progress despite an initial deferment of NDP, most of which are in energy sector.

Historically, the economy of Kuwait has been state centred and the nationalisation of oil and gas sector in 1975 has strengthened the trend a great deal. Security issues have been affected Kuwait economy during the Iraq - Iran war in 1980s and the same situation occurred during Iraqi occupation over Kuwait in 1990 - 1991 but the era after that has witnessed a significant constancy of increasing affluence in the state-led economy of the country.

The Kuwaiti government has been extremely successful in its efforts to unite the administration and legislature to pursue mutual targets by launching NDP in 2010. Approximately 800 developmental plans are in progress with the purpose of improvement in the sectors of oil production, infrastructure, transportation and services provision, causing a better involvement of private sector in national progression. Kuwait government deals with main infrastructure schemes on a priority basis despite the economy depression due to the falling prices of oil that has result in 17.8 per cent reduction in governmental expenditure during the financial year 2015-2016.

The income generated by oil and gas sector has been the source of finance for development of wide-ranging welfare scheme of international standard but it has caused numerous challenges including the high inflation rate problem that is basically triggered by excessive governmental spending. This further mounting burden on state has driven to issue the warning regarding the commitment of current revenues for these ongoing projects that can hinder the future investments (International Monetary Fund (IMF), 2017).

The Oxford Business Group's report that was published at the end of year 2015 revealed that the requirement of fiscal divergence was emphasised in the previous year due to Kuwaiti economy's turbulence as the result of lowering revenues generated by oil industry. Anyway, the country is still in a good position despite the lowering oil prices and international instability and enjoys the benefits of increasing public investment in infrastructure, a strong banking system and foreign direct investment (FDI) reforms that target the improvement in investment inflation.

2.3.1 Foreign direct investment (FDI) reforms

The declaration of FDI in Dec, 2014, describing the law of direct investment of 2013, is considered to be very important for the country's financial development in future times. Furthermore, the issuance of administrative principles that consists the steps to decrease the effects of red tape and complicated official processes by the creation of one window operation has been the ultimate stride in the implementation of this law. Only after five months of this declaration, the announcement by IBM (International Business Machine) about receiving the very first certification for establishment of a company that is 100 per cent owned by overseas investors was taken as an assurance that Kuwaiti government's FDI policy is a step in the right direction and has started bringing the benefits.

Despite the fact that the recent distress of oil prices recession has been an issue of great concern for the government, authorities are devoted to continue the NDP (National Development Plan) of years 2015 - 2020 and to sustain the principal spending on it that aims to deliver the NDP projects in pipe-line along with encouraging the FDI to inspire overseas contribution towards local economy that can cause the diversification of financial resource. Kuwait government has introduced several policy reforms that target the diversification of industry and support the private sector’s contribution in economy growth. These reforms are expected to aid the stable progress to continue in near future.

2.3.2 Kuwait GDP growth rate

Kuwait’s GDP increased about 1.80 per cent in the year 2015 in comparison to the preceding year 2014. The average of Kuwait’s annual growth rate of GDP was almost 3.65 per cent from the year 1963 to the year 2015 that reached 33.99 in 1993, the highest of its all times, and -20.62 per cent in 1980, which was the lowest. The following chart, presented by the Central Bank of Kuwait, shows the report about Kuwait’s annual growth rate of GDP.

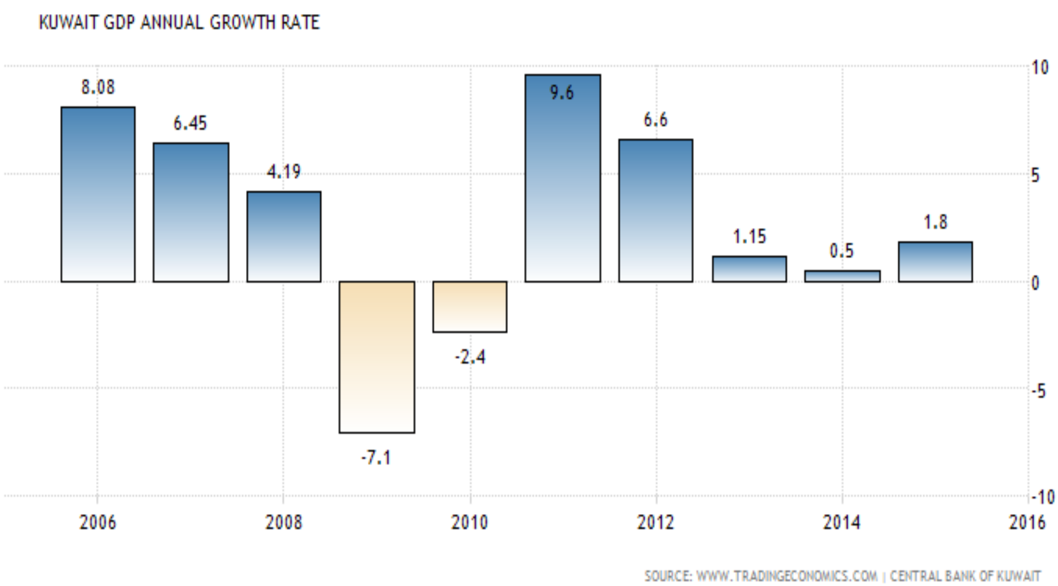


Figure 2.3 Kuwait GDP growth rate (Source: CBK, 2015)

2.3.3 Kuwait inflation rate

The statistic in Figure 2.4 shows the average inflation rate in the state of Kuwait from 2010-2015, along with the forecasts of the inflation rate up to 2020. As it shown in Figure 2.4, in 2015 the inflation rate in Kuwait amounted to about 3.23 comparing to 2014.

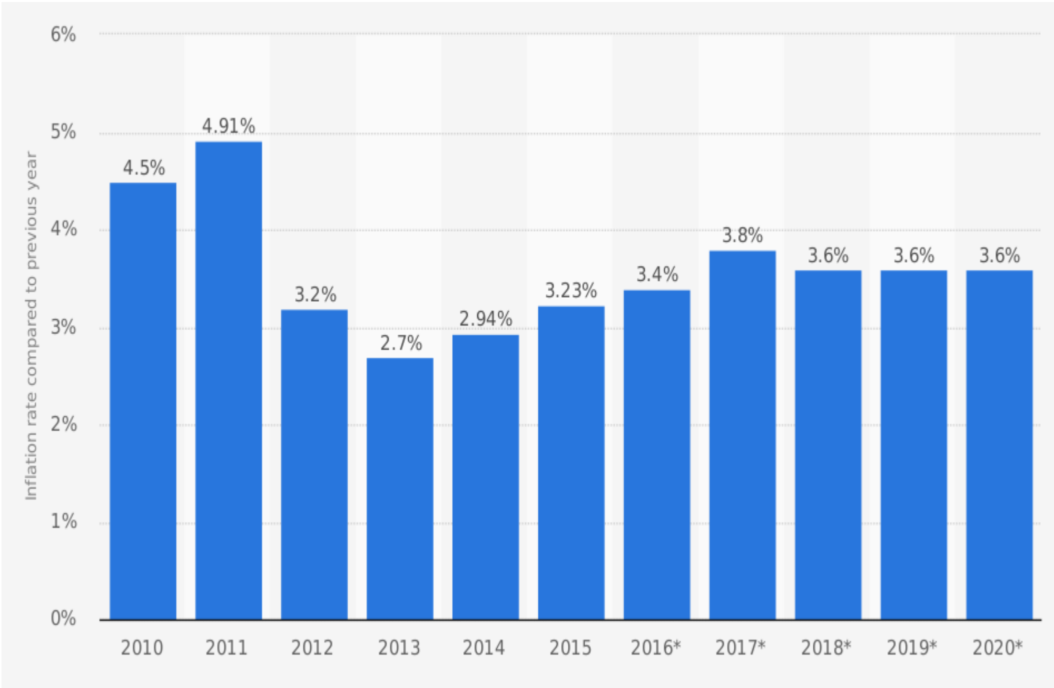


Figure 2.4 Kuwait inflation rate (Source: Statista, 2016)

2.4 Overview of Kuwait oil industry

Kuwait has a relatively small economy that is dominated by the oil business and public sector's investments. Kuwait has been rated as the 4th highest in the whole world regarding its oil reserves. Almost 101.5 billion barrels crude oil deposits, 8.5 per cent of the global reserves, makes up almost 50 per cent of Gross Domestic Product (GDP) 95 per cent of overseas trading and nearly 80 per cent of government revenues. The intense rise in oil prices in the duration of 1970s helped Kuwait to derive remarkable profits. Table 2.2, issued by OPEC, shows the records of Kuwait's oil reserves for the period of 2002 to 2006.

Table 2.2 Kuwait's oil reserves (Source: OPEC, 2006)

(bb)	2002	2003	2004	2005	2006
Reserves	96.5	99	101.5	101.5	101.5

Kuwait's' association with the Organisation of Petroleum Exporting Countries (OPEC) enabled it to derive these benefits to their maximum level. During the mid-1980s Kuwait's economy was shocked by different factors such as decrease in oil prices in 1980s, stock market crash in in the year 1982 and attack and occupation by Iraqi forces in 1990. For the duration of refuge, in the times of Iraqi occupation, the government of Kuwait was highly dependent on its foreign stocks of 100 billion dollars in order to survive and to rebuild the country. But by the year 1993 this equilibrium decreased to 50 per cent of its pre-attack level. Iraqi forces largely destroyed Kuwait's oil and monitory assets on which the country's economy heavily depended. Kuwait enjoyed a minor rise in economy afterwards the operation Iraqi Freedom when several organisations working in Iraq opened their offices in Kuwait and started business with local firms.

Kuwait government had to spend a huge amount of money (almost 5 billion dollars) to get the damages of the oil wells repaired as the Iraqi forces flamed almost 749 of the oil wells in Kuwait by the end of the Gulf War in February 1991. At the end of year 1992 the production of crude oil reached at 1.5 million barrels per day and the pre-war level of production was achieved by the year 1993.

A generous discount was approved by the Amir of Kuwait in 1934 for Kuwait Oil Company (KOC) that was mutually owned by the Gulf Oil Corporation and the British Petroleum Company. Anyway, the Government of Kuwait turned KOC into state- owned company in1976 and the very next year Kuwait took hold of the onshore oil production in the region known as the Divided Zone that is situated between Saudi Arabia and Kuwait. Kuwait Oil Company managed to deal with the production and processing of oil with the help of

Texaco, Inc., that attained the onshore discount from Saudi Arabia in the divided zone.

The Arabian Oil Company (AOC) that is 80 per cent possessed by the Japanese shareholders, 10 per cent by the Kuwait government and remaining 10 per cent by Saudi Arabian government did the production work for both countries during the time period between the years 1961 to 2000, that was the time when its discount in Saudi region ended. Arabian Oil Company (AOC) withdrew its right of drilling in Kuwaiti region just three years later, in 2003 and the Kuwait Gulf Oil Company (a company fully owned by the Kuwait Petroleum Company, (KPC) took over AOC's offshore setups.

The current organisation KPC, that comprises the Kuwait Oil Company (oil and gas production), the Kuwait National Petroleum Company (processing and local sale), the Petrochemical Industries Company (ammonia and urea production), the Kuwait Foreign Petroleum Exploration Company (dealing with developing countries), the Kuwait Oil Tanker Company and Santa Fe International Corporation, looks after the governmental procedures and interests in the area of petroleum production and processing. A purchase that was finalised in 1982 gave Kuwait Petroleum Company as international recognition in the petroleum market.

Besides this all, KPC has taken on board the processing plants and interrelated service providers in Scandinavian region and Benelux nations from the GOC (Gulf Oil Company) along with a set-up of stowing and service posts in Italy. KPC acquired 19 per cent stocks of British Petroleum in the year 1987 but later on reduced it to just 10 per cent. KPC markets its merchandises in European region with the label of Q8 and also has a keen interest in operating in markets of United States and Japan.

Kuwait is at number three in the list of the countries holding the proven, greatest oil reserves following Saudi Arabia and Iraq. Kuwait's expected capability of oil production was almost 2.4 million barrels per day before Iraqi occupation times but in the course of occupation this production decreased to almost zero. But thanks to the swift, remarkable recovery drive, oil production was at the level of 1.5 billion per day at the end of year 1992 and rose to the before war level in the year 1993.

Besides these oil reserves, Kuwait owns half of the 5 billion barrels of oil found in Saudi- Kuwaiti Neutral Zone that results in a total oil reserve of 104 billion barrels in Kuwaiti possession. Most of the Kuwaiti oil reserves are found in the area of Burgan that holds almost 70 billion barrels of crude oil. This region includes Burgan, Ahmadi and Magwa. According to OPEC statement the production of Kuwaiti crude oil reached an average of 2.46 million barrels per day in 2007. Kuwait's total oil production was at the average of 2.54 million barrel per day at the end of year 2006 whereas the production of crude oil was 2.54 million barrels per day for the same time period.

Apart from these production fields, Kuwait has some other production facilities at various locations such as the south-western production fields of Umm Qudayr and Minagish with production capacity of 190,000 b/d; the northern facilities of Sabriya (95,000 b/d), Ratqa (45,000 b/d), Abdali (33,000 b/d) and Raudhatain (380,000 b/d). Similarly there is also a Saudi-Kuwaiti Neutral Zone which is shared by Kuwait and has the production capacity of 270,000 b/d. The statistics clearly states that the southeast oil fields of Kuwait produce approximately 2/3 of Kuwaiti oil while the northern field produces 1/5 western fields produces approximately 1/10 of the total Kuwaiti oil.

Kuwait's' oil production is exported as the medium Mideast crude oil. Kuwait sales nearly 90 per cent of the produced oil by the means of tenure agreements that attach its prices to Saudi Arabian medium Crude oil that transfer the benefit to the buyers from west and a monthly average of Dubai and Oman benefits to the buyers from Asia. Kuwait is the main supplier of crude oil and petroleum products to the countries of Asia-Pacific region such as India, Japan, Singapore, South Korea, Thailand and Taiwan. The approximate average of Kuwait's net petroleum exports during the year 2006 was 2.2million barrels per day. According to the OPEC, s announcement, Kuwait's petroleum trades were estimated at 54.7 billion dollars in 2006.

2.4.1 Oil production projects

Special plans were announced by the Kuwait Oil Company (KOC) regarding the escalation of oil production volume up to 3.0 million barrels per day by the end of the year 2010, 3.5 million barrels per day by the end of the year 2015 and 4.0 million barrels per day by the end of the year 2020.

Now Kuwait has a main focus on production of heavy oil despite the fact that the heavy oil is not appropriate because of its high stickiness level and comparatively low price and there has been an enormous movement to achieve the target of production volume of 4.0 million barrels per day. Kuwait Oil Company propelled its Lower Fars Pilot Project (LFPP) in June 2007, in order to produce heavy oil by means of sands. This venture aimed to appraise the elimination of sand from heavy oil in the northern region, Ratqa. This project was run for two years on the bases of set up and task rental. Five wells were to be dug and activated by the service provider, each with a capability of 200 barrels per day to 500 barrels per day production capability of heavy oil.

An initial agreement was signed up with Exxon Mobil to get help in investigation of heavy oil, in Rataq region of northern Kuwait, under the Lower Fars Pilot Project in October 2007. This was going to produce a total of almost 50,000 barrel per day by the end of year 2011, 250,000 barrels per day by the year 2015 and an estimated amount of 900,000 barrels per day by the end of year 2020.

2.4.2 ‘’Project of Kuwait’’ is overdue

The rise in production will be decided by the execution of ‘’Project of Kuwait’’ as this project has been a dynamic factor in governmental scheme of escalation in production volume up to 4.0 million barrels per day by the end of year 2020. The basic purpose of this plan is to advance the subordinate reserves, acquiring the support of International Oil Companies (IOCs) in the oil fields of northern region, with the purpose of escalation in oil production from 500,000 barrels per day up to 900,000 barrels per day with an expected cost of 9.0 billion US dollars. This project is expected to bring an investment for the growth in the production in five oil fields named as Abdali, Bahra, Ratqa, Raudhatain and Sabirya, situated in northern areas nearby the Iraqi border.

A group of Kuwaiti members of parliament had been in opposition of this project with the point that this project will let the overseas organisations to get the command on precious oil resources of Kuwait that would be a breach of Kuwaiti constitution and furthermore there was no need of involvement of International Oil Companies. Some other MPs asserted that in recent times Kuwait does not need another additional volume of production, as it already has an excess production capability since long.

Kuwait has three oil processing plants which are situated at Mina al-Ahmadi, Mina al-Abdullah and Shuaiba. There is a plan to set up the fourth processing plant at Al Zour, the largest in the Middle East region, with a proposed capability to refine and process almost 615, 000 barrels per day. This plant that was expected to start working in 2010 will be set up with a cost of nearly 200, 000 billion American dollars and will be a replacement of the current refinery of 200,000 barrel per day capacity located at Shuaiba. The proposed, plant will improve Kuwait's overall capability of oil processing from 917, 000 barrels per day in 2005 to nearly 1.5 million barrels per day by the end of year 2010. Anyway, there was a danger that this project can get delayed as Saudi Arabian Texaco has an objection about the proposed location for development of the new facility. This objection is based on the fact that the proposed site is in the area of the Neutral Zone which should not be industrialised according to the mutual agreement of 1954 for rebate, signed by both Kuwait and Saudi Arabia.

2.4.3 Natural gas reserves

In March 2006, Kuwait made an announcement about the finding of non-associated natural gas, in market Table capacities of almost 35Tcf, located in Um Naqqa field and in northern Sabria. This was simply an unassertive declaration but at the same time it was extremely important for the country as it was able to provide help to meet the ever-increasing demand. Kuwait government has not officially declared these reserves as proven but in the case of this declaration, there would be a remarkable intensification in the country's oil reserves by almost 55.7 per cent, resulting in improvement in Kuwait's position in terms of oil and gas reserves and marking it at 11^{th} position in the whole world.

In comparison to the oil production, Kuwait's production of gas is relatively small, just 1.2cf per day in 2006, the majority of which is actually "associated gas" (automatically found during the process of oil production). Currently, Kuwait's production of gas is enough to meet its local demand of natural gas but eventually Kuwait will have to buy the natural gas to deal with the its ever increasing demand by different industries. The following Table 2.3 shows the figures and facts about Kuwait's production of natural gas in comparison to the total gas production of the Middle East region.

Table 2.3 Kuwait's natural gas production (Source: GIH, 2008)

(Bcf/d)	2001	2002	2003	2004	2005	2006
Kuwait	0.8	0.8	0.9	1.1	1.2	1.2
Total for Middle East	21.8	23.7	25.1	28.1	30.7	32.5

Kuwait is able to raise its production of natural gas by the means of new drilling and by decreasing the escape of associated gas. New, investigative drilling is in progress in the area of Raudhatain oil field, for getting the natural gas reserves that are found much deeper in ground in comparison to the oil reserves. The following Table depicts a clear picture of gas production in Kuwait.

Table 2.4 Kuwait's upstream gas projects (Source: Zawya, 2009)

Project	Increase (Bcf/d)	Due Date	Estimated Cost (US$bn)
Kuwait's Upstream Gas Projects			
Booster Station 160	0.3	2010	5
Early Production Facilities (EPF-Phase 1)	0.4	2010	0.2
Kuwait's Downstream Gas Projects			
Al-Khafji Field Expansion-Onshore Package	0.1	2009	5

Kuwait Oil Company (KOC) has a target to upturn its production through the Early Production Facilities program by the means of treating the sour crude and later on mixing it with sweet crude manufactured by north, south and southeast regions of Kuwait. The afore mentioned project is just a small segment of Kuwait Oil Company's great plan of growing the oil production to the level of 4.0 million barrels per day by the end of year 2020. This extremely important and profitable heavy, sour crude oil manufacturing project has a target of processing almost 50,000 barrels of oil per day in the beginning, using 20 oil wells situated in the two northern oil fields of Rawdhatain and Sabriya regions, along with a production of almost 35Mcf natural gas every day Table 2.4.

2.5 Construction industry in Kuwait

The "Key Trends and Opportunities to 2020" report depicts that Kuwaiti government's constant attention towards the development of various sectors such as power generation and supply, transportation and water caused an upsurge in economy and the construction market of the country enjoyed a bounce in returns in the year 2014 after a long period of down trends. This trend of upsurge was observed in several projects and during the same year (2014), Kuwaiti parliament issued a grant of 7.3 billion KD (approximately 25.1 billion US dollars) as a fragment of its progress plan. The rate of progression rose up to nearly 400 per cent during the period of the previous year according to the report issued by the National Bank of Kuwait (NBK, 2015). The construction market upturn indicates towards an overall success in application of reforms plan that helped the government to carry on with its tactical programs.

The production division is segmented into three primary contributors namely contractors, clients and consultants (Murali and Wen, 2007). There are around 629 construction firms in Kuwait that work on contractual basis. These firms are registered with Kuwaiti government under the following categories (CTC, 2010):

- Grade-I: Contractors with vast resource and are capable of handling big production projects that needs sophisticated engineering with minimum budget greater than one million K.D. (amount approximately £2.3 million)
- Grade-II: The contractors who have good fiscal and technological background and can participate in tenders of worth 500,000 K.D. to 1 million K.D (between £1.146 million to £2.3 million) but these contractors cannot bid for projects which have budget greater than 1 million K.D.
- Grade-III: Local based contractors who can bid for projects and tenders that need the gross budget up to 500,000 K.D (approximately1.146 million).
- Grade-IV: and finally, the contractors (local) who can take part in the tenders that needs the up to 250,000 K.D (£573,000).

It is observed that in Kuwait, almost all private and public sector ventures go through the same lifespan (Salman et al, 2003) that follows as under:

- conceptualisation and initial planning phase;
- initial design phase;
- documentation phase;

- final design and execution plan;
- project implementation phase; and
- project maintenance phase.

The construction sector can be segmented into three main contributors: customers; specialists; and service providers (Murali and Wen, 2007). The main personnel that make up the project squad can be enlisted as the project manager, architect, budget engineer and programing engineer. At the end of initial, theoretical stage of the project, the patron is given a presentation to determine the expected services and benefits as the return of the money invested. An example of this is, to give presentation showcasing of project site, and project execution duration plan that indicates the total time that is required for project completion. This stage makes it absolutely clear to the client what funds would be needed for different, related stakeholders such as contractors, advisors, people with financial background to plan and manage the cash flow to keep the project running by analysing when to hold the project if the finance is insufficient and approve the execution of next phase when the resources required are available and sufficient (Ahuja, 1984).

In short, this stage implicates a viability study, budget estimation, staffing for administration and appointment of workforce, and groundwork of an application for submitting the proposal to the Ministry of Planning (Salman et al., 2003).

The “**First phase**” is the initial design study phase in which the technical team comprising the project manager, architect, budget engineer and programming engineer has to estimate the duration of the project and check that all the relative information has been collected and arranged. Furthermore, they have to finalise the ultimate budget of the project along with the required cash flow that would have been more accurate till this time (Ahuja, 1984).

It can be concluded that this phase includes the planning for project necessities, selection of a suitable project team and group of advisors, illustrations and diagrams of basic proposal and beginning the sanction procedure (Salman et al., 2003).

The “**Second phase**” is the documentation phase. Different stakeholders like project designers and managers maintain communication with the consumers of project to guarantee the effective and continuous flow of information (Ahuja, 1984). In this phase, various project documentations are done, for example, bill of quantity (BQ), and detailed project requirements and plans outlines. Also other tasks such as team development and task assignments to various stakeholders are done in this phase (Larson and Gray, 2011).

The “**Third phase**” is the project ultimate groundwork stage and involves finalising the timetables, finances, resource allocation, risks evaluation and recruitment (Larson and Gray, 2011). The finalised official papers are appraised and diagrams, rates and timetables are compared with the bill of quantity (BQ) and terms and conditions of the venture (Salman et al., 2003).

The “**Fourth stage**” is the execution stage, which embodies the inauguration of the project work (Salman et al., 2003). It is a stage where the main part of work takes is done. Moreover, it is checked that the project is following the calendar, financial plan and specifications (Larson and Gray, 2011).

The “**Fifth stage**” is the maintenance stage that highly depends on terms and conditions decided in the agreement (Nicholas, 2004; Salman et al., 2003). Maintenance involves carefully keeping in touch with people employed on the project and ensuring that each is provided with the essentials needed to carry out the task required. Here a proper evaluation of the quality and quantity of the means essential for the project is made (Walker, 2000).

2.5.1 Construction industry structure in Kuwait

The revival of construction industry in Kuwait is based on the growth of the oil and gas sector. The Kuwaiti Public Private Partnership Law and the Executive Regulations aim to promote investment prospects and offer specific tax benefits and exemptions for overseas companies in the Public Sector in Kuwait. The government’s determination to different reforms has maintained the demand for different types of construction projects. Furthermore, the new law on public-private partnerships (PPP) is expected to transform the local construction industry according to Abdel-Fattah and Kern (2015). They also stated that this Law offers the guiding principle for procurement processes and information about the investment terms and conditions and transferences of the venture to the Kuwaiti government.

Article 28 of the new law offers several benefits and exemptions for the foreign investors in accordance to the Foreign Direct Investment law, such as:

1. the right to possess up to 100 per cent share capital of a Kuwaiti company of less than 60 million KWD;
2. exemption from corporate income tax for the duration of one decade; and
3. exemption from custom duties of the imported machines, tools, apparatus, etc.

According to Abdel-Fatah and Kern (2015), this specific article in the new law demonstrates how PPP is really beneficent for overseas investors. For any government, financing all the projects is not possible still it can be the main sponsor for local construction business. PPP policy is taken as Kuwaiti government's attempt for divergence of economy. This policy is governed by an authorised steering committee that was appointed under the PPP Law of 2008. This committee administers national policy in relation to PPP deals and has the ultimate authority for all the projects of this kind. The committee refers these projects to the PTB for inspection and revision before they are advertised. Then the committee selects the most suitable organisation to participate in the project and sign the PPP agreement. The committee holds the authority to cancel a PPP agreement in case of any violation of the agreement. Contractors, suppliers and real estate developers, all are bound to work under this set-up. Furthermore, there are several government organisations that deal with the public expenses on basic framework; housing and other building projects control the construction industry of Kuwait

The Ministry of Public Works (MPW) and the Mega Projects Agency are the two bodies that lead planning, designing, implementation and supervision of the big infrastructure projects. These two manage the accomplishment of most of the projects that are financed by the government.

The housing projects that are sponsored by the government make up a large construction segment in Kuwait. The Central Tenders Committee (CTC) under the minister of economy and finance grants proposals and auctions for government bodies and Kuwait Ports Authority, the Public Authority for Housing Welfare (PAHW), Kuwait University, Ministry of Defence and the Ministry of Interior are responsible for their own proposals and bids. As the tendering procedure is undertaking reforms, the CTC is responsible for the process.

The Public Authority for Housing Welfare (PAHW) deals with the plans of construction of residential projects that aim to build the housing not only for Kuwaiti citizens but for emigrant workforce as well. The PAHW built 1263 houses under this scheme in 2014, with a future plan to construct 1200 housing units every year during the next decade. Community buildings, commercial facilities and utilities needed for the domestic development are not incorporated in this data. Generally, PAHW's projects are situated in distant areas of the country so are somehow unattractive for private sector construction companies. These projects range from less than hundred housing units to cities planned for thousands of local residents and overseas workers.

2.5.2 Ongoing construction projects

The government funding for mega building long-term plans mounted to 250 billion US dollars in 2013. According to E-architect, (2017); Constrcutionweek, (2017) and Zawya.com, (2017) Table 2.5 highlights some construction projects that were benefited from these governmental grants.

Table 2.5 Kuwait construction projects

No.	Project	US $ (Billion)	GBP £ (Billion)	Expected completion
1	Madinat Hareer (City of silk)	86,2	56.0	2035
2	New airport terminal	4,4	3.5	2020
3	Subiya causeway	3,0	2.4	2018
4	Khairan housing project	20,0	13.0	2018
5	Bubiyan island	6,64	4.31	2021
6	Shadadiya university	1,6	1.3	2019
7	Jaber Al-Ahmad hospital	1,01	0.813	2018
	West Abdullah AlMubarak residential	1,08	0.870	2018

Kuwaiti government has allowed the construction of multi-storied buildings in order to encourage foreign investment in the construction sector, extended the construction area by 30 per cent, and introduced the Build-Operate-Transfer (BOT) and the PPP schemes in the construction industry (NBK, 2013) and (CSB, 2012).

The PAHW has accomplished the construction of the Saad Al Abdullah City that is constructed at a total cost of $700m, covers an area of 514 hectors and includes 3,576 residential units that are expected to serve almost 30,000 residents.

PAHW projects that are under development comprise the Jaber Al Ahmed Residential City that aims to serve almost 100,000 people. This mega project is in progress with EPC agreements with Al Ahmadiah Contracting and

Trading Company and Mohammed Abdulmohsin Al Kharafi and Sons (MAK Group).

MAK Group is the main developer for the construction of Sabah Al Ahmad City that is expected to provide housing for almost 110,000 citizens in 11,000 housing units. Some other companies that are responsible for the construction of the new coastal city comprise the Al Tawbad General Trading and Contracting Company and United Gulf Construction Company This project was expected to be completed in 2015.

There are some big local and global construction companies working in Kuwait and it has been stated by Construction Weekly that three Kuwaiti companies were in the list of top 10 construction companies in the GCC region. Kuwait has established The National Housing Authority in 1974 with the task to deliver housing facility for 2.6 million people by the year 2030. It holds authority to launch public limited companies for construction of metropolitan housing schemes.

2.5.3 Risk management in construction in the state of Kuwait

The successes of construction projects in Kuwait would not just have significant impact on the country overall economy, but it also would have a direct effect on citizen's and general population. Therefore, the necessity of implementing an appropriate risk management in construction projects has become essential more than ever.

The complexity and size of any groundwork project is a hindrance to make a well informed risk scrutiny. It is noted that the professionals working on huge groundwork ventures are sometimes unable to understand the degree of risk due to the size of that venture (Al-Bahar and Crandell, 1990) Moreover, the concept of risk is different in different people linked with the same venture and their position in that particular project also plays an important role in perception of risk (Kogan and Wallach, 1964).

It is commonly thought that risk management needs to include all the stakeholders who are capable to handle it. In Kuwait contractors are responsible for risks of environmental and physical issues. It is observed that as outsourcing is a common practice in Kuwait so the risks factors for the contractor such as material and workforce availability are divided (Kartam, 1997). Anyway, in case of outsourcing the owner has no control over the number of workers to perform the job. There are no labour unions in Kuwait so the contractor is almost free of labour related issues such as strikes and protests that can hider and delay the projects. Sometimes the severe weather conditions in Kuwait lead to a delay in project completion. This can motivate the contractor to move the work to night shift to manage the situation and accomplish deadlines.

Government of Kuwait is the main customer for the key construction companies and most of the time the government projects are quite big and take a number of years for completion so the risk of financial failure is the most significant one. Usually, it is the decisive force for contractor’s stay in the market and to be on time even when the payments from different stakeholders are late. So, they are required to have the capability to deliver big projects Builders and buyers can agree to share some risks that include war fears and time constraints. Turbulence in political conditions can lead to a cost overrun for the builder.

The results of a comprehensive studies indicated that the buyers think that major causes of delay and swamped costs in housing projects were shortage of finances and deviations at the planning level. Thus, this can be said that allocation of suitable funds and services along with sufficient time can reduce the time and cost deviation (Koushki et al., 2005). The before mentioned study was mainly dedicated to the buyers point of view so it did not mention the shortcomings from the builder’s point of view.

It is observed that all the parties involved in construction process face risk at some level and all the projects face jeopardy and ambiguity thus it is advised that the obligation of risk bearing during the project’s lifespan should be clearly designated to different parties in the agreement (Smith, 2002). Risk management is considered as a very important factor in the Project Management Body of Knowledge (PMBOK). Identification of the best course of action for a particular condition, reduction of uncertainty, accurate estimation of resources and confidence that the project's objectives can be achieved are some of its benefits (Karimiazari et al., 2011).

Though, risk management is considered as a practice that helps different practitioners in performing similar informed decisions in similar conditions in different projects. However, this is not a reflection of the reality, due to the fact that, different practitioners within a project perceive and respond to similar risk events differently based on their perceptions, risk attitude, personality, (to name few).

In the light of all mentioned information about the current status, ongoing projects and the huge budget allocated to the construction in Kuwait, this research has come to investigate and establish the professionals' perception deviation in estimating the risk time dimension. This research would make a contribution in enhancing the performance of risk management in construction.

2.5.4 Kuwait construction future vision

In the recent past the structure establishment has been one of the most successful and the third largest industry in Kuwait that made 20.5 per cent of the total worth of construction market in the year 2015. It has been revealed in the Key Trends and Opportunities to 2020 annual statement of April 2016 that the market worth of Kuwaiti construction business grew at an amazing annual compound growth rate (CAGR) of 5.23 per cent during the years 2011 to 2015. The compound annual growth rate (CAGR) is expected to rise up to 6.44 per cent during the time period between the years 2016 to 2020 according to the forecast of Timetric's Construction Intelligence Centre (CIC) (Timetricreports.com, 2017). They expect its worth to increase from 10.1 billion US dollars during 2015 to13.8 billion US dollars in 2020. This growth is expected as the result of Kuwaiti government's struggle for the sake of progress in this domain. The industry (CAGR) increased to 8.82 per cent, rising from 446.8 million KWD ($1.6 billion) in the year 2011 to 626.6 million KWD ($2.1 billion) in the year 2015.

The five-year development program 2015-2020 revealed that Kuwait's economic growth is expected to continue till the year 2020. This growth is supported by local and foreign investments in infrastructure of transport system. Kuwait's Vision 2035 program is also recognised as a strong factor in mobilising the investment. This plan has a target of improvement in all means of transportation such as railways, roads and airports in the country, thus deals with the establishment of the groundwork needed. It has been declared by CIC that the investment in different sectors such as healthcare facilities, educational institutes and expansion of housing schemes has benefited the construction sector in Kuwait.

The Kuwait Development Plan outlines a progressive framework for the construction industry and there has been a robust indication that Kuwaiti government intends to act upon its capital venture as its budget has already allocated by Kuwaiti national assembly in April 2015. Anyway, the decreasing oil prices affect the income of government thus can affect the project's finances. Another problem can arise from the changing political conditions that can hinder the process some ways.

The local and overseas financiers are showing interest to invest in different segments of economy such as rail and road, ports and shipping and infrastructure in anticipation of progress. Furthermore, PPP scheme and supportive monitoring policy is also enhancing their interest. According to Kuwait.nbk (2017) it is to be noted that Kuwaiti government presented 2016 budget, showing an expense of 18.9 billion KWD that depicts a fall of 1.6 per cent in comparison to the CIC statement of 2015. This drop can be easily associated to the declining oil prices in international market that jolted the economies that are highly dependent on oil generated revenues and Kuwait is one of them as the oil generated income makes up almost 78.0 per cent of the total budget of Kuwait. The government has focused on establishment of railway structure with an amount of 2.1 billion KWD that will be used to construct 171.0 kilometre long Kuwait Metro Rail system by the end of the year 2020. This system will be established under the Public Private Partnership (PPP) model and is expected to solve the ever-increasing traffic problem of the country. The railways project will be a part of the Gulf

Cooperation Council's grand railways plan. The Kuwait government has planned to initiate the establishment of Kuwait National Road System that is a long-term and long-distance railways plan. This project comes under five-year growth plan and will be established under a build, operate and transfer (BOT) strategy, with an expense of 3.0 billion KWD. This project is expected to be operational by the end of the year 2018.

The trend of declining oil prices has led Kuwaiti government to move towards diversification of economy and increasing the participation of industrial sector to uplift the country's GDP. As stated by (Oxford Business Group, 2017), both construction and real estate industries in 2014 have contributed of 10.6 per cent to the Kuwait's GDP. The government has announced new policies and laws in order to encourage the industrial sector. These laws include New Commercial Licenses Law and Direct Investment Promotion Law. Furthermore, the government is providing generous loan to support the industrialists in development and extend their projects.

It is also worth noting that Kuwait has signed memorandums of understanding with Japan in order to get cooperation for establishment of public transport set-up. Both the countries have agreed to share the knowledge and skills to ensure the successful development of Kuwait's transportation and tourism sectors.

A schools development scheme was introduced by Kuwaiti government in the year 2015 with a target to upgrade the education sector of the country. The government aims to establish outstanding educational institutes at primary, secondary and higher education level under this scheme involving the private sector in this development. An excellent example is the establishment of Sabah Al Salem University City project that is still in progress, with a huge amount of 902.2 million KWD that makes 3.0 billion US dollar.

2.6 Summary

This chapter outlined information and background on the state of Kuwait in order to understand and pave the way for this research investigation. The literatures review showed that the construction in the state of Kuwait is comparable and has no distinctiveness to any other worldwide construction industries. Therefore, it is a suitable and rich environment which should help in opening up new sights and supplementing this research

Construction in Kuwait is facing considerable developments with the growth of the economy and the population, and plays a significant role in business development and respond to the demand for new buildings. The construction industry is among the strongest in the non-oil economy as in 2014, 10.6 per cent of Kuwait's GDP came from the both construction and real estate industries.

Considering the construction industry within the national development plan of Kuwait future vision, the construction in Kuwait has become more responsible and has more influence to the overall GDP. However, many of the previous and ongoing construction projects in Kuwait suffered from either exceeding the allocated budget or/and the estimated time for completion, this is due to many reasons and part of these reasons related risk management and the abilities of individuals to estimate and perform informed decisions. Therefore, there is an obvious and vital need for an appropriate and effective risk management in order to achieve the desirable results.

Next chapter discusses risk management in construction industry include risk management notions, definitions and implementation. Risk identification, risk assessment and risk responses processes are discussed in details.

Chapter 3: Risk Management and Construction

3.1 Overview

This chapter reviews the current literature relevant to risk management and risk management in construction projects. A definition and explanation of fundamental principles associated with risk management are delineated in this chapter. Typically, it includes risks, certainty, uncertainty, risk exposure and accepting risks. These principles are not only associated with managing risks within the construction industry but also include conditions and circumstances in the course of decision making. This chapter also discusses how the risks are managed within the construction industry and will attempt to view the processes involved in managing risks associated with construction works. This includes the nature of construction project, the faced challenges, project success, risks causes, recognising risks, classifying risks, and analysing risks qualitatively and quantitatively, reducing risk by means of optimisation methods and responses to risk. Individuals or entities make decision each day whether they are related to personal or business at all levels in the business world. While the importance of risk management is a matter of debate, it is generally accepted that best risk management practice, in combination with strong project processes, improves project quality, reduces costs and speeds up schedules. Risk management is widely discussed in studies but these reviews are focused on the processes of risk management in the area of construction projects.

3.2 Risk management

Risk management entails a process in which the risks of a specified operation/project are measured and modelled (Lyons and Skitmore, 2004). According to Cohen and Palmer (2004) risk management is the process applied to regulate the probability of certain occurrences which can affect the objectives, cost, time, quality and scope of a project. The basic concepts of risk management; not just in the construction but generally include risk, certainty, uncertainty, exposure and risk acceptability (Jeljeli and Russell, 1995). Risk management is a significant constituent in any decision-making procedure, be it in private life, business, industry or different levels of the business cycle, because it gives decision makers the qualitative and quantitative data they need to make informed choices. Risk management involves the systematic study of a range of relevant factors, so that the probability of problems arising can be estimated, the nature and likely consequences of these problems can be identified, and thought can be given to how these consequences can be avoided or at least mitigated (Lyons and Skitmore, 2004). The decision maker is then in a position to choose the most favourable alternative from the available options.

Risk management for construction projects can be conducted by matching the project's capital needs to the industrial context and running construction system simulations. Simulations highlight potentially precarious situations and limitations in the construction environment. Where information is non-existent or difficult to find, the risk is described in qualitative terms (Cerić, 2003). Where information is available and easy to obtain, the risk can be measured in quantitative terms (Dey, 2001). Possible deviations from the construction scenario are then modelled to identify their likely favourable or unfavourable impacts on the project's cost and/or schedule.

In making sure of satisfactory performance, risk ought to be thoroughly considered and appropriately managed. This is a known fact regardless of whether the affected party is the company's management, a project or in providing customer service. The key issue with management of risk is how the risk is quantified and managed with appropriate means. Various methods have been developed in dealing with this problem. With the advent of science and technology, some areas of the business environment have become more complex. This necessitates decision-makers to focus on risks as virtually all human actions involve some elements of risks. Decision-makers then should give advice means of handling the risks, thus, initiating a risk management plan.

Risk management being around for quite a while now, it has been considered as a practice intended to identify and quantify all possible risks likely to affect a project so that appropriate decision can be made in managing them. The entire objective is to have an effective risk management. Client will usually assume some risks and this ought to be made known and understood by the project manager as well as himself. This residual risk should be taken into account when preparing for the project cost and time estimation. Despite the fact that the adopted risk management practice may be effective and requires substantial amount of data, it ought to be viable, realistic and economical. It is essential to have sound judgement, knowledge, assessment, experience and readiness to identify the risks. In order to efficiently manage projects with high risks, a swift, accurate forecast regarding future outlook and positive decision-making for appropriate options are required. Inadequate risk management practice combined with negative approach and unsuitable procedure has resulted in failures to numerous projects.

The definition of risk management according to Flanagan and Norman (1993) is a scheme whereby all risks to which a project or business is exposed are recognised, such that a clear resolution can be made on how these risks can be managed. Risk management recognises that it is possible for forthcoming events to result in negative or detrimental effects, thus utilising appropriate design and execution of systems or processes in handling such risks are paramount. The aim of risk management is also mentioned in the definition, for example to manage systems in an effort to minimise risks.

Despite the fact that risk management may appear immensely complex, or require massive scale of data collection, it ought to be economical, practical and representative. Besides assessment, judgement and knowledge, it should also rely on reasonableness, instinct and gut reaction. However, the most important of all is the willingness to implement a structured approach. Subject to the conditions attached in each project, the extent of analysis will vary accordingly.

Based upon previous experience, it is more challenging to recognise and categorise risks than controlling the risks. It is therefore a key for decision-makers to identify the risks and formulate a system of risk management to avoid losing control of the system and failure to arrive at appropriate solutions to the risk or in resolving any issues in the adopted system.

As soon as risks are recognised in a project, risk management will endeavour to understand the potential consequence the risks may have on the project and propose methods that can minimise their effects such that the project can be revived to its pre-risk condition as soon as possible and economically.

As risks are usually uncertain in nature, decision makers ought to assess the particular risk that must be evaluated and formulate strategies in handling them. Risk management cannot entirely eliminate project risks; however, risks should be identified at the early stage. This is to ensure that their relative importance can be analysed early and proposals are made on ways and means they can be controlled for the best interest of the project.

3.3 What is risk?

Risk is regarded as the inevitable side effect of any activity. Generally, risk appears to be an easy notion to explain. Nonetheless, according to Lifson and Shaifer, (1982), its definition is elusive and its measurement is often controversial. The term “risk” has been utilised in literature for various meanings with many different words such as hazard or uncertainty (Faber, 1979; Hertz and Thomas, 1983; Lifson and Shaifer, 1982). In reality, there is no consistent or uniform denotation of the term risk in the literature. Further, in most cases, the definitions of risk have emphasized on the negative effects of the risks, for instance damages or losses and ignoring the potential benefits, for instance, gains or returns.

The word “risk” and “uncertainty” have been used quite frequently and interchangeably in existing literature. Nevertheless, most authors explain the use of both words for clarity, However, “Probability" will be utilised to signify the likelihood of an event to take place; therefore a "certain" event has no uncertainty.

The definition of risk by AlBahar and Crandall (1990) is:

"The exposure to the chance of occurrences of events adversely or favourably affecting project objectives as a consequence of uncertainty".

As defined by this definition, risk can be categorised by the following descriptors.

- **The risk event**: What could occur that can be detrimental or favourable to the project?
- **The uncertainty of the event**: What is the likelihood for the event to take place, for example, the probability of the event taking place? A definite or certain event does not create risk, although it may generate positive or negative outcomes.
- **Potential loss /gain**: It is necessary that there should be some amount of loss or gain involved in occurring of the event, for example, a consequence of the event happening. Using the term ‘’loss’’ as a common term that refers for example; to personal injury and physical damage, and the term "gain" to denote profit and advantages. Representatively, Risk can be written as: Risk = Uncertainty of event, Potential loss/gain from event.

Based on this explanation, uncertainty and potential loss or gains are essential conditions for riskiness. It may be rather unusual to make reference to uncertainties on probable gains as risks. In circumstances of possible gains, uncertainty is not appealing as the quantum of gain is unclear and contractors are inclined not to favour gains which are unknown.

3.3.1 Types of risk

Broadly speaking, risk can be described as indefinite change in the future worth of a system. It can be seen as threats/negative changes to businesses or on other hand, it can be seen as opportunities/positive changes to businesses (Drew, 2007).

In general, risks can be divided into the following five categories.

I. **Opportunities:** occasions that provide a favourable combination of circumstances, hence, increasing the possibility for beneficial activity.
II. **Killer risks:** events that provide an unfavourable combination of circumstances; leading to hazard or substantial loss or damage causing permanent termination of operations.

III. **Other perils:** events that provide an unfavourable combination of circumstances leading to hazard of loss or damage causing disruption of operations with potential commercial loss.

IV. **Cross functional:** risks common threats which can cause potential loss of reputation.

V. **Business process unique risks:** risks which take place within a specific operation or procedure, for example, removal of a certain product due to quality issues.

In most cases, one should capitalise on every opportunities. If the opportunities are not taken advantage of, the competition will increase and therefore increased risk. Should opportunities are followed, strategic action can be adjusted to handle that specific risks. Killer risks threaten the survival of enterprise and warrant constant risk management, monitoring and reporting. Other risks need detailed study on the ownership, treatment, residual risk, measurement and reporting.

3.3.2 Development in the meaning of risk

The philosophy behind risk is rather intricate which creates differences of opinions between natural and social scientists. The understanding of risk has developed over the years and since the 17th century, its advancement has been defined by (Douglas, 1990)..

The original idea of risk started during the 17th century when Mathematics was linked to gambling. Risk was always associated with a combination between likelihood and extent of probable gains and losses. Risk was viewed as impartial idea in the eighteenth century and still dealt with gain and losses and being adapted in businesses that were related to marine insurance. During the 19th century, risk was employed in the economics syllabus. By this time, the risk philosophy, viewed more undesirably, instigated entrepreneurs to call for special encouragements to include the risk involved in ventures. A rather negative perception was developed by the 20th century when discussing the consequences of risk in science and engineering especially with regards to exposures due to advancement in modern technologies, for example, in oil and gas and nuclear activities.

3.4 Conceptualisation of risk and uncertainty

To different people, risks may mean differently, as risk has varying perception based upon opinion, attitude and familiarity. Architects, engineers and contractors perceive risks from technological angle; financiers and developers are inclined to see it from the commercial viewpoint whilst health professionals, environmentalists and chemists may consider a safety and environmental factors. According to Raftery (2003), risks can therefore, be viewed as an abstract concept which is hard to fathom.

Risk is an unwelcoming circumstances/condition that is subject to vulnerability, or possibility to result in losses or injuries. Upon defining a risk situation, an action will be taken resulting in an outcome that is uncertain however, the list of likely results and the associated probabilities can be assessed. The risk situation of risks can be compared with the equivalence of throwing a dice. One can predict a set of possible outcomes/ likelihoods although he/she is uncertain which outcome will occur (Shapira, 1995; Colman, 2009).

As mentioned by Hansson (2010) in a non-technical perspective, risk denoted a condition where undesirable event may occur although indefinite. Based upon decision theory (Bayesian Decision Theory), decision subject to risk refers to decision with known chances. In analysing risk, risk usually indicates numerical representation of severity, achieved by multiplying the probability of an undesirable event with a measure of its dis-value.

In the meantime, Coleman (2009) defined uncertainty as the state/condition of not being able to know/predict something accurately. It is a situation when the outcome that will result arising from an action is indefinite, or in cases when decisions to be concluded about the future is difficult as there could be numerous probabilities which may beget various outcomes (Moles, 1997).

A renowned difference between risk and uncertainty was given by Knight, (1921) whereby he stated that risk entails randomness with objective or predictable probabilities whilst uncertainty is about randomness with subjective or unknown probabilities. Adding to this, McLean and McMilan (2009) further differentiated between risk and uncertainty with the explanation that a risky event is one where the probabilities can be predicted, whilst an uncertain event is difficult to predict without dominant strategy. As such, based on these clarifications, risk is the cause that leads to an undesirable situation with the possible results and related probabilities can be predicted. There are a number of strategies that can be formulated to manage the risk: to detect, react, resolve; (if the problem cannot be eliminated entirely), in minimising the impacts for losses to the least.

As clarified by Lindley (1971), distinguished and highly beneficial forms of distinction are usually drawn between statistical (risk) as well as non-statistical (uncertainty) events. Nevertheless, most situations in confirming decisions are unique and related to one single incident, so that decision makers are not challenged by repeating situations. Therefore, it is necessary for them to make non-statistical/subjective evaluations that are consistent/coherent with regards to probability in representing the uncertainty in decision making situations.

In making-decision process, insufficient knowledge of the future can be categorised into two groups; namely risk and uncertainty. Risk can be identified with expected probability while uncertainty concerns entirely unknown probabilities or known but with insufficient knowledge. The main difference between both is extremely useful. However, from a more theoretical perspective, it is difficult to delineate them in a set principle (Hansson, 2010).

The above clarification is aimed at providing illustration, whilst differences between risk and uncertainty and statistical/non-statistical events are conceptual terms, with their limited value in the practicality assessing and analysing risk. Undeniably, risk philosophy ought to illustrate the realities of strategic decision situations. They have to be aware of the concerns as useful materials accessible to decision makers including the significance of outcomes and organisational aims. Current literature has categorised both as similar under the discipline of risk management where both words have been mentioned interchangeably. An argument by Black et al. (2012) revealed that, risk is a kind of uncertainty due to their notion that the actual result of an action is not known. They come to a conclusion that risk means both uncertainty, and the outcomes of uncertainty. Despite their argument, Hertz and Thomas (1983) and Renn (2008) counter that by expressing their wariness on the singular view by stating that there is a clear difference between Risk and Uncertainty by drawing on work of previous writers.

3.5 Decision-making in the face of uncertainty

Based upon a study by Baloi and Price (2003), decision-making problems can generally be grouped into deterministic, stochastic/risk and uncertain. Problems categorised as deterministic refer to those in which data are known with certainty while unknown data with certainty are classified as stochastic problems.

The process of decision-making takes place during certainty, risk or uncertainty conditions. Condition for certainty is when all influence factors are quantifiable and at situations where satisfactory decision-making techniques often results in outcome as predicted. As an example, the construction sector will never operate under certainty conditions.

In the case of risk management where at least two or more options that need to be decided upon, with unquantifiable factors of influence, the process of decision-making will take place under risk or uncertainty conditions. Under risky conditions, one can make a decision if he/she is capable of accessing instinctively and sensibly with confidence that the predicted event will happen, based upon his/her personal experience or knowledge about similar events in the past. An illustration of making decision under risk conditions is preparing an estimate for the foundation of a building without studying the predicted loads that will be supported by the foundation. The estimate can be prepared with some certainty or degree of risk based upon available information of similar buildings constructed with similar ground conditions as well as the estimator's previous experience. In the absence of these information and should the estimator has no previous involvement with comparable ground condition and building, decision-making process is under uncertainty condition. Thus, risk will become an uncertainty due to unavailability of required information or knowledge to formulate a sound mathematical model in predicting the likely outcome.

Amongst the fundamental roles of modern business management is to minimise the probability of risk for example, to collect adequate information and relying on previous experience to uncertainty into risk such that decision making process is straight forward. Risk is defined by Chapman and Cooper (1983) as exposure to the possibility of economic or financial loss or gains, physical damage or injury or delay as a result of the uncertainty associated with pursuing a course of action. The definition of risk according to (Wideman 1986) is a chance of certain occurrences to adversely affect project aims. It depends upon the extent of exposure to unfavourable events and their likely effects to the project. According to Kliem and Ludin (1997), risk can be defined as the occurrence of an event that has consequence for/or impacts on projects. On the other hand Smith and Bohn (1999), stated that risk surfaces when a decision is expressed in terms of various possible outcomes and when known probabilities can be associated with the outcomes.

3.6 Construction project definition

In existing literature, projects are described through a number of definitions. From the perspective of the Project Management Institute (PMI), they put forth a definition of a project as a "temporary endeavour undertaken to create a unique product or service". Along the same vein, the Association for Project Management (APM, 1993, pp.11) put forth the following definition to define the meaning of a project - "discrete undertaking with defined objectives often including time, cost and quality (performance) goals". Another definition that is equally significant in defining what a project entails, is provided by the ISO 10006 as a "unique set of coordinated activities, with definite starting and finishing points, undertaken by an individual or organisation to meet specific objectives with defined schedule, cost and performance parameters". All these definitions are useful as they serve to delineate and explore a number of main features or characteristics of a project. The various characteristics identified are known to be unique (command specific requirements); temporal in nature (specify commencement and completion period of certain activities), sufficient capital; a specific plan, adequate and suitable materials; cautious about risk and uncertainty, and most importantly its commitment to the employees involved in the project.

Managing and controlling the workforce and resources emerges to be one of the main characteristics in a construction project. Further reiteration of these characteristics of is clearly stated by PMI (2006) as “the art of directing and coordinating human and material resources through the life of a project by using modern management techniques to achieve predetermined goals of scope, cost, time and participant satisfaction”. Similarly, The UK Association for Project Management provides a definition of this characteristic as “the planning, organising, monitoring and control of all aspects of a project and motivation of all involved to achieve project objectives safely and within agreed time, cost and performance criteria”.

The existence of uncertainties and coupled with the advancement of technology, capital constraint and the complex development processes have made the construction industry to be risk prone and also dynamic at the same time. Currently, those who are involved in construction projects are faced with unexpected and unparalleled stages of transformation. Hence, due to the presence of diverse variables that have to be considered in a project, the construction industry is known to be unique. According to Hadavi and Krizek (1993), the construction projects can be in various forms and types, the variations in style and size of the labour force involved and also great variations in terms of the contractual relationships involved. In the construction industry, there are number of major stakeholders to be considered. In the process of carrying out a construction project, a planner has to take into account the role, correlation and impact of each stakeholder when it comes to evaluating procedures and practices undertaken. The stakeholders who are involved in a construction project include the following; employers, contractors, designers, consultants, owners and also the surrounding community in which the project is situated.

3.6.1 The challenges in managing construction projects

This section discusses on the main challenges and obstacles faced by the construction industry which could be inextricably linked to both internal and external elements. Projects can only be delivered efficiently and successfully if the entire workforces that are involved in the project are able to overcome the challenges and changes in the construction project. The main challenge that has been identified is the lack of competencies and skills amongst workers and particularly, how they can cope with the changes that are constantly evolving due to technological advancement, and how these changes are affecting the approach that are employed in project management. Apart from these challenges, other obstacles that have been highlighted in the literature are as follows; communication system that is ineffective. Organisational policy, management and procedure, suitable equipment and machinery and construction materials are unavailable.

Before starting a project, it is imperative to make cost estimation that is accurate as it is one of the main elements that helps to determine the success of the project. Taking into consideration the fluctuations in the market trend helps to ascertain cost estimation, for example, safety issues. Project costs remain as one of key challenges in managing projects. According to Oyegoke et al., (2008) these costs can rise due to changes in the environment which can be caused by drastic changes in the following aspects; Raw materials, national politics, the economy and the labour force. They also elaborated that project costs can also escalate when the project is faced with severe challenges which can further affect the project risk and uncertainty which will then affect the project outcomes and the supply chain processes. These unexpected risks and uncertainties will inevitably cause dissatisfaction in project owners.

3.6.2 Criteria for project success

The success of a project is critically measured through its final completion within the estimated budget. Yet, as discussed in earlier section, the true measure of a successful project does not necessarily rest only on this form of measurement. As such, it is crucial that all the stakeholders involved in the project including the contractors are aware of the repercussions that will entail if the project fails, which will include financial and morale loss as well as tarnishing the reputation of the construction’s company. As identified in the literature, there are four key factors that influence the success of a project and they are; time, cost, scope and quality.

In ensuring success of a project, one of the most important factors is to meet the needs of the client by putting in place a set of procedures to ensure that each level of the project is well thought out so that the rate of success is higher. As advocated by Egan (1998), one form of measuring success is by delivering to the client and ensuring their satisfaction by demonstrating the significant value of the project. There are two levels of project success; micro and macro. The micro level measures success in terms of factors likes; time, quality, ability to adhere to cost and good performance. As for the macro level, it includes factors such as adherence to projected time for completion, utility and the ability to operate as shown in Figure 3.1. In contrast, Cooke-Davies (2002) argues the need to differentiate the factors that influence project may it be at micro or macro level, as the measure of success is very much dictated by how the project is managed successfully as it has indirect and direct impact on the eventual accomplishment of the project.

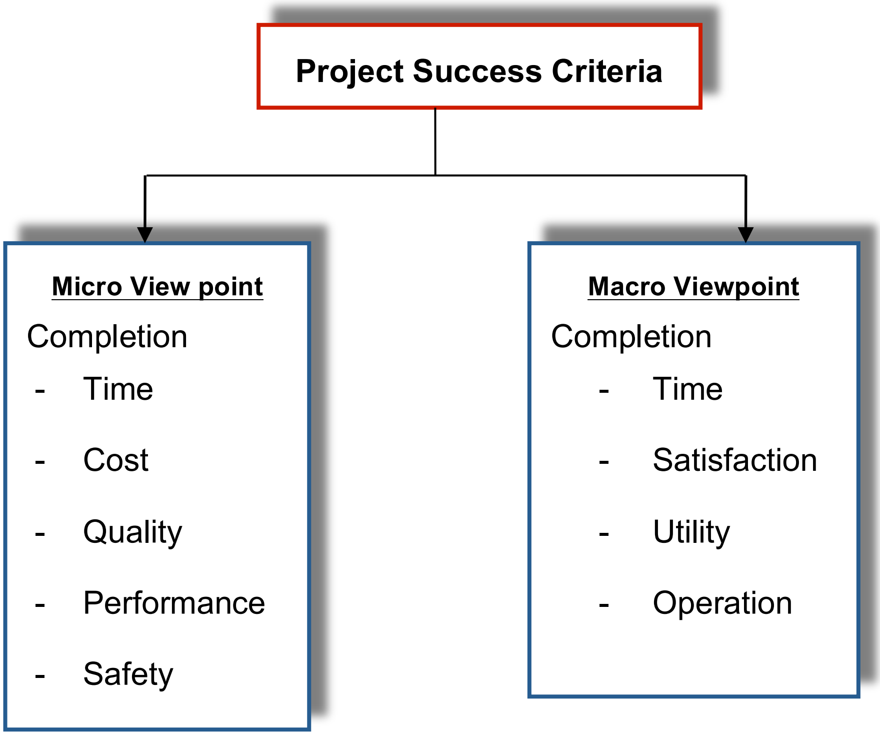


Figure 3.1 Micro and macro viewpoint of project success
(Source: Lim and Mohamed, 1999)

The success of a project is arguably to be rather subjective as it is evaluated based on individuals' or groups' viewpoints and perceptions. Hence, this subjective evaluation lead to the belief that the success of a project may vary accordingly due to the circumstances or situations of the project as well as the allocation of time given to the project (Atkinson, 1999; Bryde, 2003; Chan and Chan, 2004; Lim and Mohamed, 1999; Morris and Hough, 1987; Parfitt and Sanvido, 1993; Shenhar et al., 1997).

The success of a construction project can be measured through a specific Project Success Factors (PSFs). This instrument (PSFs) outlined specific factors that need to be achieved and adhered to in order to ascertain or measure the success of the construction project. The PSFs measure the success of a construction project based on four dimensions. The four dimensions are explained as follows.

i) The first dimension measures project efficiency which is evaluating the project as a short-term measure for example; project is completed within the specific budget and time frame.

ii) The second dimension measures project's impact on customers. This dimension specifically looks at customer as the final user and how the project is able to achieve customers' needs in terms of its performance, functional requirements and technical specifications.

iii) The third dimension evaluates the business success. It includes the project's performance against time, cycle time, yield or output and quality, as well as the overall improvement on the organisational performance.

iv) The fourth dimension looks at its readiness for the future. This includes long-term planning and considerations and the readiness of the company to keep abreast with technological advancements in order to keep up with future demands the four dimensions of the PSFs are illustrated in the following diagram.

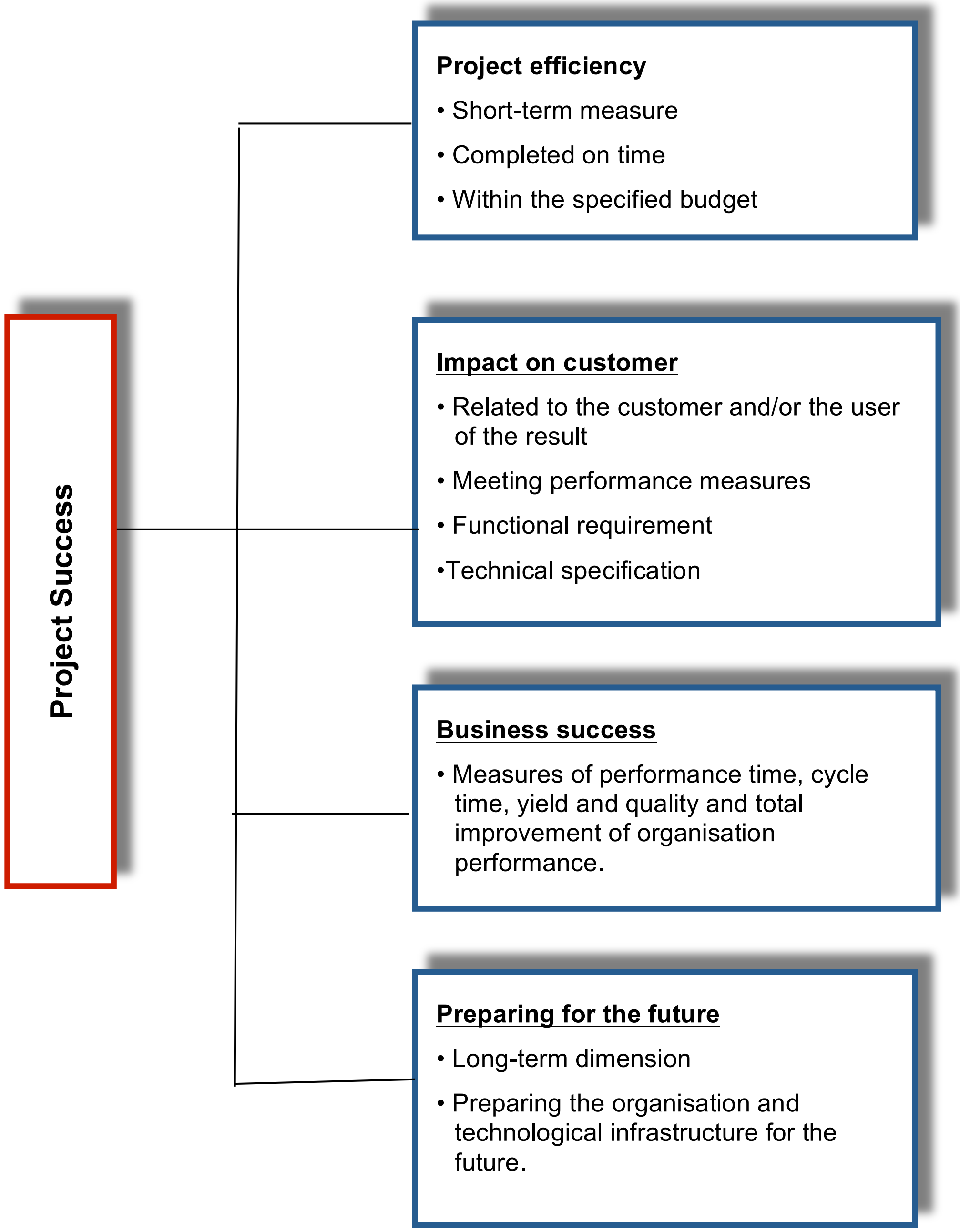


Figure 3.2 Four dimensions of a project's success.
(Source: Shenhar et al., 1997)

In any decision-making process, the objectives of the project have to be carefully thought out. This is due to the fact that all objectives are very much connected and have impacts on the stakeholders. As such, three objectives need to be achieved if a project is to be considered well managed which include time, cost and performance. As emphasised by Bower (2003), these three objectives are inextricably linked and each one has its impact on the other.

As highlighted in the literature, the project success is very much determined by the effectiveness of the project management. In managing a project, a company needs to take into account of certain elements such as enlisting individuals with suitable skills and qualifications, competencies, techniques and experience to manage the project in an efficient and effective manner. Hence, a specific standard of procedures such as schedule of values (SOV) need to be put in place. By having an established SOV and appropriate human resource to manage, the project management is able to put forth clear plans and guidelines for the project and most importantly, to ensure clients' satisfaction and needs are met by taking charge of coordinating, controlling and monitoring all project activities. As advocated by Harrison and Lock (2004), the project management must guarantee the completion of the project as stipulated in the plan according to the time allocated, set budget and ensuring that quality and standard are adhered to.

In ensuring customer's satisfaction on project success, Senior (1997) proposed the following three elements to be taken into account, they are; time allocated, budget allocated and also specification. These three elements are illustrated in the following Figure 3.3.

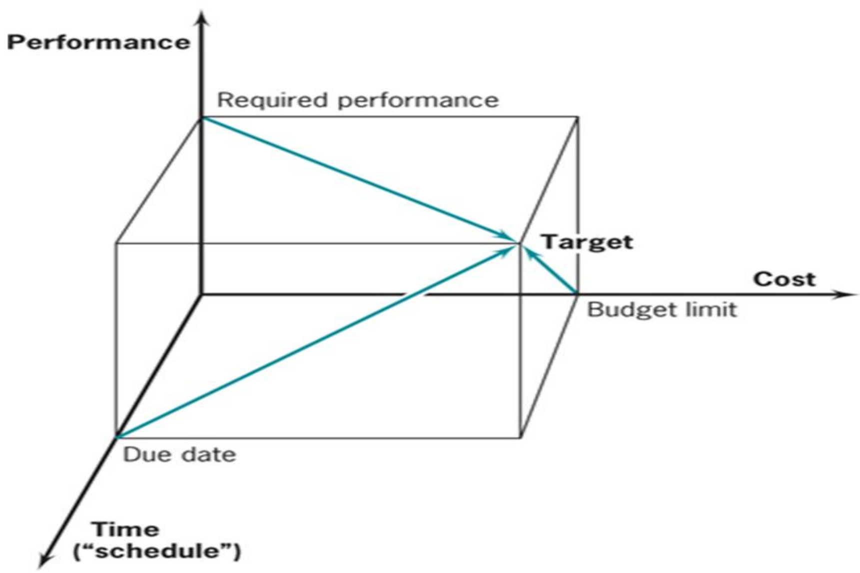


Figure 3.3 Balance performance criteria

Project managers are encouraged to use management tools to help them to plan and implement construction projects, which helps to increase the rate of success (Jaselskis and Ashley, 1991). Various researchers highlighted factors that influence project management to be numerous. Some of these factors or variables include sufficient and effective communication, providing appropriate feedback, control mechanisms, troubleshooting, making decision effectively, monitoring, specific project organisation structure, adherence to plan and schedule and other relevant management experience (Belout, 1998; Chua et al., 1999; Walker and Vines, 2000). According to Edum-Fotwe and McCaffer (2000), project managers have to constantly adapt and be flexible in their approach of confronting with the ever-changing issues due to the effects of wider changes that take place in their work environment. They may find themselves having to assume different roles, which previously may not have been conventionally or typically identified as part of their responsibility.

Risk management can be ineffectively implemented due to the following reasons.

- A non-existence of a formal risk management procedures such as risk identification, analysis and control (Tah and Carr, 2001).
- A non-existence in providing continuous risk management over the different phases of the project implementation which include the phases of designing, estimating, planning, allocation, execution, delivery, review and support.
- Improper integration between risk management and other main processes such as the process of designing, estimating, planning, production, logistics, analysing expenses, manufacturing, assuring quality, assuring reliability, analysing schedule, support (e.g. maintenance), and testing and evaluation.
- A non-existence in providing sufficient interaction between various stakeholders for example; clients, contractors, insurers and suppliers.

3.6.3 Main causes of project risks

Project risks are caused by multiple variables that at times are created by the unpredictable nature of the stakeholders and may be further compounded by external and internal environment factors (Chapman and Ward, 2004; Ghosh and Jintanapakanont, 2004). Therefore, it is paramount to identify the main causes of probable risks during the implementation process of the construction project by the construction management team. This is crucial as it provides a basis in planning these risks and does away with any costs, time delays which may have a direct impact on the quality of the project (Egan, 2002).

The project design is considered as being one of the main causes of risks to construction project. Other additional risks identified include risk in logistics, unstable political climate, contracts and competitive tender (Akintoye and MacLeod, 1997), not having effective communication process, failure in coordinating and planning sufficient activities, incomprehensive and incomplete risk management analysis and the existence of uncertainty in the contractual process (Bennett, 1985). Moreover, inability to identify skilful and competent workforce; the absence of well documented records of activities, lack of suitable equipment and communication misunderstanding during the whole process of the project implementation and issues and barriers that may arise while managing the project (Baloi and Price, 2003).

Risks that are caused by uncertainty, unplanned and unpredicted events whilst the project is in its construction process (Turner, 2005) Other additional causes of risks include contract documents and the safety procedures. These causes are considered to be some of the key risks in construction project which may affect the procurement process, political and legal circumstances, economy, social and weather conditions (Ghosh and Jintanapakanont, 2004; Li et al., 2005),

3.7 Risk management in construction projects

Risk management is an organised way of controlling risk. As suggested by Edwards and Bowen (1998), a risk management practice ought to institute a proper framework; a set of goals and objectives, a capacity to identify and analyse risks, influence risk decision-making and monitor and review responses.

Risk management entails a set of procedures which consists of the key steps namely: risk management planning, risk identification, risk assessment, risk analysis, risk response, risk monitoring and risk communication (Raftery, 2003; Flanagan and Norman, 1993).

According to Scarff et al. (1993, pp.2), risk management can be referred to as "planning, monitoring and controlling activities which are based on information produced by risk analysis activity'' whilst the description of management of risk is ''overall process by which risks are analysed and managed''.

Within the vibrant construction sector, risks are considered inevitable (Akintoye and MacLeod, 1997; Forbes et al, 2008; Tah and Carr, 2001). Risks in construction works ought to be managed in a proactive manner so that the aims and objectives can be met.

Several risk management processes suggested by professional institutions and researchers can be found within the literature (Chapman, 1997; Han et al., 2008; Perry and Hayes, 1985; Tah and Carr, 2001; Taylor, 2005; Tummala and Mak, 2001; Ward, 1999; Australian/New Zealand Standards (AS/NZS), 2004; PMI, 2004). In view of its significance, professional institutions have introduced risk management system in resolving issues during the project execution. For instance, Project Risk Analysis and Management (PRAM), as suggested by the Association of Project Management (APM) consists of nine essential stages namely; define, focus, identify, structure, ownership, estimate, evaluate, manage, and plan (Chapman, 1997). In contrast, a risk management structure was introduced by PMI (2004) comprising five phases namely risk planning, risk identification, risk analysis, risk response, and risk monitoring and control. Within the same instance, AS/NZS (2004) also proposed a risk management procedure which contains establishing the context, identifying, analysing, evaluating, treating, monitoring, and communicating risks. Despite the differences in particular risk management processes, in general, all will contain risk identification, risk analysis, and risk response. In order to gain its benefit to the fullest, risk management ought to be thoroughly and comprehensively implemented at all stages in the project's life cycle. It is equally essential to appropriately select the correct devices and methods in ensuring a successful implementation of risk management.

Risk management in construction sector as mentioned by Serpella et al. (2014) has been experimented by means of reductionist approach that resulted in poor outcomes and limits the project management quality. For instance, most of the risks associated with time are managed by applying contingency sum (monetary value) or floats (time) which are not based upon a detailed risk analysis that are likely to have bearing on the project. In a number of occasions, they prove to be insufficient to cover the consequences caused by the risks that materialise during the implementation of the project resulted in cost exceeds budget and delays.

According to (Osipova and Eriksson., 2011; Tang et al., 2007), risk management is frequently criticised for having shortfalls, and not successful in achieving its key aims in bringing certainties to a project such that risks can be minimised and prospects maximised. Some risks may be predictable at the commencement of the project and adequately managed by the managers, however, other risks may not be easily anticipated.

Clearly, individuals practicing risk management have different ways of perceiving risks and consequently they may initiate ununiformed decisions or responses in similar conditions. Having an adequate consideration to this particular aspect of practitioners' perception should help in increasing the reliability of the performed decisions.

3.8 Risk exposure

There are two common independent elements in the risk definition namely; risk probability and risk impact. These two elements ought to be measured in analysing, comparing and classifying various risks.

In real mathematical sense, risk probability; the chance of an event happening is a random variable with its own probability distribution. Statistical approaches can be employed to determine the probability of an event, mean, dispersion, confidence interval including other important statistical parameters. Essentially, this requires a broad and statistically pertinent database of previous events of similar nature upon which the probability distribution can be based. In real life, this is an uphill task as relevant databases are only available for a very few potentially risky events.

In the absence of relevant database to pull from, risk is usually quantified subjectively in accordance with available data and on most occasions depends upon the experience and understanding of the assessor. In the event of adequate information, probability is usually calculated using a value ranging from 0 to 1. In cases of limited or extremely limited information, probability of risk is subjectively analysed and categorised as Low, Medium or High.

There are many ways in which a project can be affected by risk. Risk can be detrimental to project costs, project duration and overall quality. In the final subject, both extended duration and unsatisfactory quality can be translated into escalation in expenses. With sufficient information the impact of risk can be evaluated. In real case scenario, it is usually difficult to quantitatively evaluate impact of risk. In such cases, qualitative assessment is used and the impact is categorised as Low, Medium or High.

Risk can be quantified by reflecting the above two components, either quantitatively or qualitatively. This can be performed with the introduction of risk exposure, as a result of risk probability and risk impact

According to Carter et al. (1994), Risk Exposure equals risk probability multiplied by risk impact. In the case of one single risk, risk exposure bears no significance. Should only a single risk being assessed in any stage of a project, it should be sufficient to determine its probability and its impact on the project. In scenarios where two or more risks are involved, risk exposure can be employed in comparing them and adopt ways in responding to them. An illustration of deciding priorities between three risks will be utilised to demonstrate the way risk managers employ risk exposure to arrive at resolutions.

In this illustration, three risks namely R1, R2 and R3 will be analysed:

R1 has a probability of 0.3 and 3,000 impact.

The exposure for risk for R1 is 0.3 x 3,000 = 900.

R2 has a probability 0.04 with 20,000 impact.

Therefore, the exposure for risk R2 is 0.04 x 20, 000 = 800.

R3 has a probability of 0.6 and 2,500 impact.

Therefore, the exposure for risk R3 is 0.6 x 2,500 = 1,500.

The probabilities and impacts for both R1 and R2 are different. However, the exposures are similar for both risks. Risk R3 has a high probability but a comparatively low impact. The highest exposure can be seen from risk R3 and this risk will have the highest priority in deciding the risk response.

3.9 Risk acceptability

Various terms are used to describe risk, depending on the exposure level. These include negligible, undesirable, unacceptable and acceptable (Ceric, 2003). A plan can be made to deal with the risks in each category. Unacceptable risks are those where exposure cannot be tolerated; they must be removed or shifted to a third party. Undesirable risks are to be prevented where possible, but if feasible, they may be taken on following detailed evaluation and cost-benefit justification. They will also require top level approval and consistent monitoring. Acceptable risks may be allowed as long as the risk is managed. Negligible risks need no further consideration (Ceric, 2003).

It is possible to associate a given level of exposure with a specific group/category of risk to make the risk management plan more effective (Ceric, 2003). The acceptability of individual risks needs to be assessed independently.

Subject to the risk exposure level, risks can be also categorised as Unacceptable, Undesirable, Acceptable or Negligible and one should devise a method in managing each one of them. As suggested by Godfrey (1996), the categories of risk and suitable ways of handing them are as follows.

Table 3.1 Risk categories and appropriate way to manage

Risk category	Appropriate way to manage
Unacceptable	Inexcusable, must be eradicated or shifted
Undesirable	Should be avoided if possible, detailed study and cost benefit justification necessary, top level
Acceptable	Approval required with necessary monitoring – may be accepted if the risk is appropriately managed.
Negligible	Further assessment not required

In all projects, one can decide to relate a particular risk exposure level with a certain category and therefore the proposed risk management plan. In the case where risk probability has been qualitatively categorised as improbable, remote, occasional, probable and frequent, and the impact of risk categorised as negligible, marginal, serious, critical and catastrophic, the acceptability of each risk may be evaluated individually (Godfrey, 1996).

According to Godfrey (1996), the following can be used.

- High probability and catastrophic impact = unacceptable risk.
- High probability and critical impact = unacceptable risk.
- Medium probability and serious impact = undesirable risk.
- Low probability and marginal impact = acceptable risk.
- Low probability and negligible impact = negligible risk.

3.10 Risk identification

It is important to realise that construction risks are not the same in all countries but vary depending on the local political, cultural, economy and social conditions. In the Kuwait, for example, the industry is growing rapidly, and there are now many huge and complex construction projects underway. However, these projects have placed a huge burden on the industry and created a lot of risks. Therefore, El-Sayegh (2008) stressed that the identification and assessment of the potential risks in a project is a key step in managing these risks. He observed that, generally, every project will contain a certain degree of risk, but that a good number of project managers are not prepared enough to be able to identify or adequately address them. However, he argued that it is not productive for project managers to focus their energy on trying to identify all possible risks as this is time consuming and no guarantee of success. The best approach is to determine the most significant risks and then put measures in place to control them. El-Sayegh started by categorising project risks as internal or external; depending on the source of the risk (this method of dividing risks is also supported by the Project Management Institute (PMI, 2006).

Risk has been classified in a number of ways. Arguing that risks arise as a result of interactions between natural causes, obsolete technology and organisational and human factors, (Smith et al., 2009) suggested that they may be grouped as either involuntary or voluntary, depending on whether the incidents that create the risk are uncertain or beyond the control of the people in charge. (Zack, 1996) identified physical risk as especially relevant in the construction industry as it can impact health and safety, project quality and even completion. Physical risks can interfere with the performance of the project, but the management can reduce these by implementing appropriate safety and quality protocols and ensuring the right equipment is made available. Others have categorised the consequences of risk, such as loss of goodwill, negative publicity and environmental, human and economic costs (Ayyub and Wilcox, 2001). These should also be taken into consideration when planning a project.

Several studies have used a risk breakdown structure (RBS) to organise the various categories of risks. Risk sources can be financial, strategic or operational (Xenidis and Angelides, 2005) and can lead to higher than predicted expenses in procuring materials, or lower than expected sales after the project completion, or poor accounting during the project management phases. Examples of financial risk sources include government and commercial factors, while strategic risks can arise as a result of inadequate staff training or IT, or poor marketing; and problems with production, security and maintenance are all sources of operational risk. Health and safety regulations and environmental concerns can pose an additional compliance risk. Risks are mainly be identified as internal risks and external risks (Miller, 2013). These categories may be sub-divided into contractor, political and economic risks, among others.

3.10.1 Internal risks

Those risks that directly relate to the project and fall under the project management team's control are termed internal (El-Sayegh, 2008). These risks are again divided according to the specific originator such as the designer, contractor, owner, suppliers and sub- contractors.

1 Owner Risks

Studies have identified various ways in which the project owner can become another source of risk, for example, by delaying payments to contractors, imposing an unreasonably tight schedule, making design changes, intervening in the project, delaying contractors' access to the site, not defining the scope of the project, suddenly going bankrupt or breaching the terms of the contract (Remington and Pollack, 2007). Delayed payments can cause financial hardships for contractors since these payments are the source of income for the project, while rigid schedules may be impractical or difficult to achieve. Owners may also demand design modifications which may turn out to be dangerous or jeopardise the contractor's chances of achieving the project's schedule.

2 Designer Risks

The main problem here is usually impractical designs that are difficult to implement, but risks can also arise if the drawings are poorly executed or the specifications are incomplete or inaccurate. Documents may not be issued in time. Changes made during the construction phase by the design professional, whether to improve a design or correct deficiencies, can also pose a risk for the contractor (Fazio et al., 1988).

3 Contractor Risks

Contractors become risk sources by producing poor quality work or low productivity, by demonstrating incompetence, by being involved in accidents at the construction site or by being unable to deal with unexpected technical challenges. They can also pose a risk if they have too few staff, if the key staff leaves in the course of a project, or if they become engaged in disputes with sub-contractors (Zaneldin, 2006). Accidents caused (or suffered) by contractors during the construction phase can lead to cost overruns, loss of morale, delays and loss of productivity.

4 Sub-Contractor Risks

As indicated above, sub-contractors are an additional source of risk. If they fail to deliver the work as agreed with the contractor, this can result in breach of contract. Where sub-contractors are not qualified for the job, this can lead to poor performance (Zaneldin, 2006).

5 Supplier Risks

Suppliers can cause risks in construction projects by failing to deliver materials on time or by delivering poor quality materials (Miller, 2013).

3.10.2 External risks

Internal control systems have no influence on external risks, which may be caused by social, natural, economic, political and cultural factors. Research has associated each of these categories with various risk events.

1 Political and Government Risks

Political risks include war threats and political instability. Changes in regulatory guidelines and rules may also affect the project. Other risks are posed by workers' dissatisfaction or even industrial action, which can interrupt project activities and negatively impact the project's objectives. Studies have also identified delays in permit approvals and corruption among officials as possible sources of risk affecting construction projects (Knecht, 2002).

2 Social and Cultural Risks

Social and cultural factors which have their origins in the external environment may nevertheless create conflict within the project; for example, cross-cultural differences, substance abuse and criminal act (American Institute of Architects, 2008).

3 Economic Factors

Miller (2013) found that sudden changes in prices and inflation were the most significant economic risk factors for local and international companies in his study. Other economic factors which can pose risks to construction projects are shortages, whether of equipment, manpower or materials, and currency fluctuations (Miller, 2013).

4 Natural Factors

Natural risks may include unpredicted inclement weather and unforeseen site conditions (Chuing Loo et al., 2013).

5 Other Factors

El-Sayegh (2008) identifies another category of external risks that he refers to as “others”. Into this miscellaneous category he places events such as difficulty in claiming insurance, local protectionism, unfair tendering practices and delays in resolving litigation and contractual issues.

3.11 Risk management process

Risk management relays the notion that anticipated incidents that may bring disastrous impacts should be anticipated (Ceric, 2003). When the risk management process is conducted, it guarantees that everything possible is done to ensure achievement of the project’s objectives despite the constraints. The primary goal in project management is to achieve the deliverables within the scheduled period, using the forecasted budget and achieving the desired quality. However, doing this under conditions of uncertainty is a challenge. Since the outcomes of even foreseen events cannot be predicted with certainty, it is necessary to turn uncertainty into risk and manage it.

Risk management is an ongoing process which should be present in all cycles of the project. Risks and the consequences they bring need to be addressed in all important areas of decision-making and by all those involved in the decision-making process. In all work phases, it is necessary to identify potential threats to the project, scrutinise their possible negative effects and plan to respond to them. Of course, any risk response action may itself result in newer risks which also need to be identified, analysed and controlled. Project managers should do everything in their power to achieve the project's goals and reduce or eliminate uncertainty or risk effects; in other words, risk management is inseparable from project management because the activities must be performed concurrently.

The elements of the risk management process have been documented by a number of authors. While some see the process as linear – a matter of risk identification, risk analysis and risk response – others see it as cyclical (Jordan, 2013). However, risk management process was defined by Pennock and Haimes (2002) as the process that involves the identification and documentation of risk, followed by measurement and grouping, modelling (analysis), the reporting and development of strategy, risk mitigation, minimisation and optimisation and finally monitoring and control. Henley (2007) lists risk identification, analysis, control and reporting as the key phases of the process, while Cohen and Palmer (2004) list risk identification, approximation, analysis, feedback and surveillance. The majority of authors highlight risk identification, analysis, response and control as the key phases in the process. Figure 3.4 presents Ceric's framework for the risk management process.

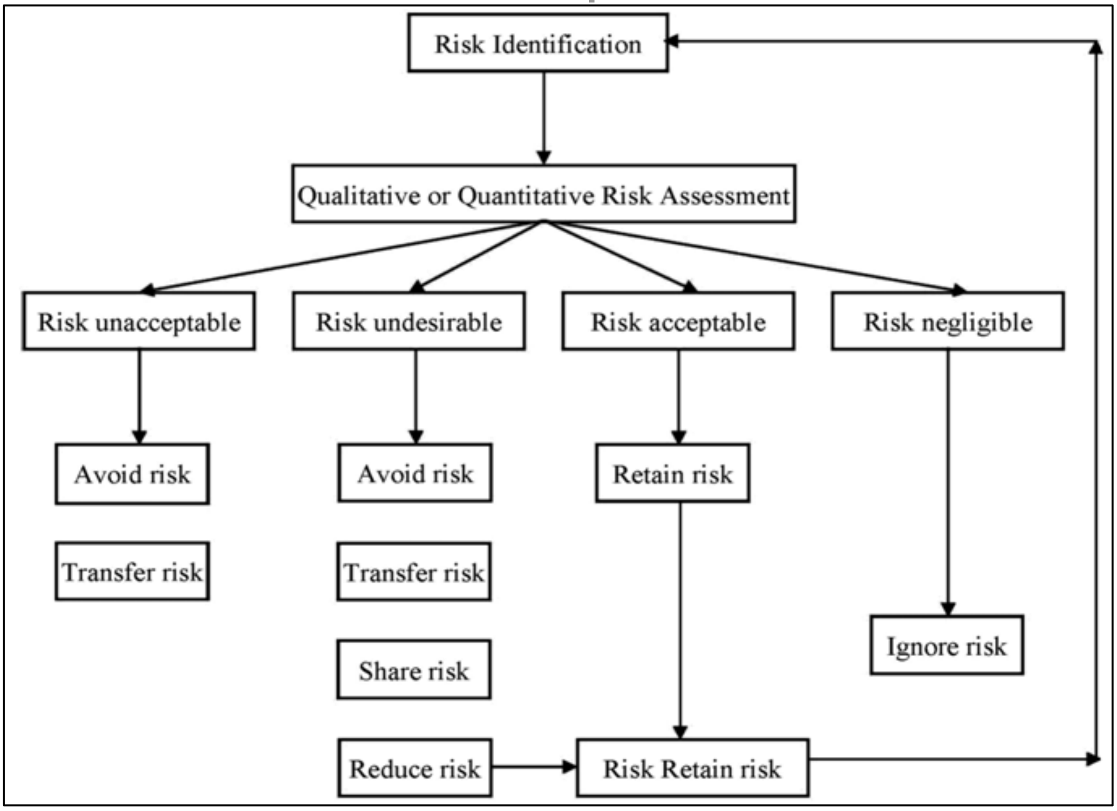


Figure 3.4 Risk management framework (Source: Ceric, 2003)

The framework describes a cyclical risk management process that starts with the identification of risk, followed by the qualitative or quantitative evaluation of risk probability and risk impact to determine the risk exposure (Ceric, 2003). The risk exposure factor is used to reach a decision on risk acceptability. After applying the risk response, risk monitoring is conducted. If new risks appear, the process goes back to the beginning – the identification stage. The risk management process can also be executed using a computational method.

3.12 Risk assessment in the construction industry

Risk assessment integrates all the general procedures in risk identification, assessment and evaluation. The risk identification process requires the organisation to name all risk sources, levels of impact, scenarios, causative factors and viable effects (Jones and Saad, 2003). The aim of risk identification is to provide a comprehensible list of risks based on scenarios that may facilitate, accelerate, inhibit or delay the realisation of a project's goals. Next, risk analysis entails developing an understanding of the risk. The findings will allow decision makers to decide whether the risk needs a response, and if so, which approaches are the most appropriate. Finally, risk evaluation requires decision makers to use the outcomes of the risk analysis to prioritise their risk responses. This involves comparing the risk level discovered in the analysis phase with the risk category set when its identity was established.

It is important that risk assessment evaluate the impact of any identified risks to a project such that they can be classified in accordance with their significance. Subject to the availability of information, risk assessment can be undertaken qualitatively or quantitatively or semi-quantitatively (Ebrahimnejad et al., 2010).

Several studies have opted to incorporate risk assessment methods into the project planning with a number of methods readily available for use by specialists. Sophisticated model (statistical) procedures can (although difficult), be adjusted to suit technical risk multidimensionality. According to Chapman and Ward (2004) , risk management has advanced mostly on the basis of cost and time risk, whereas technical risk assessment has not generated a great interest as yet, concerning non-quality risk.

There are a number of factors concerning risk assessment within the construction sector as summarised below.

1. **Minimising and Eliminating Project Losses:** Risk assessment processes assist in identifying and eliminating risks including other related resources. Eliminating risk helps in reduction related costs, for instance the cost of any dispute such as in the event of accidents and injuries (Baker et al., 1999), thereby escaping cost overruns (Wang and Chou, 2003).
2. **Project and Company's Image:** Any potential risk to a project course may have an impact on the status of the company within the construction market. This will then affect any potential projects and financial investment in forthcoming projects; thus improving profitability (Baker et al., 1999).

3. **Completion of Project:** Completing projects according to stipulated time and avoiding delays (Assaf and Al-Hejji, 2006; Wang and Chou, 2003) Avoidance of Unexpected Surprises: Risk management also offers a system, in which sudden glitches and modifications can be avoided (Cooper et al., 2005).

3.13 Risk identification techniques

As stated by Makui et al. (2010), the initial phase in the process for the preparation of any construction project is risk identification and classification. Risk identification helps to identify risks that can potentially detriment the project and subsequently register their characteristics. The members of the project team that may participate in the risk identification exercise are project managers, project team members, risk management teams (if applicable), external experts of non-project members, clients, end users, other project managers, stakeholders, and experts in risk management. Risk identification entails an iterative process as newly identified risk may assure that a project advances during its life cycle as intended.

The number of iterations required and members who should be involved in each step vary depending upon the project itself. It is vital that the project team members are included in the process to ensure that a sense of ownership is developed and maintained as well as to take responsibility for any risks and related risk response activities. Stakeholders although not part of the project, may be requested to offer extra objective information. The process of risk identification can then be followed by either a qualitative risk analysis or quantitative risk analysis processes, which ought to be undertaken by a qualified risk manager. In certain instances, making the risk identification simpler may suggest a response; any risks identified using this method should be registered for further analysis and perhaps incorporated somewhere during the process of risk response planning (Duijne et al., 2008).

The process of risk identification, regarded as the basis for risk assessment and response development at later stage, requires some decision to be offered by key personnel of project teams. As such, it is essential for them to acquire appropriate judgement when coming up with basis of information.

Further steps in the risk management process will proceed from this information basis; the realisation of these steps will be based upon the quality of the result from risk identification process.

In the risk management of a project, risk identification is an essential stage as it is impossible to manage risk before being identified (Chapman and Ward, 1996; Simister, 1994). According to Baker et al. (1999) and Flanagan and Norman (1993), the construction sector has been claimed by many as poor at performing risk identification. It is therefore important for the risk identification exercise to be undertaken early during the planning as part of the preliminary stage of the project, which should also include project planning, budgeting and scheduling. The truth is that it is unlikely for other project activities to be executed realistically without considering risk. In many occasions, failure to identify risk at early stage may result in the project being entirely abandoned or requiring major modifications.

A few procedures in risk identification are currently being utilised by construction practitioners in identifying the existence or the extent of possible risks. According to Chapman (1998), they can generally be divided into three clear categories listed below,

1. Identification performed entirely by a risk analyst.
2. Identification performed by analyst upon consulting one project team member.
3. Identification performed by analyst that leads a working group.

The methods of identification based upon working groups are brainstorming; in this regard, the assessment of nominal group method and the Delphi technique are carried out one after another in investigating their strength and weaknesses to identify risks.

3.13.1 Brainstorming technique

The process of brainstorming, adapted from business management, thus not specially crafted for risk management, entails redefining a problem, creating ideas, determining the conceivable solutions, developing realistic solutions and undertaking an evaluation (Chapman, 2001). This method of risk identification in construction contract is common and is practised in a number of industries especially in building projects. The purpose of applying the method is to create a forum, whereby various thoughts can be presented instantaneously and recorded with no comment.

Brainstorming has also been suggested as problem solving approach in view of its ability to raise a good number of ideas in shorter duration than using usual group solving method. According to Osborn (1963), the brainstorming effectiveness is dependent upon two key constituents: (1) thinking in group is more creative than individual thinking, and (2) the circumvention of criticism increases the production of thoughts. He also mentions that through experience, twelve is the optimum number of a brainstorming crowd. He added that ideally, a panel should include a head, an assistant head, and five regular or ‘core’ members with around five guests. Generally, it is perceived that a panel should ideally make up of members of similar rank since senior members are likely to confine the thinking process of the rest of the members.

3.13.2 Nominal group technique (NGT)

The nominal group technique originated from social physical studies of decision making conferences, management-science studies of aggregating group judgments, and social work studies (Chapman, 1998). There are many similarities between these techniques and brainstorming however, thoughts are recorded instead of spoken loud. This method is broadly regarded as more effective compared to brainstorming. The recorded suggestions can be transmitted to numerous groups for debate and comment and then written on a flip board; these various thoughts can then be elected and sorted according to their appropriateness to the specific project.

As explained by Delbecq et al. (1975), the NGT method operates by getting between seven to ten members of the group involved, working together with no discussion taking place and recording relevant ideas in black and white. The members of the group take turn to present their thoughts in brief for approximately five to ten minutes each. Subsequently, these ideas are written on the flip chart for other members viewing. This exercise continues until all the members are exhausted of ideas. The discussion only commences when the whole set of ideas have been documented and followed by deliberating all the ideas one at a time. Towards the end, the members record their assessment on the most severe risks and rank them accordingly. Finally, they aggregate the ranking mathematically to arrive at a group decision.

3.13.3 Delphi technique

The Delphi technique is a system whereby the systematic gathering and collation of judgments from isolated unspecified respondents concerning a specific subject are being supported. As suggested by Chapman (1998), this method depends upon a set of carefully designed sequential questionnaires interspersed with summarised data and views describing opinions resulted from earlier responses.

A set of questionnaire or a list of pertinent topics is issued to the respondents. They are requested to provide responses on these issues and the results are then gathered and returned to the originators. The originators then take this opportunity to revise their previous responses based on the feedback received. This exercise continues until a clear result is reached. In general, this method progresses at a slow pace and considerably costly, thus making it an unpopular method to identify risks.

The key benefit of the Delphi method, when utilised, is that each member of the team can be totally independent and they are secured from the influence of “strong characters”. On the other hand, the setback is that a considerably large number of iteration is usually required prior to reaching an agreement, which can also be an extremely slow process in itself.

3.13.4 Interviews

Interviews give the respondents the chance to answer prepared questions and discuss the topic in detail (Ceric, 2003). These answers are then used as the basis for analysis. The questions can be structured or unstructured. Unstructured questions allow respondents to answer as they choose, while structured questions require them to choose an answer from the alternatives given. The project/risk manager responsible for framing the questions and conducting the interviews needs to be highly knowledgeable and experienced in the process.

3.13.5 Questionnaires

Just like interviews, questionnaires can be structured or unstructured. They are the fastest and most efficient way of gathering opinions from all the project members for analysis and comparison (Ceric, 2003). The questions must be formulated so as to ensure high quality answers, but the process is fundamentally limited by the inability of the questionnaire to allow respondents to discuss their answers or to present opinions that go beyond the scope of the questions. Thus, questionnaires may hinder creative thinking.

3.13.6 Expert systems

An expert system is established using the collective knowledge and experiences of all participants in the project. The system will incorporate all of the stakeholders' experiences from earlier projects (Ayyub and Haldar, 1984), but even so, it may not uncover all the hidden risks. Crucially, expert systems give explanations of how previous problems were solved; in other words, they not only provide knowledge but also give an insight into how this knowledge was developed. As a result, people tend to have confidence in such systems and see them as reliable tools for risk identification.

3.14 Methods of risk analysis

The key task in performing risk management is evaluating the risk such that suitable measures can be taken. In evaluating risk assessment of all possible risks, a detailed review of their impacts to the project performance ought to be considered. This entails deliberations of relative significance of each risk and performing calculation of the likelihood of it to happen and the probable magnitude of the impact. Risk assessment helps developers and contractors appreciate the areas within the project scope that are vulnerable to risk and focus their resources on sectors where the most involvement can take place in minimising risk.

The object of risk analysis is gathering all possible appropriate options followed by evaluating the numerous results. Each option is given weightage so as to allow decision-maker to measure and provide responses to the risk. In selecting the most appropriate risk analysis process, it is imperative that the followings are taken into consideration:

- the project type and its magnitude;
- any available data;
- the allocated time for carrying out risk assessment, which includes the budget to perform the task; and
- the experience of the analyst.

Methods for risk analysis have allowed a range of specific values to indefinite information such that in cases where the project cost and period are indeterminate, the decision-maker may choose from a range of values that they most probably fall within. For fast and accurate assessment with various available options, the employment of computer software is essential in performing quantitative risk analysis. Table 3.2 illustrates the available tools and approaches that can be implemented while carrying out construction projects.

Table 3.2 Risk analysis techniques (Dey and Ogunlana, 2004)

SN	Method	SN	Method
1	Monte Carlo simulation	8	Sensitivity analysis
2	Fuzzy set approach	9	Program evaluation and review technique
3	Couse/effect diagram	10	Multi-criteria decision making
4	Event tree analysis	11	Analytical hierarchy
5	Risk mapping	12	Influence diagram
6	Decision tree	13	Neutral network approach
7	Checklist	14	Fault tree analysis

3.14.1 Qualitative risk analysis

Every project has varying risk associated structures and risk levels with each project need a certain approach to risk management. Quantitative analysis of a project's risk factors involves substantial amount of calculations to be performed based upon previous statistical data; as such the concern is whether the data are available. In the event of unavailability of data and in the absence of relevant experiments that may be able to provide such data, it may be sensible to assume qualitative analysis technique for example conducting interviews to main project team members, formulate a checklist, apply the Delphi system or undertake brainstorming exercise. Often, decision-making in the construction field is governed by previous related experience and availability of information.

3.14.2 Quantitative risk analysis

The implementation of risk analysis in the construction projects is the focus of the study as often, risks are not appropriately managed resulted in poor performance of the construction sector. Owing to the nature of the risk, it is not easy to assess the level of risk and this tends to lead to ambiguity and vagueness. In the risk assessment procedure, it is often required to evaluate the chance of both a detrimental incident and its impact. Although various methods and software packages are available in assisting risk analysis, they have to date mostly unsuccessful in satisfying the requirements of project managers. These methods are mostly based on fundamentals and procedures originated from the operational research techniques established in the sixties. Because of this, they tend to put more emphasis on quantitative risk analysis based upon probabilities estimation and probabilistic distributions for time and cost analysis (Tah and Carr, 2000).

3.15 Risk responses

Risk can be allocated with its responses described and categorised as the following five groups namely: (1) risk retention; (2) risk reduction; (3) risk transfer; (4) risk avoidance; and (5) Risk control and monitoring.

3.15.1 Risk retention

Risk retention is growing in significance and regarded as a key part of risk management particularly in handling project risks. It entails internal prediction of any commercial impact due to the risk on the establishment whether complete or incomplete. In the implementation of a risk-retention approach, it is imperative that the two types of retention are carefully differentiated. According to Al-Bahar. and Crandall (1990), risk retention can be grouped into two categories namely planned or unplanned.

Planned risk retention is cognisant and is considered a thoughtful assumption of risks that are clearly identified or acknowledged by the contractor. Within this category, risks can be dealt with in various approaches subject to the principles, the particular requirements and financial strengths of the contractor. On the other hand, unplanned risk retention emerges when a contractor fails to identify or acknowledge the presence of risk and inadvertently or unintentionally accepts potential losses. Another type of unplanned retention is when a contractor is aware of the presence of risk however has not fully understood the scale of the possible losses due to the risk.

3.15.2 Risk reduction

Risk reduction aims to minimise the contractor's exposure to potential risk in two steps:

1. reducing the likelihood of a risk; and
2. reducing the economic criticality of risk if it does happen.

To reduce risks refers to sharing the risk with other entities; for example trying to avoid being fined with liquidated and ascertained damages for completing the project later than scheduled. The main contractor may then embed the liquidated damages clauses into his agreements with sub-contractors and other legal provisions. Therefore, the management-fee form of contract would be appealing to contractors and should be effective in minimising risk of direct-losses and contractual claims.

3.15.3 Risk transfer

Generally, it is acceptable to have risk transfer and this method handovers the risk to a third entity without affecting its severity. In reality, it may increase the risk factor if the responsible party is not wary of the severity of the risk. The most common means to cordon risk is purchasing appropriate insurance and the risk is transformed into monetary value and being transferred to an insurance underwriter. In this way, the risk exposure is being converted into an insurable cost. Construction projects are susceptible to liabilities, as deficiencies may only be exposed well after the project completion. These defects may involve latent defects that are not noticeable even when the project is completed and handed over. The benefit of risk transfer is that the need to file legal action between various entities can be minimised.

3.15.4 Risk avoidance

Risk avoidance can be defined as disagreeing to accept risk. Typically, this takes place at pre-contract negotiation stage but usually prolonged to making decision during the project lifetime. One of the techniques adapted is utilising exception clauses to avoid a particular risk and its potential impacts.

3.15.5 Risk control and monitoring:

Increasing productivity and reducing the project's risk exposure to schedule escalations and costs are the responsibility of the risk management team (White, 1980). Any risk within construction projects should be monitored and controlled, beginning with the development of the risk management plan.

3.16 Risk management plan

Ceric (2003) argue that a comprehensive risk management plan incorporates the following seven stages.

- Stage one: Defining objectives. It is important to record the project goals and objectives in a way that can be comprehended by all team members. At this stage, the stakeholders should be identified and the project requirements assessed to ensure that they are realistic. Any assumptions and challenges relating to achieving the project's outcomes must also be reviewed. The expected benefits should also be noted.

- Stage two: Production of the risk management document. This should set out the objectives and scale of the risk management process, the roles and responsibilities of the project team, the contracting organisation, the devices and techniques to be implemented, details of the reporting cycle, review arrangements and deliverables. All project management team members should work to this document.
- Stage three: Identification. Risk identification techniques include interviews, mind mapping, brain storming and fish bone diagrams. Identification should be consistent, comprehensive and meaningful even to those with little knowledge about the subject. Risk is unavoidable in construction projects, so this step is crucial. The main objective of risk identification is to enable project managers to deal with risks proactively rather than reactively.
- Stage four: Assessment. Risk assessment, which should be strategic and objective, may be conducted using qualitative or quantitative methods. Quantitative methods describe risk in mathematical or statistical terms and are used to identify the main issues in construction projects and to justify a comprehensive risk analysis. Qualitative methods, on the other hand, provide explanation and allow prioritisation of the risk issues. This is especially important in large projects, where it should always be given top priority.
- Stage five: Planning. When the risk has been identified, the risk management team(s) must develop a response plan that is achievable, appropriate and affordable. Teams are assigned to handle specific activities and a timetable is set.
- Stage six: Management. The effectiveness of the chosen response strategy should be monitored as the project progresses. If necessary, better alternatives should be identified in order to sustain the risk management process.
- Stage seven: Feedback. Effective feedback is a key helps managers learn from mistakes and successes throughout the lifecycle of the project. It allows for continuous revision and amendment of risk responses to ensure

a positive outcome. Many projects allow the project management team to revise their initial risk estimates.

At all stages, communication between team members and the public or other stakeholders is essential to control and reduce risk. The development of a plan containing an estimated schedule and initial cost planning is part of risk analysis. A comprehensive risk management process can be performed using modelling techniques to simulate situations and gain insight into how risk may be minimised (Zack, 1996).

3.17 Summary

The philosophy of risk analysis and its management is mainly based upon principles and methodologies that originated from Operational Research established in the 1960s.

This chapter also has illustrated the way many researchers have endeavoured to provide the best response to the issue; How to deal with risk in construction? There has been notable advance in construction on deploying qualitative and quantitative tools. Within construction there is no evidence of any systematic or uniform estimations for the timeframe of events in risk management practice. The lack of attention to timeframe is arguably the source of sub-optimal decisions in management of risk events associated with a project. Therefore, the timeframe within which risk event should be mitigated or ‘‘risk time dimension’’, holds the potential for enhancing how risk events are managed in construction by professionals.

Obviously the differences in the way that decision-makers such as professionals in construction projects think, believe, perceive and react to risk events have a significant influence on the decisions they exercise in their project roles. Currently there is a clear missing link in risk management that takes account of these differences.

The next chapter presents and explains the proposed concept of risk time dimension and perception theory. It also covers of individual differences in ability and attitudes when it comes to perceiving risk.

Chapter 4: Risk and Time Perception

4.1 Overview

The aim of this chapter is to provide a description of the concept of 'time dimension of risk' and how the concept is related to the responsiveness of executives in the decision-making process. It includes a review of perceptions of time from different perspectives, temporal horizons of risk, and the importance of time in the implementation of the project especially during the stage of planning, scheduling, and execution. This chapter also reviews the risk perception theories and the differences between subjective and objective risk perception. An exploration of the philosophy of risk and risk-taking behaviour, that includes, risk perception, risk propensity and risk preferences. The chapter finally highlights risk attitude and how individuals respond to the same situation differently based on their risk attitude classifications. Individuals' abilities in forecasting near and distant future according to their time orientation are explored.

4.2 Risk perception theories

According to Tsohou et al. (2006), risk management in the construction industry consists of a number of human related activities which its realisation and assessment depend upon how managers perceive risk.. Furthermore, in order to implement and embark on risk management within the construction industry, several actors drawn from various departments are often involved in the process. For that reason, the success or failure of any project rely heavily upon how those actors; typically project managers, site managers, engineers, consultants and other related parties who are involved in identifying risk factors associated with the project.

Several empirical studies have noted that perceptions of risks vary from one person to another; which emphasize the view that individuals involved in project decisions are often concerned about different risk issues (Nelson, 2004; Garland, 2002; Beck, 1992; Boholm, 1998; Bontempo et al., 1997; Renn et al., 2000; Douglas and Wildavsky, 1982; Tsohou et al., 2006; Slovic et al., 1982; Brenot et al., 1998). Therefore, a subjective risk assessment would “result in risk being estimated differently, based on the separate perspectives of individuals” (Nelson, 2004). For instance Ricciardi (2004) is of the opinion that some risks could be acknowledged by one person as major risks whereas they could be recognised by another as minor. Additionally, Bontempo et al. (1997), and Weber and Hsee (1998) pointed out that there are systematic individual, group and cultural variances in perceptions of risk. Some of these opinions are addressed in the present literature on risk management. It could be more challenging to integrate the perception of risk associated with complex construction projects between departments with varying backgrounds and with varying techniques of looking at project related risks.

As mentioned by Tsohou et al. (2006), people perceive the same risks in a different way when discussing perceptions of risk events linked to a particular project (or a phase of the project). Similarly, people tend to have dissimilar estimations in terms of rating the same risks (Tsohou et al., 2006). These assertions support the view that there are many aspects and personal factors that can influence people’s perception of risk; making their perceptions different from one another. According to Belton (2001), culture is one of the factors influencing the manner people perceive risk. Furthermore, individual proficiency, and information gathered from outside an environment; watching and listening to views from the mass-media, for example TV, radio and newspapers; familiarity with the source of the risk; and background and professional experience are other elements that may cause differences in the perceptions of risk among people (Ricciardi, 2004; Belton, 2001; Renn et al., 2000; Tsohou et al., 2006). Within construction, the inadequacy of information often means that people do not perceive risk to be associated with a certain activity. As such, people tend to make incorrect judgements or decisions due to inaccurate or inadequate information (Ricciardi, 2004).

There are three approaches by which risk perception has been studied, namely: the axiomatic measurement paradigm; the psychometric paradigm; and the socio-cultural paradigm.

Studies within the axiomatic measurement paradigm focus on the way in which people subjectively transform objective risk information (for example, possible consequences of risky choice options such as mortality rates or financial losses and their likelihood of occurrence) in ways that reflect the impact that these events have on their lives (Luce and Weber, 1986).

According to Marris et al. (1998), the second method of measurement relates to 'psychometric paradigm' which is obtained from the field of psychology and the decision sciences. The psychometric paradigm endeavours to clarify differences in an individual's perceptions of risk by emphasising differences in their cognitive factors (Wilkinson, 2001; Rippl, 2002). The noteworthy assumption within the psychometric approach is that risk is characteristically subjective (Sjöberg et al., 2004). Slovic et al. (1982) employed the psychometric model of risk perception and discovered that the 'dread risk factor' and the 'unknown risk factor' are the fundamental cognitive factors that govern the perception of risk in individuals.

Research within the psychometric paradigm has identified people's emotional reactions to risky situations that affect judgments of the riskiness of physical, environmental, and material risks in ways that go beyond their objective consequences (Slovic and Weber, 2002). Nonetheless, one setback on the psychometric paradigm was that it did not take into account the impact of social and cultural perspectives on perceptions of risk (Rippl, 2002).

The third method is termed as socio-cultural paradigm or 'cultural theory' and was initiated by sociologists and anthropologists who were interested in studying the effects of values and cultural settings on the perception of risks (Marris et al., 1998). Cultural theory assumes that perceptions of risk within social groups and arrangements are predictable based upon the group and individual opinions.

4.3 Subjective versus Objective risk

As defined by Millburn and Billings (1976), risk is "a perceptual or subjective response to an environmental event that encompasses uncertain danger or the possibility of suffering harm or loss". This idea includes the notion of a human response or perception to the risk as the author views risk from a subjective perspective. Boholm (2003) pointed out that subjective risk is the beliefs and opinions of people that often diverge from scientific assessments. Boholm (2003) highlighted that subjective risk is the views and opinions of individuals that often deviate from scientific assessments. Boholm (1996) also stressed that a personal or subjective estimation of risk is not the same as an objective estimation.

While making comparison between objective and subjective risks, it has been discovered that the former indicates a risk that has been scientifically established by means of the best available data and knowledge; this is unlike perceived risk which is based entirely upon subjective impressions (Garland, 2002). It has been mentioned by Boholm (2003) that “Objective risk refers to phenomena and causality in the natural world that can have harmful effects. It is the task of science to disclose and assess sources of potential harm, identify measurable correlations and assess the probabilities of harm”. The objective risk is quantitative in nature; which means that it relies upon the past occurrences of an event and incorporates these into a numerical assessment so as to estimate risk (Ricciardi, 2004). According to Oltedal et al. (2004), objective risk is derived from statistics and probability distributions. While subjective risk relies upon individual’s perception on risk, objective risk is measured based on the number of observations or calculations (Ricciardi, 2004). Also, according to Boholm (2003) and Beck (1992), risks become subjective when they are based on perception. Starr et al., (1976) mentioned that perception is regarded as the subjective interpretation of a risk and not an objective assessment of that risk. However, social science supports the concept of subjective risk instead of the notion of objective risk (Ricciardi, 2004). As highlighted out by Ciancanelli et al. (2001), the definition of risk has started to be regarded as something related to the manner one view the world, and how these views come to be constructed. Risk has been understood to be a factor of individual perception.

4.4 Perception of risk

A number of studies in various fields such as social science, psychology, anthropology, psychometrics and technology studies have endeavoured to understand the perceptions of risks and the way individuals perceive these risks (Ricciardi, 2004). These studies have been undertaken in an effort to assess how people perceive, handle and endure risk; and the way personal feelings, attitudes, expertise, and social and cultural aspects affect people's interaction with the risk. Perception of risk has been described by Sjöberg et al. (2004) as "the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences".

As clarified by Ricciardi (2004), perception of risk is an individual interpretation with regards to the possibility of incurring the risk associated with a particular activity. As stated by Soetanto and Dainty (2009) Individuals' perception of the future is the product of experience, instincts, emotion, value, and other cultural and socio-political aspects. Sjöberg (1979) stated that perception of risk concerns people's views, thoughts, beliefs, attitudes, judgements, and feelings. In addition, an individual's perception of risk is linked to his/her personal experience (Chiu, 2002). In order to identify a risk, one needs a specific knowledge about possible unwanted consequence and the repercussion which can cause danger due to the outcomes. Because of different background and experience, people may perceive and fear about different risks. Therefore, without knowledge, people do not really appreciate a concept of risk. As mentioned by Douglas and Wildavsky (1982, pp.1-15)), "Can we know the risks we face, now or in the future? No, we cannot; but yes, we ought to take action as if we do. Some dangers are unknown; others are recognised, but may not be by us because no one person can identify everything. Generally, most people are not aware of the risks at most of the times. Henceforth, no one can estimate exactly the full risk to be experienced. How, then, do people decide which risks to manage and which to disregard?".

According to Douglas and Wildavsky (1982), risks ought to be viewed as product of knowledge. As stated by Slovic and Weber (2002), 'experts' and 'novices' occasionally have varying perceptions of risks. One of the essential discordances between ‘expert’ and ‘lay’ conceptions of risk is that the “lay person views risk more generally compared with the expert whose expertise is narrow and therefore tend to “miss something” of importance to the wider community” (Margolis, 1997). Fear of risk is associated with knowledge and has some connection with people. People should be prepared to take risks and ready to appreciate it. People utilise interpretative frame to make things sensible. Risk perceptions by experts usually depend upon the norms of their acquaintances. Outlining of risk perception is more widely used which is subject to personal knowledge’s and situations, and is significantly affected by factors such as social networks.

As described by Pidgeon (1998), risk is perceived as “the wider social or cultural values and dispositions that people adopt towards risk”. One’s perception of risk is usually not a remote matter but is influenced by the way he/she lives and works within a network of social relationships since people are a part of a society and a culture (Ciancanelli et al., 2001). According to (Rippl, 2002; Douglas and Wildavsky, 1982; Wildavsky and Dake, 1990), individuals are entrenched in a social environment that has particular values, thoughts and characters; as such, an individual’s perception of risk is moulded by the values and worldviews of his/her social or cultural circumstances. In addition, the people’s perception of risk is influenced by the risk communication among people. The collective experiences are the main factor that influence upon perception of risk. Thus, researchers in the social sciences show special interests in the ways in which risk is socially built. However, according to Soetanto and Dainty (2009) the way in which individuals perceive the risk and uncertainty that are embedded in the future and incorporating this perception in a strategy is inadequately explored.

4.5 Risk propensity

Sitkin and Weingart (1995), Sitkin and Pablo (1992), and McCrimmon and Wehrung (1990) provided the definition of risk propensity as an individual's inclination to court greater or lesser uncertainty. Their view is disregarded by the structured risk management process. Notably, Sitkin and Weingart (1995) have indicated that risk propensity restricts the individuals search for information and biases their assessment of the decision domain and their risk perception, finally pre-conditioning that individual’s risk preference. According to Adam (1995), decision-making in indeterminate environments entails a cognitive balancing act between risk perception and risk propensity whereby one’s perspective of the environment is balanced against one’s fundamental wish to court or circumvent uncertainty. The result of this balancing act compensates the person with their preferred risk which is directly converted into action as decision making. Figure 4.1 has been described as a model representing an individual’s risk sensor, a representation that describes an individual’s desire to live with uncertainty at any upcoming moment (Adams, 1999). Figure 4.1 demonstrates the way the danger perception and the possibility for reward in any decision domain are balanced against the individual's propensity to assume risks. Their propensity is sequentially influenced by their past experience (the `accidents' element) with the decision domain faced at present, supporting the appreciation of risk propensity as an unstable personality attribute that is free to be influenced.

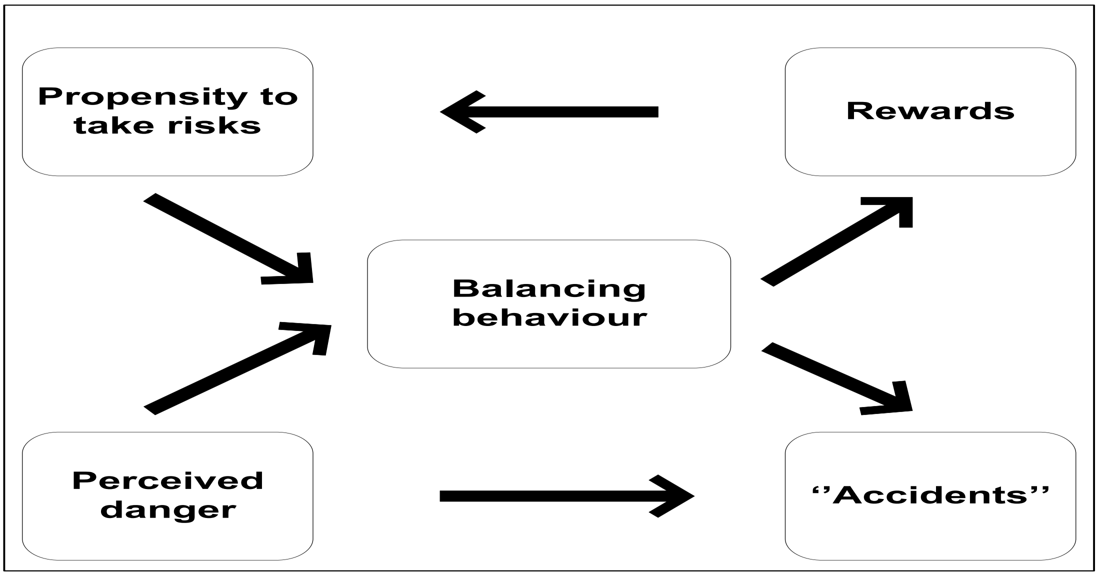


Figure 4.1 The risk “thermostat” model.
(Source: Adams, 1999)

The balancing behaviour may be assumed to signify the individual decision makers risk preference’ at any given time in which the individual's perceptions relating to any likely advantage and/or disadvantage are assessed against the anticipated utility of the outcome.

Slovic (1972) promotes the dominance of situational specific factors, for example economic scenario above the influence and certainly the existence of risk propensity as a stable personality trait. Also, Kozielecki (1974) discovered that environmental factors coupled with other personality traits, for instance, aggressiveness and platitude, interact to determine situational specific risk behaviour and subsequently claimed that risk propensity could not be established as a stable personality trait.

Nonetheless, Sitkin and Pablo (1992) are of the view that risk propensity is effective in decision making than has been earlier understood and have established risk propensity as the important influence upon decision-making under uncertain conditions. As propensity evolves over time it develops into an emergent feature of the decision maker that, as experience increases, it tends to be less influenced by situational specifics permitting greater cross-situational consistency (Sitkin and Weingart, 1995).

Risk compensation theory expects that each person assumes a set level of uncertainty or risk, their propensity that they are prepared to put up with and will therefore manage their lifestyle (Duilisse, 1997; McCarthy and Talley, 1999). It is considered that the idea of experience and familiarity bring improvement towards the perception of control over forthcoming events. Thus, strategizing structured risk management helps increase the perception and compensating behaviour of the individual by translating an already underestimated threat or overestimated prospect into an objective certainty.

Finally, it can be inferred that risk perception is a subjective opinion of the decision domain whereas risk propensity is the wish to either seek or circumvent uncertainty in such situations. The risk perception and risk propensity tend to vary subject to the change in situational parameters. In the case that risk propensity of a person becoming stable in line with his increased experience, there is a high possibility that it is specific to the phenomenon which relates to the experience.

4.6 Risk preference

According to Sitkin and Pablo (1992) risk preference is regarded as an individual's personality trait which either attracts of keeps them to or away from risk. Three generally recognised terms have been widely used in describing an individual's attitude towards uncertainty, or their risk preference. First of all, individuals who proceed on and court uncertainty are considered as risk seeking, whereas the second are those who avoid uncertainty and deemed to be risk averse. The third are people who are unresponsive towards uncertainty, and are labelled as being risk neutral. Propensity has been demonstrated to be liable to change, similar to risk preference. As such, it is not appropriate to associate people with any of these preceding three preferences. This can be further explained by looking to the fact that, the way perception and propensity interact in producing a risk preference. Both perception and propensity are subject to change, similar to the individual's risk preference.

On the other hand, Weber and Milliman (1997) pursued to establish risk preference as the stable personality trait in influencing individual choice. The researchers' view is that varying preferences can be directly caused by the varying cognitive perceptions of a problem domain and continue to be distinct from the emotional response that controls risk preference. As such, one's perception of the decision domain can be influenced however not their fundamental risk preference. Somehow, there are some similarities between the dichotomous opinions of risk seeking and risk-averse individuals. As observed by Maehr and Videbeck (1968), some degree of uncertainty of outcome increases the saliency of the task for both high and low risk-taking subjects.

According to Sitkin and Pablo (1992), Sitkin and Weingart (1990) and McCrimmon and Wehrung (1990), risk propensity is part of the one's personality which influences their desire to either assume or circumvent risks. Nonetheless, Weber and Milliman (1997) has demonstrated that risk preference is a stable personality trait, positioning it in the previously specified role of risk propensity, even though subject to influence through the one's perception of the problem domain. All former writers are agreeable with the fact that the cognitive function of risk perception is the key variable that can be changed to produce varying results. The varying views of propensity and preference trust that they constitute the flexible personality traits which influence decision making, therefore their relative positions would appear to be based upon semantic differentiation.

4.7 Risk attitude

Risk attitude has significant influence on risk management process at the level of individual as well as group. As mentioned before, risk is an uncertainty which could have negative or positive effect on one or more objectives. The attitude, however, can be defined as mental view or chosen state of mind with regard to a state or fact (Mengel et al., 2016). Therefore, by combining the two definitions of the two words that make the term “Risk Attitude”, a definition of risk attitude can be derived. Risk attitude can thus be defined as the chosen state of mind with regard to uncertainties that could have negative or positive effect on one or more objectives (Hillson and Webster, 2007).

By taking a close look at that definition, one can notice that there are three components that reflect the risk attitude; (namely, perception, propensity and preference) and the way individuals respond to risk. For example, perception is a cognitive process that takes place inside the mind of human being (Bundy et al., 2012). It relies mainly on the level of information available to individual or group, analytical skills of their minds, and experience. The result of processing this information is interpreted by response to perception. In construction industry, information can be made available to engineers as well as intelligent information systems in different format. In fact, intelligent information systems can be used to help engineers and decisions makers to better analyse and manage project information to formulate better perception of risk associated to their projects, and hence better response to that risk (Haimes, 2015).

Having seen the crucial role of perception in risk attitude, the term’s definition can now be reconstructed to provide more clear and accurate detail. According to Mengel et al. (2016) risk attitude is the “chosen response to uncertainty that matters driven by perception. Given that perception is subjective, the risk attitude is expected to be different from one person or group to another. In other words, the risk attitude adopted by certain individual or group can be similar or different from the attitude adopted by other group or individual. As stated by Raftery et al. (2001), attitudes toward risk change over time and response to stimulus. Attitudes in this regard can be considered to replicate risk preferences, which have been revealed to be a combination of perception and propensity.

4.7.1 The spectrum of risk attitude

Many attitudes can be formulated and adopted towards the same situation. This in return leads to intended and unintended behaviours and consequences. Figure 4.2 shows the attitude, behaviour and consequences of risk attitude. Human factor plays a key role in risk management since the behaviour is the only reliable indicator and diagnose to the inner attitude; perception and response to perception of risk.

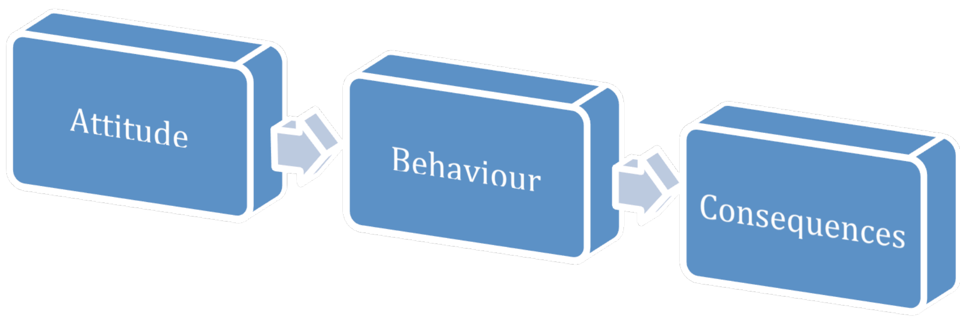


Figure 4.2 Attitude, behaviour and consequences
(Source: Hillson and Webster, 2007)

According to Hvide and Panos (2014), there are five risks attitudes, as detailed below.

1. Risk Paranoid
2. Risk Averse
3. Risk Tolerant
4. Risk Seeking
5. Risk Addicted

While risk paranoid and risk addicted, as attitudes are rare, the other three attitudes are relatively common and widely displayed within most communities (Vieider et al., 2015). The following detail characterises the three common and key risk attitudes.

1. **A *risk-averse*** person or group feels uncomfortable with uncertainty, has a low tolerance for ambiguity, and seeks security and resolution in the face of risk. People who are risk-averse tend to be practical, accepting and have common sense, enjoying facts more than theories and supporting established methods of working. When applied to threats this attitude is likely to lead to increased sensitivity and over-reaction, as the presence of a threat causes discomfort to people with a risk-averse attitude. This has a significant effect on all aspects of the risk process, as threats are perceived more readily by the risk-averse and are assessed as more severe, leading to a preference for aggressive risk responses to avoid or minimize as many threats as possible. When applied to opportunities, however, a risk-averse attitude is likely to lead to the opposite result, as the person or group may not see as many opportunities, or may tend to underrate their significance, and may not be prepared to take the steps necessary to enhance or capture the opportunity. As a result, risk-aversion tends to over-react to threats and under-react to opportunities.
2. ***Risk-tolerance*** implies being reasonably comfortable with most uncertainty, accepting that it exists as a normal feature of everyday life, including projects and business. The risk-tolerant person or group tends to take uncertainty in their stride, with no apparent or significant influence on their behaviour. For both threats and opportunities this may lead to a failure to appreciate the importance of the potential effect of the risk on achievement of objectives, whether the impact is upside or downside, as the laissez-faire approach fails to result in proactive action. A person or a group that adopts this attitude are simply accepting and/or perceiving risk as part of the 'normal situation'. They do not manage the risk appropriately, which leads however to more problems from impacted threats, and loss of potential benefits as a result of missed opportunities. Risk-tolerance may

appear balanced, but progress cannot be made while remaining perfectly balanced.

3. People and groups who are ***risk-seeking*** tend to be adaptable and resourceful, enjoying life and not afraid to take action. This can lead to a somewhat casual approach towards threats, as the risk-seeker welcomes the challenge of tackling the uncertainty head-on, pitching their skills and abilities against the vagaries of fate. The thrill of the chase can outweigh the potential for harm, leading to unwise decisions and actions. During the risk process the risk-seeking person or group is likely to identify fewer threats as they see these as part of normal business. Any threats that are raised are likely to be underestimated both in probability and possible impact, and acceptance will be the preferred response. The effect of risk-seeking on opportunities is quite different, however. Risk-seekers will be sensitive to possible opportunities, may overestimate their importance and will wish to pursue them aggressively. Wang et al. (2016) expand common risks attitudes to include risk neutral attitude. .

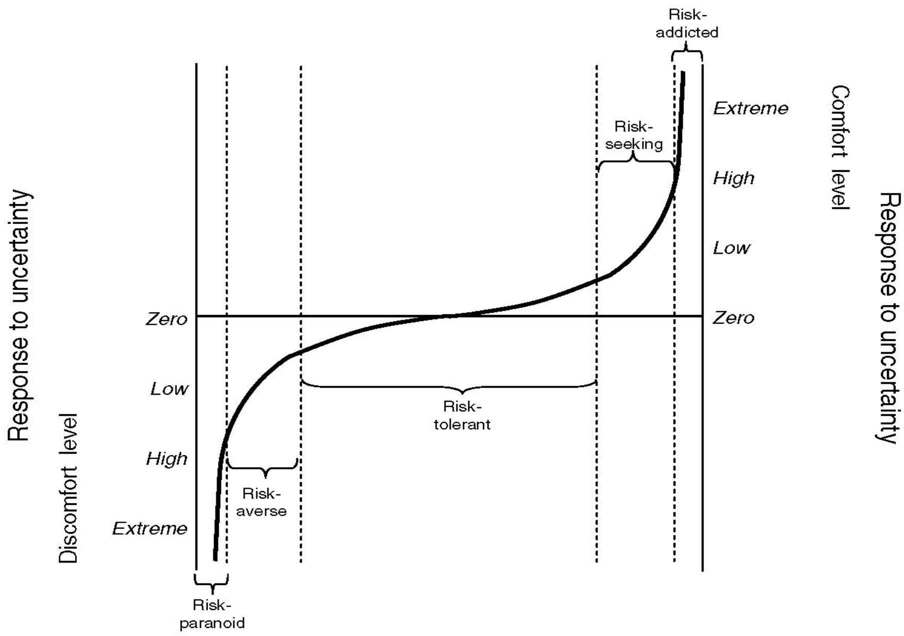


Figure 4.3 The spectrum of Risk attitudes
(Source; Hillson and Webster, 2007).

It clearly shows risk attitudes adopted by individuals and groups in case of risk; uncertainty with regard to a given matter. The Figure 4.3 shows that for individuals and groups that are risk paranoid and risk averse, the level of discomfort is ranged from high to extremely high – depicted in lower left of Figure 4.3. In the case of such types of attitude, individuals and groups seek security and resolution to deal with the risk. At the top right of the same figure, another two types of risk attitudes can be seen, and adopted by individuals and groups. These are risk seeking and risk addicted attitudes. The level of comfort in dealing with risk in the case of these two types is high. Individuals and groups who fall under these two categories of risk attitude are adaptable and resourceful. They possess the spirit of changelings in tacking uncertainties pitching their abilities and skills against change of fate.

In the middle of the Figure 4.3, risk tolerance attitude can be seen. Groups and individuals that are risk tolerance are comfortable with uncertainty. To them, uncertainty is normal daily feature, and therefore, they tend to be less actionable compared to another risk attitude group. In other words, individuals and groups with risk tolerance accept the risk and take no actions to deal with it.

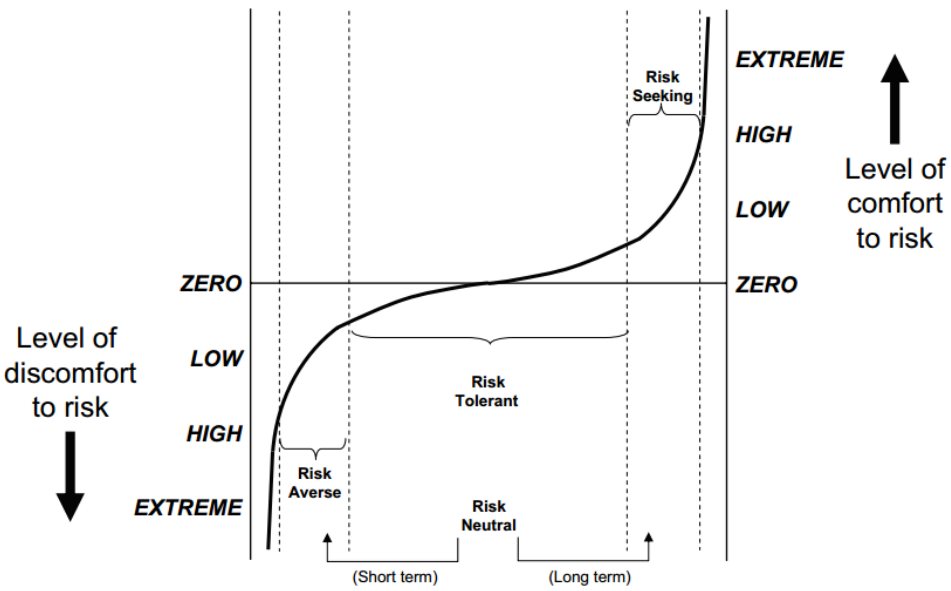


Figure 4.4 Level of discomfort to risk averse, neutral and seeking (Source: (Murray-Webster and Hillson, 2008).

Figure 4.4 shows risk attitudes with risk neutral added to them. According to Murray-Webster and Hillson, (2008), a ***risk-neutral*** attitude sees present risk-taking as a price worth paying for future pay-offs. Risk-neutral individuals and groups are neither risk-averse nor risk-seeking, but rather seek strategies and tactics that have high future pay-offs. They think abstractly and creatively and envisage possibilities, enjoying ideas and not being afraid of change or the unknown. For both threats and opportunities this risk-neutral approach is quite mature, focusing on the longer term and only taking action when it is likely to lead to significant benefits

It can be seen that individuals and groups that adopt risk neutral as an attitude are very close to those that adopting risk averse as an attitude for short-term objectives. However, when it comes to long-term objectives, risk neutral individuals and groups adopt risk seeking attitude. They want to ensure that the risk to any activity they are undertaking is analysed and managed appropriately to the lowest level; mitigating the risk as much as they can. They also want to ensure not to miss opportunities. That is why this attitude is favourable in construction industry as well as other industries that are dynamic and vibrant, yet it strives for stable and calculated progress in delivering projects.

There are several factors that influence risk attitude adopted by an individual or group. Hillson and Wevster (2007) believed that risk attitude is influenced by level of relevant skills or knowledge, perceived probability and impact, degree of perceived control, temporal proximity of risk and potential for direct consequence. These factors are proactive factors that require action to be taken once a risk was identified. Adopting tolerance as an attitude means leaving the situation as exposed as it is, the factor that is less favourable especially in construction (Loosemore, 2013). This leads to considering risk adverse, risk neutral and risk seeker to be the most commonly adopted types of attitudes towards risk.

4.8 Risk-taking behaviour

The risk-taking activity of individuals and companies entails the deliberation processes that show their risk acceptability. According to Isaac and James

(2000), presently, the risk acceptability differences amongst individuals and/or companies are due to the fact that what is only deemed acceptable to the individual and/or company is frequently defined after careful consideration and evaluation of their actual status with that which is required (Rasmussen, 1987). As such, risk taking behaviour may be regarded as the degree of individual behaviours to engage in future objectives whether they are seeking an opportunity or avoiding risks.

As a result, organisations employ structured risk management processes in realising organisational objectives whilst individuals use unstructured cognitive processes to achieve desired results.

Figure 4.5 demonstrates the way the subjective perception of risk varies between people.

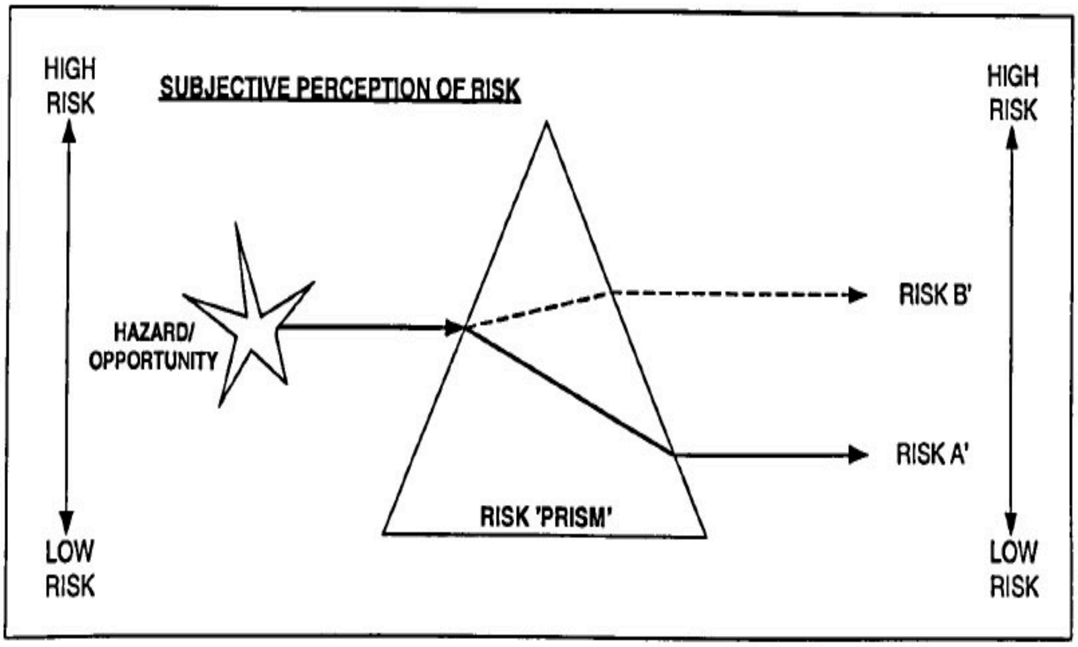


Figure 4.5 Subjective perception of risk.
(Source: Greene, 2002)

It also explains how individual characteristics such as; propensity, experience, problem understanding, preferences and perception, interact together and formulate their risk attitude and cause the uncertain decision maker to come up with a personal inference of the decision domain which reflect their risk taking behaviour. This personal interpretation may not be in line and may be against the organisation's perception of the risk or opportunity as dictated by the objectivity suggested by the structures risk management approaches of the organisation. The self-interpretations of two different individuals are named as Risk A' and B'. These views are assessed against subjective benchmark as low or high risk in relation to the individuals. They are assessed by measuring the likely occurrence against the desirability of the potential consequence; their association is proved as risk taking behaviour.

The definition of risk-taking provided by Weber and Milliman (1997) is the decisions for which skill and information are assumed to reduce uncertainty and influence outcomes. A number of previously cited definitions of risk are applicable similarly to risk-taking behaviour stressing the consequential relationship between behaviour and risk; according to March and Shapira (1990); Glendon (1987) and Beck, (1986). According to Vlek and Stallen, (1980), there are three elements that are influencing individuals and determining their risk-taking behaviour, which commonly known as risk perception, propensity and preference. The 'acceptance' as a potential fourth element was included in the risk preference as they define the similar end condition for example, what is acceptable is incorporated in the individual's preference. As viewed by Sitkin and Pablo (1992) and Sitkin and Weingart (1995), and displayed in Figure 4.5, both risk propensity and perception are regarded as filters through which situational determinants are perceived. Despite the fact that risk preference is excluded in Figure 4.5, 'risk taking behaviour' can still be taken into consideration.

4.9 Decisions over time

Regardless of the future plan whether it relates to health, wealth, affection or education, the final outcomes from the decision made are always unknown and will normally require long time to happen. Besides, as mentioned by Yeung and Morris (2001), individuals are inclined to put more emphasis upon the potential severity of the consequences than they usually focus on the probabilities under such unclear circumstances.

Two of the most important attributes in almost all decisions are time and probability. As mentioned by Baucells and Heukamp (2012), decision makers face a trade-off between an immediate and/or certain reward and a delayed and/or uncertain reward. Several researchers have identified the parallelism between the role of uncertainty and time in decision making (Rotter, 1954; Prelec and Loewenstein, 1991; Quiggin and Horowitz, 1995; Mischel and Grusec, 1967). As stated by Trope et al. (2007), both time and risk put distance between the decision makers and the outcome.

Some authors such as D'Alessio et al. (2003), Nuttin (2014) and Zimbardo and Boyd (1999) arrived to a conclusion that people frequently use, as part of their reasoning in making decision, time perspectives that divide their experiences into present and future temporal frames. Several people demonstrate a strong alignment towards one of the time frames. In the existence of such alignment, Zimbardo and Boyd (1999), suggest that it may function as a cognitive bias that affects judgment and decision-making.

For instance, as described by (Strathman et al., 1994; Zimbardo and Boyd, 1999), a person with a strong present temporal frame orientation will be inclined to give emphasis on current components within decision alternatives, such as convenience and the instantaneous result. On the contrary, individual with a strong future frame orientation tends to centre his attention to prospective long-term results and is prepared to sacrifice current rewards in achieving preferred forthcoming state (Boniwell and Zimbardo, 2004; Strathman et al., 1994; Zimbardo and Boyd, 1999; Trommsdorff, 1983).

4.10 Projects and time

Time is regarded as a key element in studies of project and it is placed at the centre of how projects are defined. In accordance with Bengtsson et al. (2009), the time dimension in projects involves wider scope than the typical dimensions of duration (commencement and completion) or scheduling (mile-stones). The complexity surrounding projects mostly shoots from aspects that are associated with time for example sequence (dependencies overtime), period (long-term perspective or short-term), organisation (the need to undertake various activities concurrently), and the rate or pace (relaxed or demanding and intense).

As quoted by Engwall and Svensson (2004), projects are not stable objects, but rather evolve over time. This shows that the time required from the project commencement to completion ought to be perceived as a change process or a series of undertakings evolving over time with a number of complex time - and space-related characteristics (Lundin and Söderholm, 1995).

According to Engwall and Svensson (2004), it cannot be presumed that all knowledge is readily available for projects particularly product development related projects at the commencement of the project and that learning and knowledge are improving as the project runs its course.

Based on definition, projects are unique and future states knowledge is inadequate. Project managers realise that there is always new knowledge acquired at each phase of a project and up to-date, practical project management is necessary to re-evaluate project plans, to think of new possibilities, to make revision to plans and to execute changes. It is usual that the uncertainty of the project decreases with time as additional knowledge is gradually discovered. Taking this into account, it explains the necessity of considering the time as an isolated factor in projects environment and how uncertainty and inadequate knowledge evolves over time, and most importantly the extent to which it influences professionals current decisions

4.11 Planning in connection with time dimension

Clearly, planning is an essential step within the risk management process and decision-making. The planning procedure includes a systematic and organised technical evaluation that is used as an introduction to decision making thus making the decision makers wary of the important considerations surrounding a final judgement.

According to Kerzner (2013), planning can broadly be defined as the process of selecting the enterprise objective and establishing the policies, processes and programs required to achieving them. Within an environment of a project, planning can be defined as setting up a prearranged procedure in an anticipated environment. The needs of the project determine the key milestones. Should the managers are of the opinion that the milestones are unachievable and impractical; alternatives ought to be established by the project managers.

Planning is considered a non-stop process in making business decisions bearing in mind the future requirements and at the same time making necessary arrangement required to perform the decision making. For individual planning window, planners could assess the anticipated level of risk for each work crew following by either reorganise the work to dodge any specific peaks of risk level or, if they are inevitable, strategies for suitable alternative measures to be undertaken (Rosenfeld et al., 2006).

It is necessarily to take into account that, planners in any project are individuals who are influenced differently by their perceptions and responses to future anticipated risk events. Therefore, it is essential for project managers to pay attention to the aspect of time dimension.

4.12 Time perception in scheduling projects

In accordance with time, scheduling and sequencing is related to the ideal allocation of limited resources over time (Herroelen and Leus, 2005). Scheduling outlines the appropriate activities that should be conducted at any specific time whilst sequencing deals with the order in which these actions ought to be undertaken.

As described by Antill and Woodhead (1982), scheduling is to determine the timing of the project operations and their incorporation into the whole duration of completion. It is necessary to have schedules to improve the likelihood that the project is completed within stipulated time and budget and with no disagreements (Callahan et al., 1992). As stated by Koski et al. (1995), scheduling is one of the key factors to facilitate in achieving more efficient production, improved quality and reduction in project duration.

An understood fact is that project activities are exposed to substantial uncertainty, which may result in multiple schedule disruptions during its implementation (Herroelen and Leus, 2004). This uncertainty may shoot from a few potential causes. As mentioned by Herroelen and Leus (2005), it is normal for activities to take longer or shorter duration than the original schedule, resources may become inaccessible, materials may be delivered later than planned, ready time and deadlines may have to be revised, new actions may have to be introduced or even some activities may have to be omitted as a result of revision in the scope of the project, severe weather conditions etc. that could interrupt the project delivery. Interrupted schedule may prove to be costly in view of the inability to meet dates and deadlines, resource idleness, higher work-in-progress inventory and increased system anxiety due to repeated revision in rescheduling.

It is usual within projects that the duration for certain activities is uncertain especially at the beginning stage of the project, due to the absence of an adequate and formal estimations for the timeframe within which risk events should be mitigated and determining the last opportunity to mitigate them.

4.12.1 Activities

A project comprises a few activities or sometimes called jobs, operations or tasks. So as to satisfactorily perform the work, each activity ought to be processed in one of numerous modes where each mode characterises a discrete way in undertaking that particular activity (Kolisch and Padman, 2001). The mode decides the time required to complete each activity, measured in a few periods which indicate the time taken to complete the activity, the requirements for resources of various categories, and possible cash inflows or outflows occurring at the start, during processing, or on completion of the activities.

4.12.2 Timing

The term “timing” can be explained as the moment or a specific point in time where an event or phenomenon, process, or part of a process begins or ends, or a time at which a specific data are being documented. Hence, it can be said that a process can be further broken down into sub-processes. As such, each sub-process has its own commencing and ending point. When a discussion evolves around frequency and pace, the commencing and ending times are immensely important. According to Lawrence et al. (1998), when it comes to timing dimension, it refers to a state and very much dependent upon people's perception. As such, Lawrence et al. (1998) stated that the idea of timing may be perceived differently and what one perceives as good timing may be viewed as bad timing by another. Though the idea of timing has been debated for a long time, yet the debate ensues and remains to be an unfathomable aspect of our life. Until now, the notion of timing has remain rather subjective and no common agreed theory has been accepted regarding what time is all about, how it works, or what kind of effect it has on business culture and the society at large (Quintens and Matthyssens, 2010). According to Adam (1998, pp.387), time can be defined as "Time is a synergy of aspects, a mixture of contradictory, yet supportive characteristics". In fact, the word 'time' illustrates a particular moment ("it is time to do something") besides the duration ("for some time").

4.12.3 Duration

The notion of duration can be explained as a form of measurement, for instance, how long a specific state lasts over time. According to George and Jones (2000), to capture the temporality of phenomena, the notion of duration can be used as one of the possible ways. When it comes to the notion of duration, there are two specific concepts that could be associated to it: time horizon and empty time. The time horizon is used to define duration as being in terms of its time length as long-term and short-term. Nevertheless, the ultimate question that will be raised is 'what is long-term and what is short-term'. Therefore, there is no defining or straight forward answer to this question as it entirely relies upon the process and context of each scenario. According to Das (1991), organisational effectiveness and strategic planning are very much determined by time horizon. Adding on to this concept, a time when nothing "noticeable" (worthy of being noticed by the observer in terms of events, occurrences or processes) occurs is termed as empty time. This term is very much part of many things, for example, the idle times in machines.

4.13 Temporal horizons of risk

According to Lopes (1996), it is generally agreed that time plays a vital part in risk and risk behaviour. In essence, risk and uncertainty are related to unknown futures and as such they are naturally implanted in time. Undeniably, time appears to hugely make difficult the complicated concept of risk. As described by Lopes (1987, pp.289), "the temporal element is what gives risk both savour and sting". Significant number of years have been spent by psychologists in trying to understand this temporal dimension (Shelley 1994). It has been noted by researchers that a few risk behaviours are time related. As mentioned by Vlek and Stallen (1980), one key finding is termed as discounting in time, which is the inclination of a person to assume risk when potential gains are comparatively immediate and potential losses are relatively in distant future.

Whilst the research findings above discuss the significance of time on risk, one should realise that time and temporal dimension have been sufficiently embedded into risk consideration. Kahneman and Tversky (1979), stated that the majority of the studies conducted on risk behaviour indirectly concern only short range risk, whereas the reality of risky decision usually discovered in the long range temporal horizon. As noted by a number of studies, this difference in time-spans may have a huge impact on how risks are valued or/and risks under consideration (Vlek and Stallen, 1980). As such, it is essential to clarify the specific temporal horizon of risky decision.

4.13.1 Short- range and Long-range risk

As broadly defined by Drucker (1972), short-range risk entails differences in outcomes in the near future, while long-range risk relates to differences in outcomes in the distant future. In other word, short-range risk behaviour concerns performing or evading actions that may cause outcomes to vary considerably in the near future ranging from massive gains to massive losses. On the other hand, the definition of long-range risk behaviour is performing or evading actions that may cause outcomes to vary considerably in the distant future. As such, when decisions are made that tend to cause severe outcomes in the distant future, they are involved in long-range risk behaviour either low-risk or high-risk (Das and Teng, 1997).

Milburn (1978) tested people's bias in the prediction of future events. It was discovered that in the beginning, negative events were seen more likely than positive events, while the relationship was reversed in the prediction of events farther into the future. This finding appears to suggest that majority of people are more able to recognise downside risk in the future. Further, it has been discovered that the views of future time dimension is different from individuals with regards to the relative cognitive dominance of near-term future and distant future (Das, 1991).

4.14 The time perspective construct

Some individuals have the ability to predict the future consequences resulted from their current behaviour. They understand how their present task engagement is usefully related to desired future targets and how their current behaviour helps to achieve future targets. Some would prefer to live in the present as they do not predict as strongly the future repercussions out of their current actions. The ability of people to look into the future and therefore the importance of their current behaviour varies from one individual to another. As stated by Lens (1986) and Nuttin (2014) the motivational importance of those differences in length or depth of future time perspective.

Nuttin (1964) and Zimbardo and Boyd (1999) defined time perspective as the process whereby individuals automatically divide the flow of their personal experiences into psychological time frames of present and future. Lewin (1948) mentioned that a future orientation is defined mainly by targets and inclination to associate immediate choices with more distance objectives. A current orientation emphasizes more on immediate events in themselves and eliminated concern for, or interest in future consequences. According to Karniol and Ross (1996), there is a volitional part to time perspective, in a way that people have the option to choose the time perspective that best meets present objectives. For instance, parents who opt to spend quality time entertaining their offspring may deliberately become present-oriented; subsequently later assume a future-oriented mind-set as they deliberate their children's educational plans. As mentioned by Levine (1997) and Lewin (1948) time perspective can be moulded by situations. For example, a birthday celebration may raise future orientation while a seminar on personal development tends to induce future orientation.

Nevertheless, unique time perspectives may also reflect enduring individual variances (Karniol and Ross, 1996; Nuttin, 2014; Strathman et al.,1994; Trommsdorff and Lamm, 1975; Zimbardo and Boyd, 1999). As stated by Levine (1997), Lewin (1951) and Teahan (1958), social class, way of life, education, belief, family models, and employment may influence a person's orientation toward the present or the future. Undeniably, investigators of time perspective have recognised types of time perspective which relate to these temporal categories. Based on findings by Kastenbaum (1961) and Strathman et al., (1994), individuals with a future-oriented mind is a person whose decisions at any given moment are essentially influenced by abstract mental representations of future consequences and concerns for responsibility, liability, gains, and damages.

Due to the inclination and appreciation to the long-term and future outcomes, people with future-oriented minds have better ability to battle enticements of immediate gains which may distract them from their long-term goals. In accordance with Baumeister (1990), Zimbardo and Boyd (1999) and Zimbardo et al., (1997), in contrast, people with present-oriented minds attend more to the concrete reality of the immediate present. As such, these individuals are less expected to consider potential costs and consequences, or to contemplate on past actions and the importance of past experience, when involved in a decision or action moment.

To conclude, time perspective forecasts subjective definitions of the future. Harber et al. (2003) provided future-oriented and present-oriented participants timelines which involved yearly increments until the year 2060. Participants were requested to show the years at which the "near future" and the "remote future" started on these timelines. As indicated in the timeline data, compared to the present-oriented participants, the future-oriented participants foresee both the present and the future further out in time, as one would have anticipated. These outcomes indicate that people with future-oriented minds can view further out in time than the opposite counterpart and as such, they ought to realise equivalent benefits with regards to future planning.

4.15 Future and present time orientation

According to Cottle (1976) and Fraisse (1963), the flow of time has a significant influence on individuals' inclination towards time. For example, one's orientations towards the future, have the tendency to change with respect to the relative cognitive dominance of the present against the near future. This terminology is known as individual 'future time perspective'. With this attribute of the individual future time perspective, one can deduce the likely impact of the planning actors upon their preferences, for example, precise time horizons for various strategic planning areas. Undoubtedly, this impact is subdued and given the 'unobtrusive' character of time. In the case of a specific time perspective, this subjective orientation to the future (the true realm of strategic planning) would tend to affect one's overall view of how things are going to take place in time. A person's overall interpretation of the nature of future time may possibly limit choices about such time-related aspects as planning cycles or planning horizons.

Powell (1992) stated that the relevance of the temporal perspective of planning actors has been clearly proven. In particular, it has been demonstrated that there seems to be a noteworthy contingent relationship between near and distant future time perspectives on the one aspect and short and long planning horizons on the other. The short-term impact with regards to strategic planning is that should this be right, only a certain executive type which is the ones with distant future time perspective would be appropriate to making the longer period planning decisions subject to a satisfactory appreciation of time passage in the long-term future. On the other hand, it is possible that the decision maker with a shorter future time perspective, when asked to plan for long-term, would be just extrapolating whatever short- term visualizations he or she is capable of. Regrettably, these routine extrapolations (usually in the inadvertently fake garb of value judgements about the expected future scenarios) happen which are not openly apparent in typical planning exercise. This is due to the fact that it is not straight forward to identify appropriate parameters which govern the subjectively made forecasts and goal-setting by individual planning actors. In the practice of management however, it is essential to be mindful that particular planning actors, with relevant time perspectives, are more appropriate as compared to others for various planning phases.

4.16 Phenomenological perspective on time

Conceivably, the most important factor why time ought to be regarded as key element instead of a boundary condition is that time, or temporality, is an inherent characteristic of consciousness. In other words, the stream of consciousness is organised temporally, and all conscious and motivated information processing occurs within the flow of time (Schutz, 1967). Significant to all phenomenological debates regarding time that clarify the importance of time in constructing useful experience and the reality of daily life is the difference between inner time and standard time as described by Berger and Luckmann (1966, pp.40): “Every individual is conscious of an inner flow of time, which in turn is founded on the physiological rhythms of the organism though it is not identical with these however, the world of everyday life also has its own standard time which is inter-subjectively available. This normal time may be perceived as the intersection between cosmic time and its socially established calendar.”

Considering the perception of the society which put greater emphasis on standard time, it is not surprising that standard or clock time has developed to be the leading orientation toward time in the organisational literature, in the case that time is actually considered at all (Bluedorn and Denhardt, 1988; McGrath and Rotchford, 1983). Nonetheless, as mentioned above, the manner in which time is experienced is phenomenologically different from standard time.

As stated by Strathman et al. (1994), in consideration of future consequences (CFC), individual differences reveal ‘‘the extent to which people consider the potential distant outcomes of their current behaviours and the extent to which they are influenced by these potential outcomes’’.

4.17 The time dimension of risk

Time is considered as a key constraint on projects and can adversely affect the time required to understand the issue and in search for solution. In addition, the chances that majority of outcomes to be eliminated are great, for example, if there is 70 per cent probability of an identified risk event that can be resolved immediately, the probability of an identified risk event nine months down the line should also be looked at. The unexpected outcome is that the time passage can cause other outcome to develop that may not be possible to forecast at current time. Also, these outcomes are expected to reduce the chances of the outcomes that have been forecasted to happen. Nine months later, the outcome may not be applicable any longer.

The nearer the event becomes the more reliable prediction can be made while the further events in the future have less reliable forecast. As every risk event occurs at a certain time during the course of the project, the time during which the risk is experienced can be known. On the other hand, moving unavoidable events may cause alteration to the nature of the risk. As an example, during the construction phase, the magnitude of risk varies all the time and exposed to a number of threats at every interval of time. By obtaining latest information, the indeterminate future will gradually be confirmed. Typically, managers are not rigid in handling the preliminary operating strategy implemented for the project to reduce the probability of risk or manage the exposure to risk.

So as to predict time dimension of most expected risks, managers have a duty to make use of the readily available information concerning prevailing environmental conditions, construction undertakings, labour force and all related items of the project. Advanced information of the likely origin of various risks levels will assist managers to handle the risks in a proper manner and perform risk levelling by avoiding, mitigating, controlling or mentoring the risk.

The allocated contingencies (money) allowed to cover potential risks can be minimised by putting more emphasis and prediction of the time dimension of risk by the decision makers. If not spent, the same amount can be re-utilised for as many times as possible during project life cycle determined risk's time to another determined risk's time. Furthermore, giving more attention upon the factor of time in predicting risk event may assist in determining the magnitude of risk and the importance of each expected event.

Taking into consideration of those, and as mentioned by Aldaiyat et al. (2014), ***Risk has a time dimension*** that can be described as **"the time between a decision on risk and the last opportunity to mitigate it"*.*** Within the context of risk management, this terminology is known as timeframe.

This can also be defined as the 'Point of No Return' or the Spontaneous Reactions when it becomes impossible to mitigate although there would be risk consciousness.

The proposed concept of risk time dimension in this thesis is illustrated in Figure 4.6 showing the philosophy behind risk time dimension, from the phase of risk identification until the time where risk become apparent, followed by mathematical equations to demonstrate the expected concept of risk time dimension.

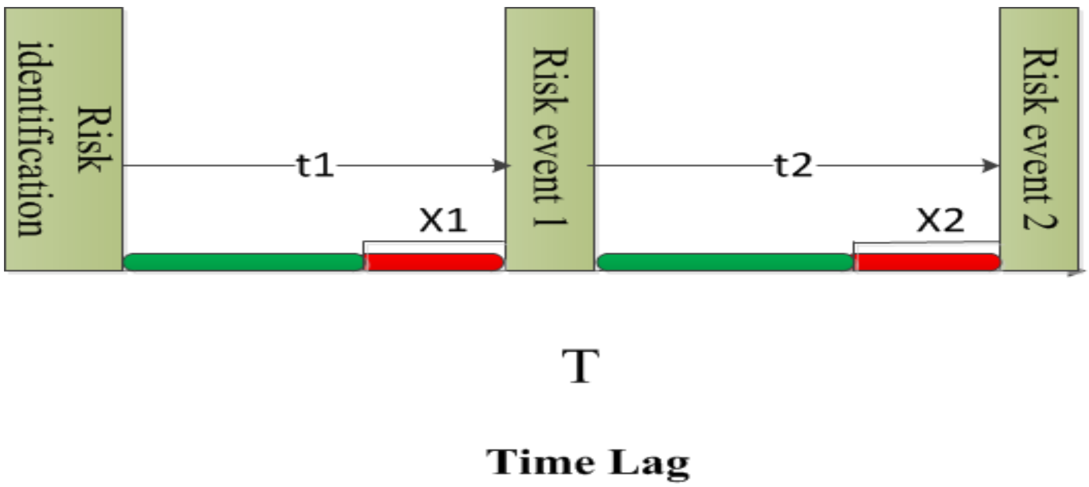


Figure 4.6 The proposed Concept of Risk time dimension

$$\boldsymbol{R_T} = \frac{\boldsymbol{t_n - x_n}}{\boldsymbol{Total\ Duration}} \qquad (1)$$

Where R_t stands for Risk time dimension.

$t_n > 0$ Indicates to the time left to the risk event occurrence.

x_n Indicates to the minimum required time for the risk event to be mitigated. From Figure 4.6 an equation can be formulated for the risk time dimension as following.

The current equation to calculate risk exposure according to Carter et al., (1994) is

Risk (R) = probability (P) × Impact (I) (2)

The proposed equation in this thesis is an emerged equation for prioritising risk events according to their time dimension which, was derived from the current known equation for the risk exposure (see appendix D) for more illustrations.

$$\mathbf{R}_{Prioritisation} = \frac{P\ .\ I}{R_t} \quad (3)$$

In cases where two forecasted events (R1, R2) both with the same impact and probability, supposing that event R1 is within two months of the present time while event R2 is likely to occur in five months' time, what would then be the risk priority of both events? Usually, both risks events will be viewed and handled in the same manner. Nonetheless, by taking into account risk time dimension factor into the equation, both risks events should not be viewed and treated in the same way as the priority of both risk events are not the same.

The following analysis will show the difference between the risk priority in both R1 and R2.

Assuming R1 has a probability of 0.4 and 3,500 impacts.

The priority for risk for R1 is = $\frac{0.4\ x\ 3{,}500}{2}$ = 700

Assuming R2 has a probability of 0.4 and 3,500 impacts.

The priority of risk for R2 is = $\frac{0.4\ x\ 3{,}500}{5}$ = 280

Both R1 and R2 have similar impact and probability. Yet, the priority of risk in the two events is different. As clearly shown, the priority from risk R1 is the greatest as such it should be more important to decide the risk response. Risk R2 on the other hand is more flexible and has more time in planning the appropriate mitigation measures to manage it or even to potentially eliminate it totally.

It is undeniably true that ignoring time dimension can lead to project failure. Prediction of the future is basically an indefinite process. A few occurrences that require describing or forecasting include some sort of risks within them. In the risk management analysis, preparation of inventory and performing forecasting are some of the essential processes. As stated by Pender (2001), probability analysis is not normally useful as the range of future states varies at each point in time, as additional knowledge is discovered.

Different people rely in different sources of information when they are making their own decisions. It is essential to be aware of the types of information that are required and not to be over influenced by them in order to perform rationalised decisions. In construction projects professionals have to deal with substantial amount of information in order to make decision. On the other hand, the nature of the available information should have some influence on individuals' decisions and the degree of its influence is different from one to another.

Understanding the nature and the characteristics of the time dimension of risk as well as the common sources of information required in estimating it and the degree of risk time dimension influencing professionals' decisions should help professionals to enhance their awareness on their performed decisions and ultimately that would improve risk management in construction.

4.18 Summary

As concept, the review has shown that the time dimension of risk provides a potential solution to fill the gap that links individuals' perceptions to the current practice of risk management. Individuals such as professionals in construction projects arrive at their decisions with influences from many different factors. With the outcome of their decisions one of the most common risk attitudes (namely; risk-averse, neutral, risk-seeker).

The importance of time in the implementation of the project especially during the stages of planning, scheduling, and execution explained the necessity of providing clarity and considering time as a key influential factor in the process of implementing risk management in construction.

The review has also established that individuals perceive time differently. Risk attitudes govern the way individuals respond to risk events, which in turn are determined by factors such as personality, characteristics, experience, awareness, risk attitude classifications. The variation in these factors account for why individuals respond to the same situation differently. Furthermore, the review has established that differences in forecasting abilities of individuals for near and distant future events could be the essential reason accounting for variation in their time orientation.

The next chapter addresses the research strategy, adopted methods, interviews and questionnaire design, sample selection and data collection process, as well as the statistical and mathematical analysis methods adopted for the study.

Chapter 5: Research Methodology

5.1 Overview

This chapter provides a detailed description of the research concept and research design used, the philosophical assumptions made, and the research strategies employed in this research in order to achieve its aim and objectives. It also explains the sampling method adopted, and the data collection process used, which included exploratory interviews and questionnaires. This chapter provides a detailed description of the data analyses process, reliability and validity tests applied in this research. Finally, this chapter describes the design and development of the assessment matrix.

5.2 Research concept

The time dimension of risk in construction is somehow considered to be subsumed within the assigned probability of risk events and/or project activities. Moreover, due to the absence of a formal and uniform attention to the time dimension of risk, professionals are currently performing decisions related to risk in construction are considering the time dimension of risk differently according to their level of awareness. On the other hand, the influence of risk time dimension on professionals' performed decisions is varying, due to their different risk attitudes, perceptions, personalities and characteristics.

The separation of the time dimension of risk within the process of risk management becomes a necessity in order to give the opportunity for professionals to pay an adequate attention by formally estimate the time dimension of risk which consequently should enhance their performed decisions. However, in order to separate the time dimension of risk it is essential to develop an assessment tool that can capture professionals' perception eccentricities in the time dimension of risk and this includes their tendency in performing related decisions along with their awareness of the time dimension of risk.

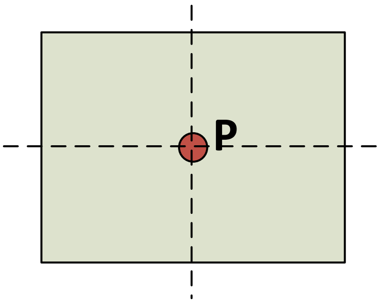
5.2.1. Theoretical foundation

According to the Oxford dictionaries, the word eccentricity is associated with the social behaviour of individuals and describes *'a person of unconventional and slightly strange views or behaviour', in essence a deviation from the norm*. The word can also be defined technically as *'not centred on the same point of another'.* This second use of the word eccentricity derives from engineering and provides a foundation for making explicit the effect of the conceptual mis-alignment between a risk stimulus and a response by the decision maker. In this regard, the notion of eccentricity is derived from the design of compression elements in structural engineering and the underlying principles are adopted and applied to the management of risk.

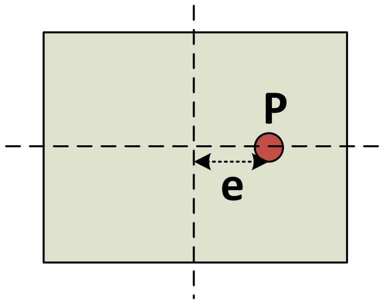
In the design of an ideal column under axial loading, the member remains straight until the critical load $\boldsymbol{P_{critical}}$ is reached, beyond which material failure results. Equation 5.1 defines the maximum stress that informs the designer's adopted solution.

$\sigma_{max} = P/A$	Eq 5.1
Where: σ_{max} is the maximum design stress P is the equivalent load A is the required sectional area for the maximum design load	

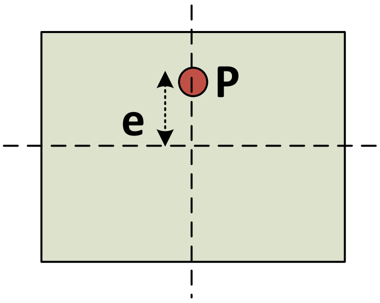
Figure 5.1a illustrates the section of the column under ideal or concentric loading conditions. In practice however, the loading condition is often not concentric, but reflects a deviation along the major or minor axis and causing uniaxial flexure as depicted in Figures 5.1b and c. Alternatively, the deviation could be offset from either axis, leading biaxial flexure as depicted in Figure 5.1d. If the axial load is applied with eccentricity, depicted as e in Figure 5, the column is subjected to moment and needs more flexural strengths.



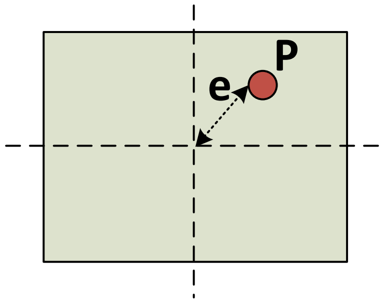
a. Section with concentric load - no flexure (ideal case)



b. Section with eccentric load - uniaxial flexure



c. Section with eccentric load causing uniaxial flexure



d. Section with eccentric load - biaxial flexure

Figure 5.1 Different states of loading and design implications for columns

When the bending moment increases, its axial load strength decreases. The relation between axial strength and bending strength varies according to eccentricity, as well as the material properties. So, for the same material the response in terms of design solution will be affected by the magnitude of the eccentricity. Equation 5.2 illustrates the adjustment that need to be made as a consequence of the flexure caused by the eccentricity.

$\sigma_{\max} = \sigma_{concentric} + \sigma_{flexure}$	Eq. 5.2
Where: σ_{max} is the effective stress to be designed for, $\sigma_{concentric}$ is the stress arising from concentric loading $\sigma_{flexure}$ is the stress from flexure as a due to the eccentric loading.	

5.2.2. Adaption of eccentricity theory to risk management

In the management of risk, the risk event itself (or notional risk) often can be represented by the axial loading. The attitudes and associated perception of the individuals making the decisions reflect the flexural influence (or attendant risk) and needs to be accounted for in order to establish the nature of mitigation that is required to complement the notional risk. This attendant risk is often ignored, and the derivation of risk level only addresses the notional component. Establishing the equivalent of eccentricities in the personal disposition of decision makers should enable the estimation of the magnitude of such attendant risk. It should also pave the way for establishing the required adjustment that has to be made for risk decisions exercised by construction professionals. As a first step, establishing whether such eccentricity exists among professionals need to be given due attention for the subsequent exploitation to be a possibility. Mapping such eccentricity on a matrix plane should facilitate the opportunity to determine how individual professionals influence normative risk decision. The investigation of the nature of eccentric among construction professionals and the development of a proposed matrix form the thrust of this thesis.

5.3 Research design

To achieve this purpose of the study, it is essential to select the right research methodology, which is dependent upon the research objectives and any resource constraints, for example time and funds. In terms of collecting relevant and reliable data, the selection of a methodology that is appropriate for the research objectives is of paramount importance.

Responding to different types of research questions requires a different approach, which is the research method. This method should be specially designed, such that the best possible outcome and most accurate answers to the research question being pursued can be provided.

In order to achieve the aim of this research, two sets of data collection complementing each other were necessary. First, the data gathering exercise commenced with a preliminary investigation to explore the pre-existence of time dimension of risk among construction professionals. This phase of the investigation also addressed wider risk-related themes including the current consideration, current methods of setting-up mitigation plan of period, current mitigation approaches and professionals predications on their risk capabilities. Second, the results of the preliminary investigation paved the way and served as a foundation for a further investigation in order to contextualise the nature and characterise the parameters and boundaries of time dimension of risk.

The outcomes from both investigations provided a basis for the development of an assessment matrix for representing the level of professionals' awareness of time dimension of risk and to explore the existence and nature of eccentricities that characterise executive risk decisions in construction. Normalised forms of the matrix could provide the basis for classifying risk decisions and possible moderation factors (eccentricities to correspond to attendant risk) in accordance with the common risk attitude classifications. Figure 5.2 summaries the research concept.

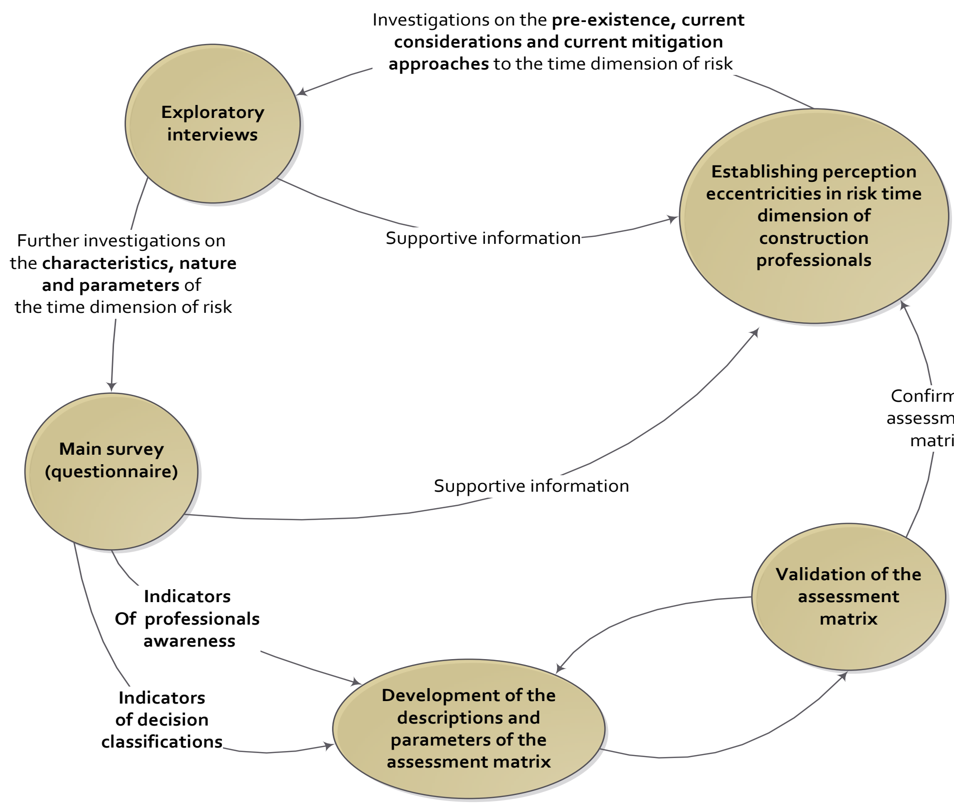


Figure 5.2 Research concept

A research design is not merely a plan of work. Typically, a work plan outlines the items or tasks required to complete a project; however, the work plan starts with the research design. The research design aims to ensure that the collected evidence enables the researcher to respond to the research question as explicitly as possible. Collecting the required evidence involves first identifying the type of evidence required to address the research question, to assess a theory, to appraise a programme, or to precisely define some phenomenon. Nevertheless, research design is greatly influenced by the relevant philosophical thought, and the research methods that have been widely or predominantly used in that discipline. As explained by Neuman (2006), research can be defined as an in-depth study of an issue or event that requires a systematic procedure, and planned effort towards achieving a solution. Leedy and Ormrod (2005) defined research as a process that makes one appreciate the systematic operations of collecting, examining, analysing, and explaining data to make a research case. The systematic procedure adopted for this study is set out in the next sub-section.

5.3.1 Key steps for delivering the research

In response to the aim and objectives of this research, the following steps were pursued to ensure a consistent procedure for arriving at the essential answer to the principal question posed at the start of the study.

- A comprehensive and critical review of essential literature
    - This was directed at characterising the nature and context of project delivery in the State of Kuwait, along with the essential capabilities for managing construction-related risk.
    - The review also explored essential theories and fundamental principles associated with the current and established notions of risk and its management in/outside construction.
    - The review was also directed at establishing the different perceptions of time and risk within various disciplines and industries.

- Empirical work
  - To investigate and establish the scale of awareness on the part of key decision-makers in construction industry of the time dimension of risk, in order to develop a common risk perception classification.
- Assessment matrix development and validation
  - To develop an assessment tool that identifies polarity in practitioners' decisions regarding the time dimension of risk in accordance with the common risk perception classification.
  - Tested and validated the assessment tool for the construction risk management.

For the develop phase of this study, the purpose was to develop a method that would help to contextualise and capture the full picture of the deviation in individuals' perceptions of the time dimension of risk in the context of risk management practices in construction projects. This tool helps to categorise the decisions made by professionals according to common risk attitude classifications. Evidently, there are gaps in associating individuals' perceptions of time and risk to the current practice of risk management. As such, an exploratory study with professionals involved in the delivery of construction projects within the state of Kuwait was required in the early stages of this research. This was primarily to identify the current level of awareness, and the various techniques, applications, and understandings of the time dimension of risk prevalent amongst professionals. This phase of the investigation was addressed by a thorough investigation with an instrument that emerged from the review. It explored and established the current risk management landscape in construction, and contextualised the characteristics of time dimension of risk.

Research as an activity of enquiry to establish new knowledge often involves a dynamic process, made up of many steps usually defined by the questions posed at the start of the study., The research questions pursued in this study were formulated following an in-depth literature review and exploratory interviews. Figure 5.3 shows the steps taken in this research in order to respond to the research questions and to achieve the research aim.

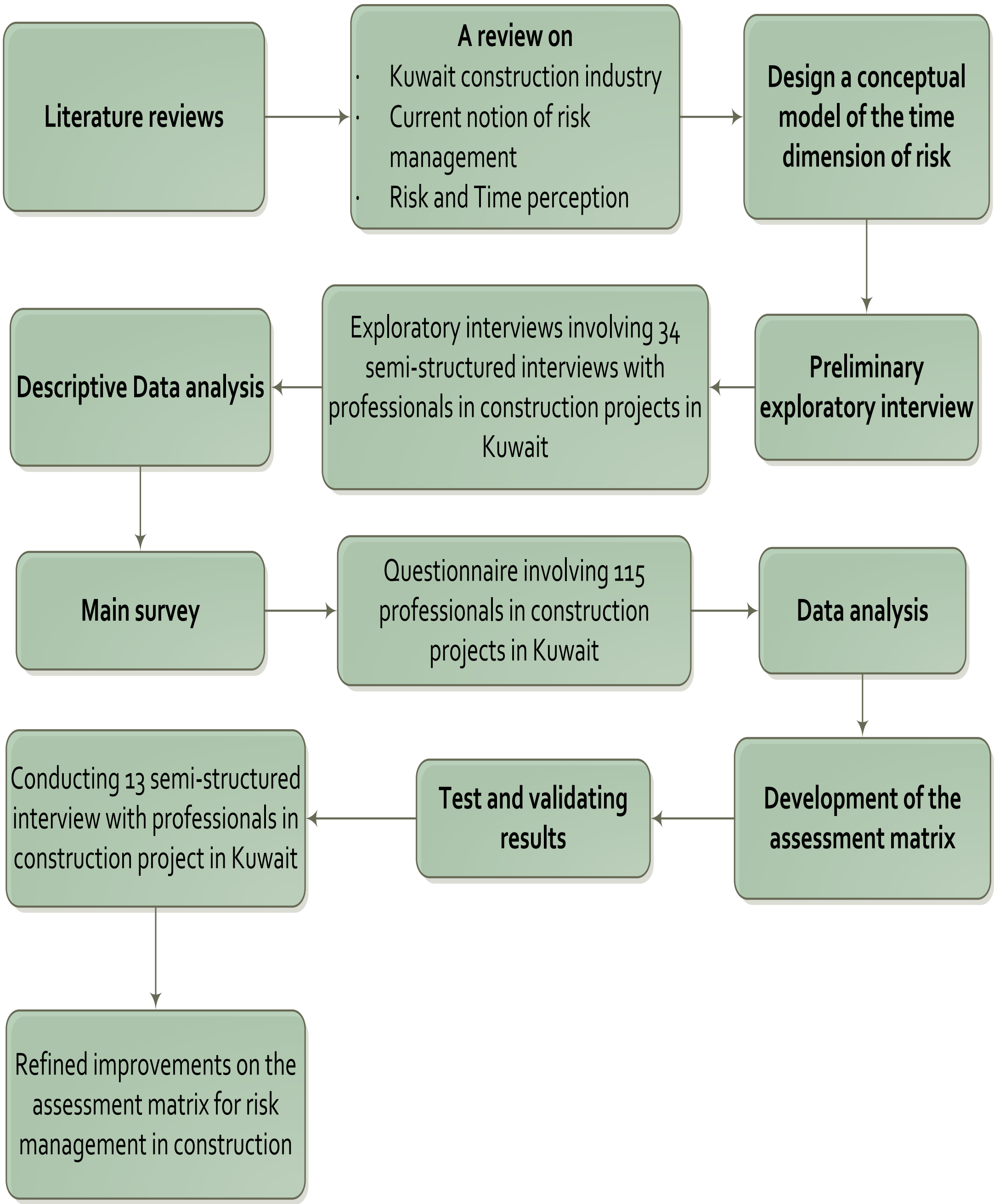


Figure 5.3 The actual research process

5.4 Philosophical consideration

In order to have a clear direction toward achieving the intended results, it is of paramount importance to address philosophical paradigms in the early stages of a research study. According to Creswell (2009), in practice, research is underpinned by certain philosophical concepts, even though these remain in the background. Easterby-Smith et al. (2012) gave three reasons to explain why it is useful to understand the different philosophical paradigms that can inform research; which are the following.

1) It assists in clarifying the research design and offer answers to research questions.
2) It identifies suitable designs and constraints on a specific technique.
3) It helps to shape research design according to the constraints on various knowledge foundations or disciplines.

According to Slife and Williams (1995), a philosophical worldview helps to shape the research strategy and thus, influences the research practice. Furthermore, such a philosophy takes cognisance of and generally enables the researcher to identify and confront their personal biases and preferences in constructing new knowledge. Guba (1990, pp.17) defined the term worldview as, “a basic set of beliefs that guide action.” As described by Creswell (2009), there are four main categories of philosophical worldview, namely: post-positivism, constructivism, advocacy and pragmatism. A brief description of these four categories is provided below, and their characteristic features regarding the essential aspects of research given in Table 5.1.

Post-positivism, is frequently linked to quantitative approaches. According to Slife and Williams (1995), researchers claim for knowledge on the grounds of (1) determinism or cause-and-effect thinking; (2) reductionism, by narrowing and emphasising on chosen variables to correlate; (3) detailed observations and measures of variables: and (4) the testing of theories that are constantly refined.

Constructivism, usually connected to qualitative approaches, works from diverse perspectives. The perception or denotation of phenomena, moulded through participants and their independent views, constitutes this perspective or worldview. When participants view their opinions, they express from denotations moulded by social interaction with others as well as their own personal experiences. On the basis of inquiry; research is designed ‘’from the bottom up’ ’from individual’s perspectives to wider profiles and eventually to broad and comprehensive understandings.

Advocacy/ Participatory, worldviews are susceptible to political apprehensions, and this viewpoint is frequently linked to qualitative than quantitative approaches, however this link is not always there. These views illustrate the need to improve our society and the inhabitants. Topics for instance empowerment, marginalisation, hegemony, patriarchy, and others which can influence marginalised groups should be given consideration, and at the same time researcher's work together with those who have gone through this unfairness. Ultimately, researcher involved will aim for the social world to be transformed for the better, in order for the individuals to feel less marginalised.

Pragmatism is usually linked to mixed methods research. The emphasis is on the significances of the research, on the main significance of the question asked instead of the approach, as well as utilising several approaches of data collection to apprise the issue of concerned. Therefore, it is diverse and geared towards ''what works'' and eventually the adoption of an appropriate practice.

Table 5.1 Four major philosophical worldview. (Source: Grimstad, 2013)

Research Paradigm	Epistemology - Philosophical assumption on what constitutes knowledge	Research/ Researcher approach	Strategy of inquiry	Strategy of researcher	Method of data collection
Post-positive Positive Determination Empiricists scientific Method	Knowledge is: positive data, i.e., Facts that can be measured, verified and replicated Assumes that science can objectively measure the world, Theory is tested through measurement and deduction	Quantitative "measure /verifier"	Reductionist in that it reduces the ideas into small sets that can be tested against theory	Researcher is an objective/ neutral observer. Events happen uninterrupted by researcher	Surveys experiments predetermined instruments statistical analysis
Constructionist multiple meanings social and Historical Construction Theory generation	Knowledge is: socially or historically constructed from meanings of reality by individuals or groups. Assumes that sciences can uncover constructed meaning through observation and induced understanding/theory	Qualitative "observer/ Meaning-Making"	Inductive process theory is generated "afterwards" out of the data collected in the field	Researcher is subjectively involved with stakeholders to achieve a good understanding of their world	Ethnographies Grounded theory Case study Phenomenology Narrative research
Advocacy/ Participative Critical theory Political transformative empowerment Issue-oriented Collaborative Change-oriented	Knowledge is: uncovering injustice and suggesting actions that would lead to social empowerment. Often focused on feminist, racial, queer and disability	Qualitative "Emancipator/Action oriented"	Inquiry is part of political agenda and should suggest action to improve the solution. Inquiry is practical collaborative and emancipatory	Researcher and participants are actively involved in creating awareness and implementing alternative	Action research Historical Contextualisation
Pragmatism/ Transformative paradigm Consequences of action problem centred Pluralistic Real-world practice oriented	Knowledge is: A combination of facts and words/meanings in order to solve problem. Combining inductive and deductive thinking measuring observing and developing new meanings	Mixed methods "Pragmatic problem-solver"	Inquiry in practical and pragmatic in that it uses the paradigms and methods that seem to best fit the problem researched	Researchers are pragmatic, uses many method to seek convergence or divergence of analysis outcome	Triangulation sequential procedures May use positivist and interpretivist methods, interviews survey, and text analysis.

During the initial stage of the research design, the pragmatic approach was adopted, because of the nature of enquires in this research, the investigations were divided into two stages;

First stage: an exploration of the pre-existing conceptions of the time dimension and this includes the current mitigation approaches and responses. Second stage: to use the outcome of the first investigation as a foundation for a further investigation in order to contextualise and characterise the time dimension of risk.

The pragmatic worldview has led to the selection of the mixed-methods strategy, which allowed the researcher to focus on the key issues and apply all applicable methods in order to collect all of the relevant information. The pragmatic worldview involves using different techniques at the same time or one after another. For instance, in this research the investigation started with face-to-face interviews with construction professionals in order to understand their perceptions to the dimension of risk and to explore the current existing concepts, approaches and understandings, then to use the findings to construct a questionnaire in order to establish the scale of professionals' awareness on the time dimension of risk.

According to Creswell (2009), the theoretical basis of research that is dictated by the characteristics of pragmatic worldview, is governed by:

- no restriction in the selection of suitable techniques and approaches in the related investigation;
- using a mixed methods approach (qualitative and quantitative method) to enhance the understanding of the research problem; and
- adopting various methods to collect and analyse research data.

The sample population under study in this research was focusing on individuals managing risk based upon their knowledge gained over a number of years. As the research was concerned with the perceptions of professionals, as human beings shaped by their social, historical, and political backgrounds, among factors, the pragmatic worldview was the most suitable approach for this study. This is because it provided the researcher with an opportunity to study *how* the time dimension of risk in construction projects was being considered and managed by professionals.

5.5 Research strategies

According to Knight and Ruddock (2008), construction management is a diverse industry that fascinates a great number of researchers who approach their research objective from diverse disciplinary and methodological viewpoints. Gould (2002) stated selecting a research methodology is not a simple task; it is a personal and reflective, but also laborious, rigorous, and difficult process. Personal appraisal of perceptions, beliefs and interests requires rational evaluation. As argued by Gould (2002), research is part of an overall process consisting of a number of different social elements. Knight and Ruddock (2008) defined the research strategy as the overall research process. Therefore, it is essential that construction management researchers understand the differences between natural and social sciences in order to produce better, and more comprehensive, results and explanations.

As mentioned by, Creswell (2013), Bryman (2012), Fellows and Liu (2009) and Blaxter et al. (2010), qualitative and quantitative research methods are still the mostly widely employed amongst social science researchers. Creswell (2013) explained that the two methods should not be regarded as contradicting each other; rather, they each offer distinct perspectives. Several authors have also claimed that there are discrepancies between the qualitative and quantitative research methods based on their epistemological backgrounds. Table 5.2 presents the differences between qualitative and quantitative research methods. The most obvious disparity is in regard to the nature of the data collected, and the technique employed to collect it. Using the qualitative method, data collection and analysis are carried out by means of “opinions and/or flexible questions” (i.e., conducting interviews). By contrast, a more structured approach, guided by statistics and/or quantitative hypotheses, is used in the quantitative method.

5.5.1 Quantitative

Typically, a quantitative research method includes carrying out with numerical data. A study was conducted by Creswell (2013) utilising a quantitative approach to investigate various magnitudes of objective notions by studying the correlations between the data collected (Bryman, 2012). Following data collection, in quantitative research, the information gathered is then measured and examined using sophisticated analytical tools to explain the ‘how’ and the ‘what’, followed by an assessment of the data reliability using statistical approaches (Easterby-Smith et al., 2012; Creswell, 2013). Usually in using the quantitative research method, the reliability of the data is closely linked to the scope and extent of the sample (usually on a large-scale) in defining the set of information. Blaxter et al. (2010) explained that quantitative research entails the gathering of ‘facts’, based on the assumption that numbers signify better accuracy, and thus the study arrives at a clearer conclusion. Furthermore, Coombes (2001) stated that the distinguishing feature of this technique is that the researcher remains objective and detached from the research process. Robson (2002) highlighted a number of explicit characteristics of the quantitative research approach, as follows.

i. Quantification represents the results of an enquiry by numerical and statistical data.

ii. The use of quantification for studying human activities is often limited to creating standard categories their verbal responses or physical actions.

iii. The quantitative or scientific technique is more suited to and thoroughly exploited for non-human investigations, such as in chemistry and physics experiments.

5.5.2 Qualitative

On the other hand, the qualitative method does not collect numerical data, and is considered to be empirical research which mostly concerned with, and strongly relates to, theory generation (Bryman, 2012). Studies that gather and examine non-numerical data are known as experimental studies (Baxter et al., 2010). According to Fellows and Liu (2009), the aim of qualitative studies is to better comprehend and understand social phenomena, and, according to Creswell (2013), to identify, and understand the distinct components of social issues. Moreover, Creswell contends that this method of research, which is inductive in style, focuses on an individual. In a similar vein, Robson (2002) argues that there are several other features of a qualitative study, namely: non-numerical data in the form of oral presentation, and an inductive reasoning in that underpins the collecting and analysing of data. Table 5.2, adapted from Bryman (2012) and Blaxter et al. (2010), shows the key differences between quantitative and qualitative methods that feature in construction management research.

Table 5.2 Differences between qualitative and quantitative research methods

(Adopted from Blaxter et al. (2010) and Bryman (2012))

Qualitative paradigm	Quantitative paradigm
Inductive: generation of theory	Deductive: testing of theory
Concerned with understanding behaviour from actor's own frames of reference	Seeks the facts/causes of social phenomena
Interpretivism	Natural science model, in particular positivism
Naturalistic and uncontrolled observation	Obstructive and controlled measurement
Constructionism and Subjective	Objectivism
Close to the data: the 'insider' perspective	Removed from the data: the 'outsider' perspective
Grounded, discovery oriented, exploratory, expansionist, descriptive, inductive	Ungrounded, verification oriented, reductionist, hypothetical-deductive
Process-oriented	Outcome-oriented
Valid: real, rich, deep data	Reliable: hard and replicable data
Un-generalisable: single case studies	Generalisable: multiple case studies
Holistic	Particularistic
Assumes a dynamic reality	Assumes a stable reality

5.5.3 Mixed methods

Mixed methods, is a combination of both qualitative and quantitative methods. Alternate procedures range from simple to complex systems; it is used by a combination or mix of qualitative and quantitative methods (Saunders, 2011; Creswell, 2013). A single study in which a researcher has improved appreciation of the result can be strived due to the aspiration of carrying out data collection and analysis using both qualitative and quantitative methods. The most suitable strategy to accomplish the aim and objectives of the present study, as discussed earlier, was judged to be mixed methods. Some of the reasons for this include:

- the methods are interlinked, whereby the questions to be asked in the next method are derived from the results of earlier method;
- if the results of one method contain any bias, this can be countered through the use of another method;
- both qualitative and quantitative data can be combined to form one large database; and
- the result from both methods can strengthen and complement each other.

Creswell (2013) explained the mixed method design strategies as follows; concurrent mixed methods, transformative mixed methods and sequential mixed method .

Sequential methods in when the researcher enhances the results of one method by subsequently employing another method. Creswell (2013) explained that the order is not important here; the researcher can start with a qualitative method, followed by quantitative, or vice versa. On the other hand, concurrent mixed methods enable the researcher to employ both qualitative and quantitative methods at the same time during the process of the study (Saunders, 2011). Creswell (2013) also stated that both sets of results should be examined simultaneously, in order to deliver a wider range to the topic of research. Nevertheless, transformative mixed methods can establish the basis of theory, and makes full use of both qualitative and quantitative data. Creswell (2013) further stated that “a framework for methods for collecting data, and outcomes or changes anticipated by the study," which forms the basis of a theoretical framework. It is possible for the framework to be a method of data collection which employs a concurrent or sequential method within the framework.

Figure 5.4 provides an overview of the philosophical considerations, design, strategies and methods adopted in this research, based on the pragmatic worldview.

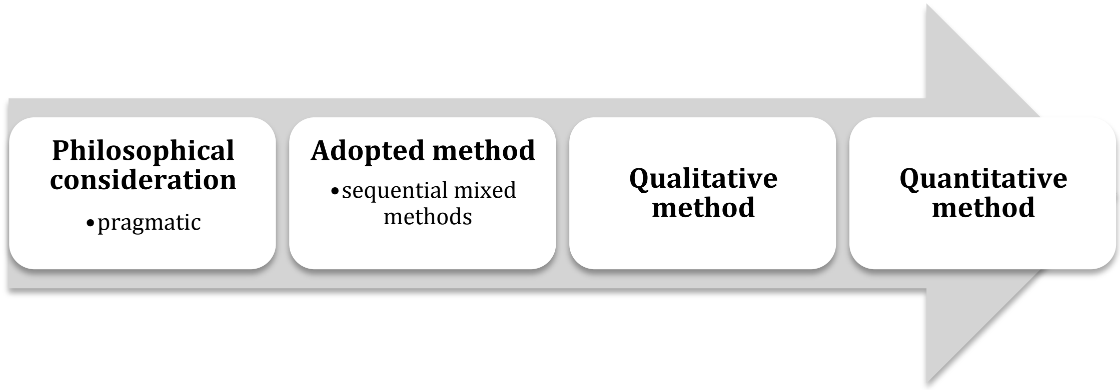


Figure 5.4 The research design and strategies

Suitable questions in the survey (quantitative data), were formulated and derived from the collected qualitative data. The data collection was carried out in two phases. As recommended by Creswell (2009), two methods were used in order to assist in collecting diverse kinds of information, to improve comprehension, and to achieve complementation of specific types of data.

5.5.4 Sequential mixed methods

<u>Qualitative approach (interviews):</u>

Qualitative data was collected through interviews. The interviews were selected as to explore the pre-existing concepts and the way of which professionals currently perceive and respond to the time dimension of risk. As stated by Soetanto (2002), the interviews are the most appropriate way of exploring and gaining sufficient understanding of individuals feeling, belief, value and other subjective or initiative aspects.

There are three types of interview method: structured, semi-structured and unstructured. The key difference between them relates to the extent to which interviewee responses can be led and directed by the researcher. In addition, interviews can be conducted in different ways, such as face-to-face or remotely through the telephone (Denscombe, 2004).

Denscombe (2004) recommends that prior to conducting an interview, planning and preparation is vital and can ensure data that responds to effective analysis. It is also preferable for the interviewer to possess a clear list of issues to be addressed. Thus, the interviewer should formulate a framework of questions and criteria for the selected participants, which, in the case of the present study, were specialists or individuals with extensive experience in the field being studied.

Denscombe (2004) and Creswell (2009) highlighted a number of advantages and disadvantages of interviews, as follows.

Advantages:

- higher response rate;
- interview can be fully controlled by the interviewers;
- ideas can be easily explained and responded to during the process of the interview;
- only simple are required, such as a tape recorder, note-taking equipment, and interviewing ability and skills; and
- detailed, in depth information can be extracted.

Disadvantages:

- the data extracted will take time to be analysed;
- no pre-determined responses;
- the interviewee responses might be influenced by the researcher’s interviewing skills;
- time might be wasted if interviewees are slow to respond;
- Interviewee responses can be postponed or delayed due to the recording process;

- if the interviewees feel that the questions have invaded their privacy, they might provide false information; and
- the geographic locations of the interviewees may incur extra costs and/or cause delays.

These advantages respond well to the aspirations of this study and helped to justify the use of an interview technique for leveraging data. The researcher in this study set out a number of tasks before conducting the interviews as a preparation for ensuring a viable outcome for each session.

- Formulation of semi-structured question list.
- Authorisation and consent were obtained from the interviewees.
- The tools required to capture data from the interviewees (note-taking equipment, audio recorder) were prepared.
- The interviewees were informed of the time needed to complete the interview.

Quantitative approach (questionnaire):

Many studies and organisations have used questionnaires as a tool to assess and analyse risk data in the field of construction, examples of which include El-Sayegh (2008), Jannadi (2008), and Tang et al. (2007). The number of questions that can be included in a questionnaire is potentially limitless, but in practice depends on a number of factors, such as the nature of the subject being investigated, and the characteristics of the respondents, as well as the required time to complete the questionnaire (Denscombe, 2004).

There are two types of questions that deployed in a quantitative instrument: namely, open or closed-ended. The questionnaire in this research used both open and closed-ended questions, in order to achieve a more comprehensive set of information and thus, gain a better depth of the phenomenon being studied. However, the disadvantage of closed-ended questions is that respondents do not have the opportunity to fully express their sentiments or views when responding to the questions, and limitation is acknowledged.

Closed-ended questions are used in various structures, including multiple-choice questions, ranking questions, and attitudinal scales, where respondents are expected to answer the questions according to their degree of preference or opinion. In order to provide opportunities for the respondents to freely and completely express their opinions, open-ended questions were also used, so that richer data could be collected to help achieve the purpose of the study.

According to McNeil (1990) and Denscombe (2004), there are advantages and disadvantages to using questionnaires. These are as follows.

Advantages

- respondents' answers can be easily analysed, compared and categorised;
- the results can be presented as statistics, graphs and tables; and
- answers and questions are standardised.

Disadvantages

- respondents cannot fully express their views;
- difficult to distinguish whether respondents have understood the questions as intended; and
- questions may be interpreted differently by respondents.

Descombe (2004) outlines the following criteria in constructing a questionnaire.

- simple and clear word choice;
- no sensitive questions;
- no leading questions;
- logical flow;
- questions are not pre-determined by previous questions or answers; and
- questions are relevant to the topic.

5.6 Data collection process

Every individual has a different personality, preferences, values and perceptions. Therefore, their judgements on time dimension of risk will also differ. As explained by Silverman (2007), it is crucial that the data collection method for such judgement related phenomenon is appropriate for achieving the aim of the research. There are a variety of methods and means of collecting data available, and the selection of the right method, or a mixture of different methods, depends greatly on the subject of the research (Yin, 2009; Silverman, 2007). Knowledge emerges from the collected data and evidence which gathered and combined with the considered logical aspects (Creswell, 2013).

The survey method is typically used to collect data from individuals in a short period of time. There are two types of survey techniques, descriptive and exploratory, and many researchers use a combination of both methods (Fink and Kosecoff, 1985; McNeil, 1990). A dynamic approach was required to collect all of the required information relating to the time dimension of risk in construction projects. For the primary data collection, two methods were chosen, exploratory interviews followed by a questionnaire.

5.6.1 Exploratory interviews (Qualitative approach)

Semi-structured interviews

According Knight and Ruddock (2008) interviewing key professionals representing different perspectives generates a comprehensive picture of the current status on any key phenomenon being investigated. Belson (1981) stated that collecting data from practitioners through face-to-face interviews is the most appropriate method during the initial stages of data collection, rather than relying on postal questionnaires or telephone options. In addition, it is helpful to collect data face-to-face, as interactions with participants who have first-hand experience of the problems that occur in the field can afford additional information beyond the designed scope of desired data. . Therefore, a face-to-face, semi-structured interview was selected as the primary data collection method for this study. The adoption of the interview technique enabled rich data to be obtained and a provided opportunity for a thorough investigation of complex issues by accommodating unsolicited interviewee views on the subject. The primary purpose of an interview is to collect information that often cannot be perceived directly, such as thoughts, feelings, behaviours and intentions (Patton, 2002).

In the present study, the primary objective was to gather data from professionals associated with risk management regarding their perceptions of the time dimension of risk in the construction sector in Kuwait. For each participant, the interview revealed their level of awareness of the time dimension of risk in risk management, their comprehension of the time dimension of risk, the context in which they comprehended it, and whether it is a factor that influences risk management within the sector.

To further clarify the aim of the research, it was expected that, by conducting the exploratory semi-structured interviews with practitioners (professionals in the industry) on the time dimension of risk, a robust questionnaire instrument could be developed to elicit critical information in order to characterise the time dimension of risk which should consequently help in achieving the research aim.

Yin (2003) suggests that in order to help validate and organise a suitable questionnaire for the main study, all of the interviewees would have to be selected based on the criterion of researcher relationships as well as recommendations from other professionals.

In order for the interview data to be reliable a voice recorder was used to record the interviews, which were subsequently transcribed and reviewed. No names were stated or recorded in the data, and all data collected was kept confidential. The duration of the interviews varied from 30 to 50 minutes, depending on the interviewee’s interaction, interests, opinions, and understanding of the subject.

Communication barriers were removed by the interviewer, by encouraging participants to contribute any additional and unsolicited detail beyond the planned content. Where it was required, further clarifications were provided to enable the interviewees to provide clear detail in their responses for the study objectives to be achieved. Cavana et al. (2001) explained that the interviewer should remove obstacles that that potentially could be a discomfort to the participants from giving full responses. This was achieved by easing the flow of communication and creating a rapport with the interviewee. Based on the recommendation of Sekaran (2006), the interviewer listened carefully to the interviewee, displaying an interest in their responses, delivered the questions clearly, rephrased or repeated the questions when necessary, maintained an interest in the interview as it progressed, and recorded the interview accurately in order to get the most out of the process. Careful preparation for the interviews was essential in order to achieve optimal results, including managing time, scheduling visits, acquiring the relevant permissions, and making sure all notes were recorded. It is crucial that appropriate preparations are made, in order to attract an increased number of enthusiastic participants (Robson, 2002). The next section presents and discusses the relevance of the interview questions in greater detail.

Formulating Interview Questions

The formulation of the interview questions was based on both the literature review, and the initial conceptual model. In order to properly fulfil the research objectives, the interview questions were phrased in a focused way, with a direct link to the topic of discussion.

The objectives of the interviews were as follows:

1- To investigate the awareness of key decision-makers in the construction industry regarding the time dimension of risk.

2- To establish how perceptions of time can be characterised and taken advantage of, to provide more effective and integrated management of all risks associated with the delivery of construction projects.

Introductory questions about the participants were asked at the start of all interviews. To enable participants to further expand on the topic of discussion, the interview questions were wide-ranging and covered both general and more precise areas. Diverse questions were included by the interviewer to ensure that the topic was covered thoroughly, including investigative, follow-up, direct, indirect, organising and analysing questions. A microphone and tape recorder device was used by the researcher to produce a clear audio recording. The recorded interviews were transcribed immediately.

Piloting Interview Questions

The questionnaire was pilot tested in order to establish its suitability as a data collection tool. The researcher conducted two interviews with professionals within the construction industry were conducted to obtain their opinions on the clarity of the questions and to ensure that the data were collected correctly and in accordance with proper processes. At the beginning of the pilot interviews the interviewees were informed of the aim and structure of the questionnaire. Then, the interviewees were asked whether they understood the questionnaire items, and whether it covered all of the areas of the topic under discussion. The participants were then given the opportunity to recommend any alterations that they believed were necessary. Additionally, the interviewees were also requested to write any opinions or comments they had about the questionnaire on the hard copy that they were provided with. Furthermore, conducting pilot interviews enabled the researcher to estimate the time required to ask and resolve queries. The researcher used all of the feedback from the pilot interviewees to establish a final questionnaire for the real interviews. This resulted in additional questions being included in the final questionnaire, and some of the initial questions being revised. Receiving feedback in this initial step was extremely helpful, as the researcher was able to make necessary alterations to the phrasing, wording, structure, and clarity of the questions asked.

Interviewees

The participants involved in the study were key professionals that practice in the construction industry of Kuwait at the project level. The focus on the project level was to ensure the right context for establishing the time dimension of risk. The selected interviewees included the following.

• Project managers • Site managers • Consultants • Engineers • Surveyors
• Planners • Architects.

Informed Consent

The researcher obtained an official request letter in order to gain access to the target organisation and to those involved in its construction projects. Informed consent was also obtained from the participants before the interviews were conducted. Ethical and confidentiality issues were addressed in the written consent form, so that each participant was fully aware of their participation in the study.

Confidentially and Reciprocity

Prior to the interview, the participants were informed that their participation in the study was voluntary, and how they may not benefit from the study directly. The data gathered from the participants was treated confidentially and stored in a safe repository. The participants were given the right to withdraw from participation at any stage of the interviews if they were unhappy or dissatisfied with disclosing any information to the researcher. They were also given the right to request for their full individual response.

Interview Location

Interviewees were given the freedom to choose where the interviews would be located, so that their participation in the interviews would be easy, safe and confidential.

5.6.2 Questionnaire survey (Quantitative approach)

Kendrick (2015) explained that, when designing a risk assessment questionnaire, its format needs to be examined, and a careful selection of relevant risks is needed to align key elements to a specific type of project, and to elicit straightforward and simple responses. This helps to keep the number of questions to a minimum. In addition, throughout the pilot study, the questions need to be continually re-examined to ensure their usefulness, effectiveness and reliability at all times.

The different stages of designing the questionnaire for this study are described in the following sub-sections.

Stage I

A questionnaire comprising 23 items was formulated to explore the time dimension of risk based on the reviewed literature and outcomes from the exploratory semi-structured interviews. The full detail of the instrument can be viewed in Appendix C. To ensure content validity of the questionnaire, two practitioners were enlisted to identify any possible flaws in word choice, sentence structure, question sequence, instructions, format, and layout. They also assessed the relevance of the content, and highlighted any irrelevant questions.

Stage II

The validated questionnaire comprised of two sections. The respondents' demographic profiles and general information was collected in the first section, in order to increase the credibility of the information gathered. This was followed by the required content for the analysis of the study in the second section. This second section explored how practitioners assessed the time dimension of any identified risks, and how these risks were alleviated; this helped to address the key research questions and ultimately achieve the aim of this research.

Pilot Study

In the process of designing a questionnaire it is important to carry out a pilot study in order to identify and amend any problems that might be encountered when completing the questionnaire (Sudman and Bradburn, 1982).

In order to ensure the validity of the content and the design of the questionnaire (which helps to further strengthen clarity and consistency of the instrument), a pilot was carried out. The pilot helped to improve the questionnaire items and the format to be used in the actual survey (Creswell, 2003; Sudman and Bradburn, 1982). To validate the questionnaire, it was sent to a sample of three respondents: two professionals; an engineer and a manager with roles on site within the construction industry in Kuwait; and a researcher as a third respondent.

The participants were requested to provide feedback on a number of specific issues. The list is as follows.

- time required to complete the questionnaire;
- clarity of questions posed;
- sensitivity of questions posed;
- clarity of instructions in the questionnaire; and
- further suggestions to improve on the presentation and specific issues in the questionnaire

After completing the questionnaire, the respondents were all of the opinion that the instrument was well defined and could be easily addressed by potential respondents. However, some issues were highlighted, such as the clarity of some of the questions and also issues with format and word choice. Taking all of these suggestions into consideration, the questionnaire was subsequently revised and reformatted.

5.7 Population and sampling

5.7.1 Population

Groves et al. (2009) defined a population as all possible ‘units’ (people, workers or members) that can be included in a survey. The population of the present study consisted of professionals detailed in Figure 5.5, from different organisations represented as clients, consultants, contractors, within the private and public sectors, working on construction projects in the State of Kuwait.

5.7.2 Sampling

The process of selecting units, (for example sections of people or organisations) from a population of interest is called sampling. If a sufficient sample size is achieved, this enables analysis that can be generalised for the population from which the sample was drawn.

According to Knight and Ruddock (2008), sampling is usually employed in research, as it is impossible to include every individual in the population. In addition, it saves time, money and effort when conducting the research. In this regard, it is important to bear in mind that the necessity of selecting a sample that represents the population (Knight and Ruddock, 2008), in order to attain reliable, valid and accurate results.

This study employed a purposive sampling method. Purposive sampling is a technique in which the researcher looks for respondents that possess distinct characteristics and qualities that are representative of the total population (Creswell, 2009). According to Flanagan and Norman (1993), compared to the general population, professional practitioners possess a wider range of knowledge, skills and experience on the subject area of their practice.

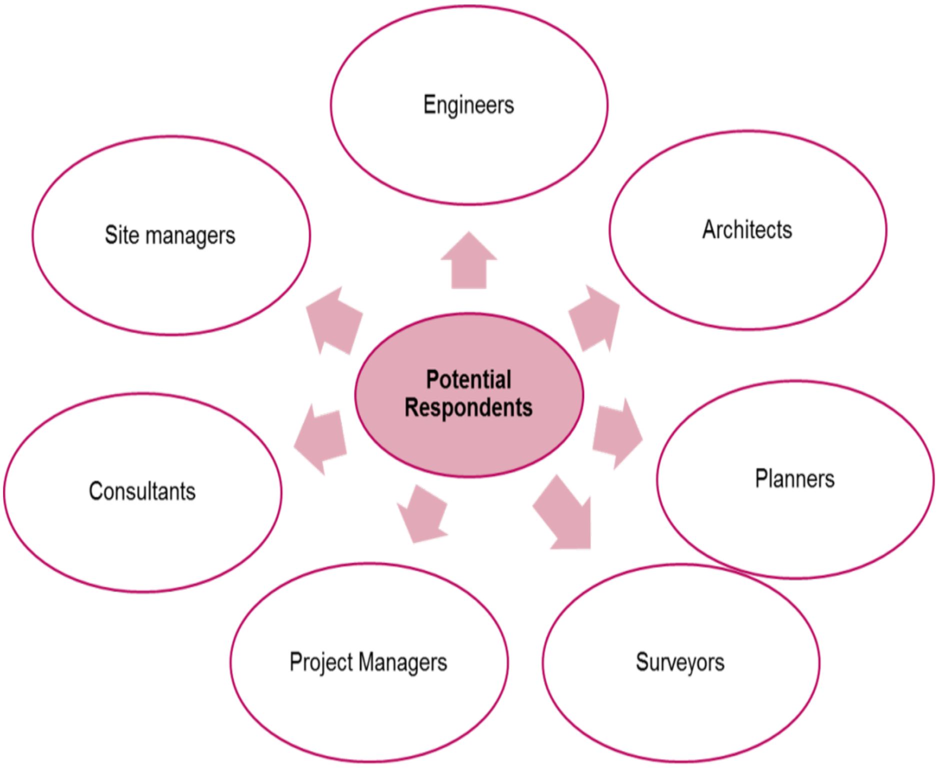


Figure 5.5 Targeted sampling units

Groves et al. (2009) assert that a fraction of the target population should be selected as a sample. The actual total of the target population was indeterminate, and that made random sampling inappropriate. As such, the participants in both the exploratory interview and the questionnaire were selected through the researcher relationship and by adopting the snowball techniques where one participant refers to another. The researcher initially set up 49 invitations for the interview, but a saturation point was reached whereby no new insights in responses were forthcoming after 19 interviews were completed. ;. All the same, the researcher seized the opportunity to conduct additional 15 interviews which were already arranged as the dates and time for interviews were confirmed in advance with agreed participants.

Following the interviews the researcher distributed 250 questionnaires to a wider group of professionals placed on construction projects with no insight on this research topic and who did not participate in the interviews. This wider survey achieved a total of 115 completed questionnaire. . Table 5.3 illustrates the number of valid responses from both investigations; exploratory interview and questionnaire.

Table 5.3 Number of valid responses

Position	Valid Interview	Valid Questionnaire
Project manager	4	15
Site manager	4	11
Engineer	12	52
Consultant	1	9
Surveyor	4	7
Planner	5	13
Architect	2	8
Other	2	0
Total	**34**	**115**
Response rate	**69.3 per cent**	**46 per cent**

5.8 Reliability and validity

McNeil (1990) stated that research reliability means the degree to which the selected research method used produces stable and consistent results when applied at different times under similar conditions, or by different researchers. Means of ensuring research reliability can be broken down into several categories, such as test-retest, the internal consistency method (Cronbach's coefficient alpha), the split half method, and the parallel-form method (Oppenhein, 2000).

In this study, Cronbach's coefficient alpha test was used to assess the reliability of the data collected, in addition to other strategies to ensure errors were eliminated, such as reviewing the coding procedure and transcripts.

The most important point here is that ensuring research validity is a process where "the researcher checks the accuracy of the findings by employing certain procedures". A quantitative validity refers to "whether one can draw meaningful and useful inferences from achieved scores of a particular deployed instrument" (Creswell, 2009). A number of strategies can be used to test research validity. Creswell (2009) recommended options such as using participants' perspectives as a triangulation strategy, using follow-up interviews to enhance the concluding description and to carry out a final verification of interview results, or contacting a respondent to ascertain the accuracy of the findings by reviewing and asking questions. All of these strategies were applied in this study.

According to Ghosh and Jintanapakanont (2004), the most common form of validity tested by researchers is content validity. This was true in the case of the present research. The steps followed when designing the questionnaire enabled the testing of the content validity.

5.9 Data analysis process

5.9.1 Interview analysis (qualitative data)

Several approaches to analysing qualitative data can be employed. Green and Thorogood (2004) claimed that most researchers use an amalgamation of a number of different approaches. One of the approaches they highlight is framework analysis, which was introduced in the 1980s by the National Centre for Social Research (Ritchie and Spencer, 1994).

According to Ritchie and Spencer (1994), framework analysis is an analytical procedure encompassing a few distinct but interconnected stages. The five main stages of the framework are: familiarisation; identifying a thematic framework; indexing; charting; mapping; and, interpretation. The term 'framework' initially relates to the thematic framework, regarded as a key component of the process. The thematic framework is employed to categorise and arrange the data based upon the main themes, concepts, and emergent groups. The benefit of using this approach is that it provides a concise sequence of work that would enable researchers to handle a large volume of complex qualitative data more easily. Significantly, this approach allows the researcher to synthesise the outlined themes throughout all instances. According to Rabiee (2004), framework analysis offers several practical advantages when analysing data pertaining to the individual, stressing that this type of framework is best employed for separate interviews. It has since become the preferred method of qualitative researchers. Krueger (1994) explained that a useful way to understand this method is to assume a continuum of analysis extending from the collection of raw data to the final data interpretation comprising: the analysis continuum, raw data, descriptive statements and interpretation.

Another distinctive feature of framework analysis is that, in utilising a thematic process, it provides an opportunity for themes to develop from both the research questions and the participants' own narratives. Consequently, this technique plays an important role in analysing interview data, owing to its highly systematic process. Indeed, the technique is very useful in handling and managing data, in trying to comprehend what is happening, removing excess and unrelated data, and navigating safely through a mass of large and complex paths of information, and consequently addressing the research objective. Accordingly, this study employed the framework analysis method for the investigative stage of the research, through performing the familiarisation, identifying a thematic framework, indexing, charting, mapping, and interpreting the data.

5.9.2 Questionnaire analysis (quantitative data)

The analysis of the quantitative data was accomplished with the Statistical Package for the Social Sciences (**SPSS**). The package was used to generate several statistical analyses that held relevance to the study, including a Kolmogorov-Smirnov (K-S) normality test**,** Cronbach's Alpha reliability analysis, Chi-square test of data significance, crosstab analysis, and correlation.

Kolmogorov-Smirnov (K-S) normality test

This Kolmogorov-Smirnov (K-S) test is a non-parametric test used for normality assessment. It can be utilised to differentiate between the frequency distribution of one data set and the theoretical distribution, as well as to compare the frequency distributions of two separate groups of data (Frude, 1990). In the case of normally distributed data, parametric processes were used, while non-parametric procedures were utilised for non-normally distributed data. According to Pallant (2013), data are categorised as normally distributed if the value of statistical Significance is greater than 0.05. The non-parametric statistical option would be exercised if the significance value is less than or equal to 0.05.

Cronbach's Alpha:

Cronbach's Alpha is a statistical analysis that evaluates the reliability and consistency of test components. The Chi-square test is a statistical analysis that examines and describes the extent of discrepancy between data and to establish the relationship between two categorical variables.

Descriptive analysis:

Descriptive analysis presents the results according to the responses collected for every variable and every item in a questionnaire. Survey data collected from the questionnaire forms can be explained in the form of percentages and frequencies, and then presented in the form of tables for further specific and collective discussion.

Crosstab analysis:

Crosstab analysis aims to provide an understanding of the outcomes from two separate variables. Using this analysis, one can determine the link and importance between two variables.

Spearman correlation coefficient (r_s) test

This statistical test assesses the strength of a relationship between paired data sets. According to Pallant (2013), typically, the range of the test results is from zero ($r_s = 0$) implying no relationship whatsoever between two variables, to one (r_s = 1), which signifies an ideal positive and direct relationship. Tests can return values that range from -1 to +1. In the case of r_s = +1, this implies a direct and proportionate linkage between variables. In such cases, by increasing the value of one of the variables, the other variable would also increase by a proportionate amount. By contrast, when r_s = -1 this denotes an inverse correlation, which indicates that as one of the variables decreases the other will increase by the same proportion.

5.10 Design and development of the assessment matrix

The development of an assessment matrix, as an instrument for establishing the nature of and moderating the performance of practitioners in construction projects concerning risk management practice, was facilitated by the results of the exploratory interviews and questionnaires. It was also reinforced by an extensive literature review on the subject of risk management in the construction industry, particularly in the State of Kuwait, and time and risk perception. The exploratory interviews and questionnaires helped to investigate and comprehend the nature and features of the time dimension of risk. The assessment matrix was judged to be an appropriate and suitable tool to design, due to the volume of information that it can capture.

The results from the analysis of the data revealed five indicators that together can provide a comprehensive picture of practitioners' level of awareness of time dimension of risk. It also achieved the association of their decisions regarding time dimension of risk in accordance with the common risk attitude categorisation. The discovery of these five indicators enabled an assessment matrix to be developed, as the ideal tool for assessing and comprehending this phenomenon. The assessment matrix comprised of two axes, each with three categories. The X-axis categorises decisions as optimistic, normative, or pessimistic, while the Y-axis categorises awareness into three levels: low, medium, and high. A detailed discussion of the assessment matrix and its development process is provided in subsequent sections of this thesis.

5.11 Summary

This chapter has established the most suitable research methodology for this study as the sequential mixed-method.

To ensure clarity and ease of use for both methods (interviews and questionnaire), a pilot study was performed. This was done in order to ensure the validity of the research instruments for a field study. In total, 34 interviews and 115 questionnaires were achieved with professionals for the main investigation; a further 13 interviews were subsequently conducted as a means of enhancing the credibility to the results obtained in this study.

In order to test the association and discrepancy between the obtained data from participants; Chi-square analysis was used, as well as crosstab analysis and correlation tests. In addition, several techniques and statistical procedures were used to analyse the responses, such as descriptive analysis, the Kolmogorov-Smirnov (K-S) normality test, and Cronbach's Alpha reliability analysis.

The next chapters, six and seven, present the analysis of the exploratory interview and the main survey (questionnaire) respectively. This is followed by the research results extracted from the analysis and the development process chapter.

Chapter 6: Analysis of Pre-existing Conception of Risk Time Dimension

6.1 Overview

A descriptive analysis of the exploratory interviews is presented in this chapter. This chapter begins with a general overview of the participants' information and background. This chapter is also presents a descriptive analysis on the current unit of time measurements used in their projects and their preferences of the time measurements. The extents of professionals' different abilities in allocating reliable predictions for different length of time to all identified risk events are presented. The mitigation plan of period and different considerations amongst participants are explained and described. This chapter also presents different mitigation approaches adopted by participants and explains the current methods of how they perceive and mitigate risk events. The hidden obstacles in predicting the time of mitigation of risk events that have been encountered by practitioners and their solutions were presented. Finally, how time interacts with probability and impact predictions are explained.

6.2 General information of participants

This section provides the background to respondents' experience, and therefore to indicate the degree of reliability of the data provided by them. The researcher interviewed 34 participants from different companies and organisations from both the public and private sectors of the Kuwaiti construction industry, all of whom attended the whole interview process and answered all the questions. Consequently, as shown in Figure 6.1, the participants were equally represented as 17 out of the 34 interviewees were affiliated to the private sector of the Kuwaiti construction industry whilst 17 out of the 34 interviewees were affiliated to the public sector of the Kuwaiti construction industry.

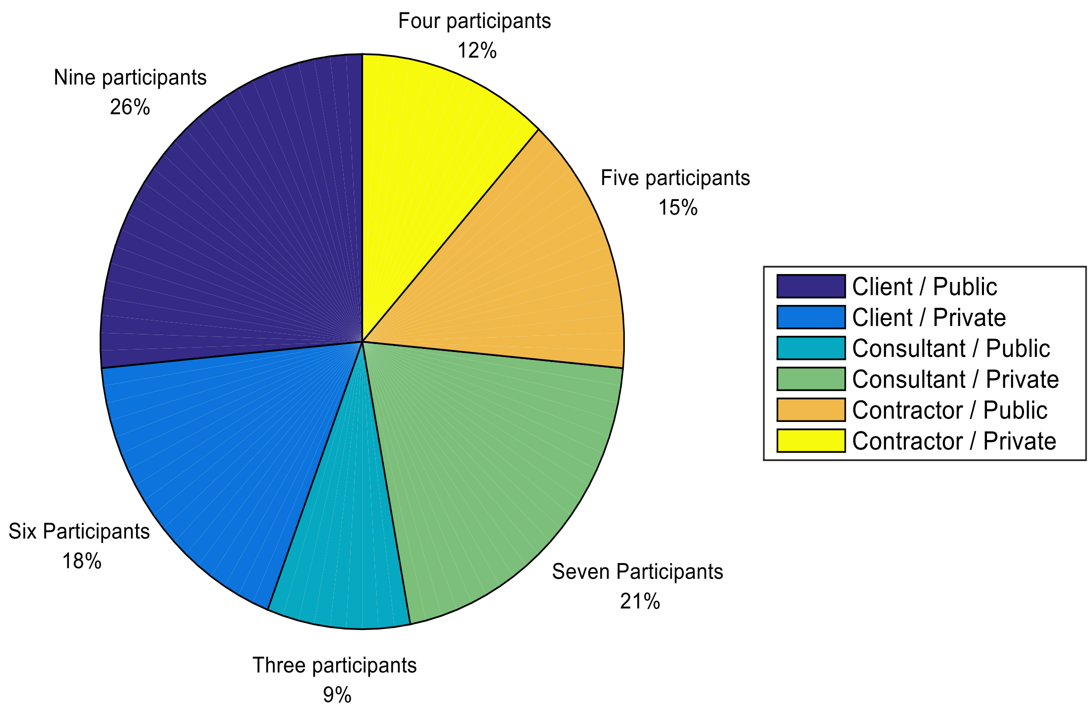


Figure 6.1 Interview participants

Interviewees in this research were the type Odendahl and Shaw (2002) and Marshall and Rossman (2006) referred to as elite participants. With varied professional backgrounds, most of the interviewees occupied management positions and were well-placed to have first-hand insights into practice within their organisations. Even though there is an unvoiced acknowledgement that they work with very demanding schedules, the interview appointments were secured without causing the interviewees any inconvenience. All the interviewees have professional construction backgrounds and hold different positions within construction projects as shown in Figure 6.2. In terms of professional backgrounds, the majority of the interviewees (12 individuals) were engineers. These 12 individuals worked in diverse engineering environments with different experiences in practice and training in construction and civil engineering. Interviewees who are project managers and site managers were four individuals respectively, whilst there was only one participant who was a consultant with surveyors and planners being four and five respectively. Two of the interviewees had backgrounds in architecture and the remaining two interviewees had other professional backgrounds.

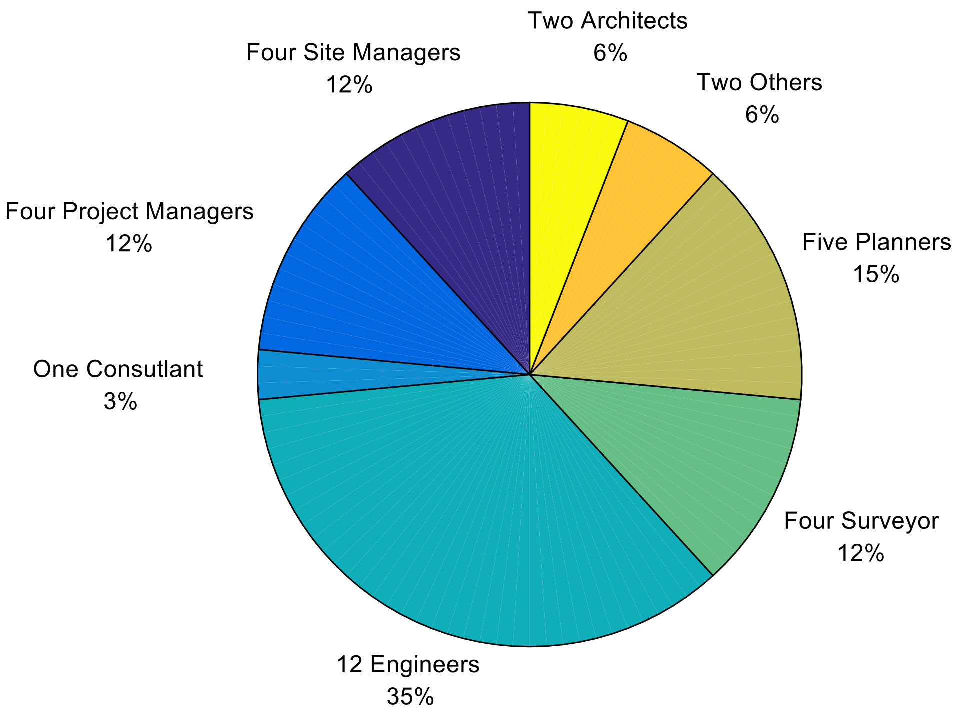


Figure 6.2 Professional backgrounds of the interview participants

All participants were asked about their years of experience in the construction industry, their current organisation/company and current position. This is to add more clarity and credibility of their answers to the interview questions. A summary of their experiences is show in Figure 6.3. Fortunately, the professionals who participated in the research have more than 20 years of experience in the construction industry between them, which reflects well on the reliability of the data collected.

Figure 6.3 shows the years of experience of the interviewee participants. It shows that six of the participants had experience of more than 21 years, four participants had between 16-20 years, and eight participants had between 11 to 15 years. Of those remaining, ten participants had experience of between six and ten years, whereas four participants had less than five years of experience in the construction industry.

Figure 6.3 also shows how many years of experience each participant has in their current company/organisation and how many years they have spent in their current position. The highest number of participants (18 individuals) have spent less than five years with their current company/organisation, whereas 12 individuals have spent between six and ten years with their current company/organisation, whilst three individuals have spent between 11 to 15 years with their current company/organisation and only one individual has spent between 16-20 years with their current company/organisation respectively.

Simultaneously it is observed that from all the participants 17 individuals have been in their current position less than five years, whereas ten individuals have been in their current position between six and ten years, whilst six individuals have been in their current position spent between 11 to 15 years.

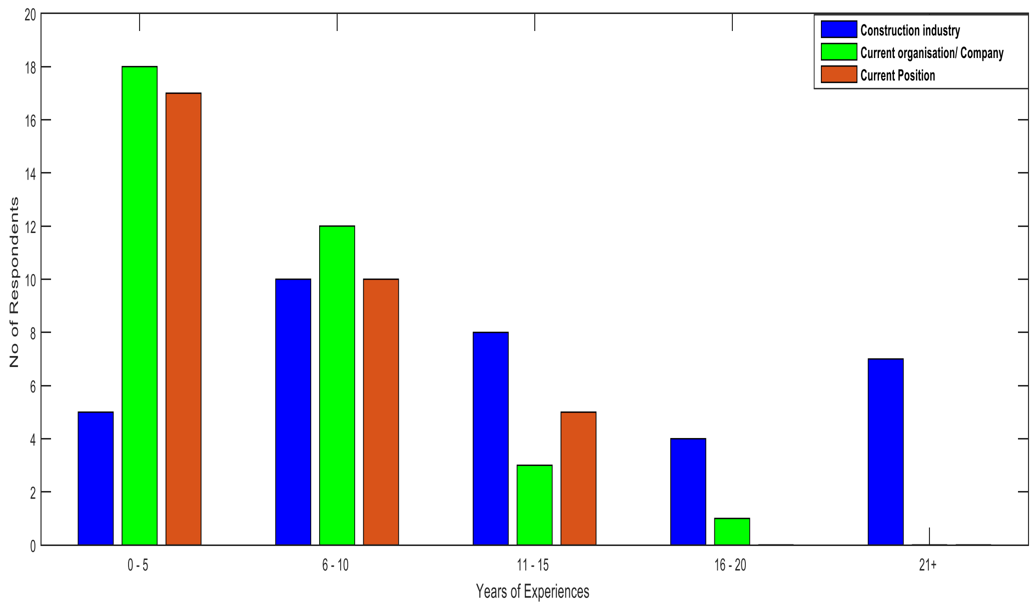


Figure 6.3 Years of experience of the interview participants

All of the interviews were noted and some of them were voice recorded depending on the interviewee’s acceptance; however, all of them were coded, transcribed and analysed statistically. The collected data are categorised and classified in a systematic way where all the answers are gathered under its enquiry to ease the mission of finding the emerging theme.

6.3 Time units

The participants were asked about which type of time measurements they are currently using and also about their preferences on the type of time measurements. The answers from the interviewed participants showed that 56 per cent of them are using days unit as standard measurements in their projects while 44 per cent are using weeks as a time measurement. On the other hand, 76 per cent of the respondents preferred days as standard time measurement while 20 per cent preferred weeks and three per cent of the respondents preferred months. Figure 6.4, illustrates the responses of all the participants.

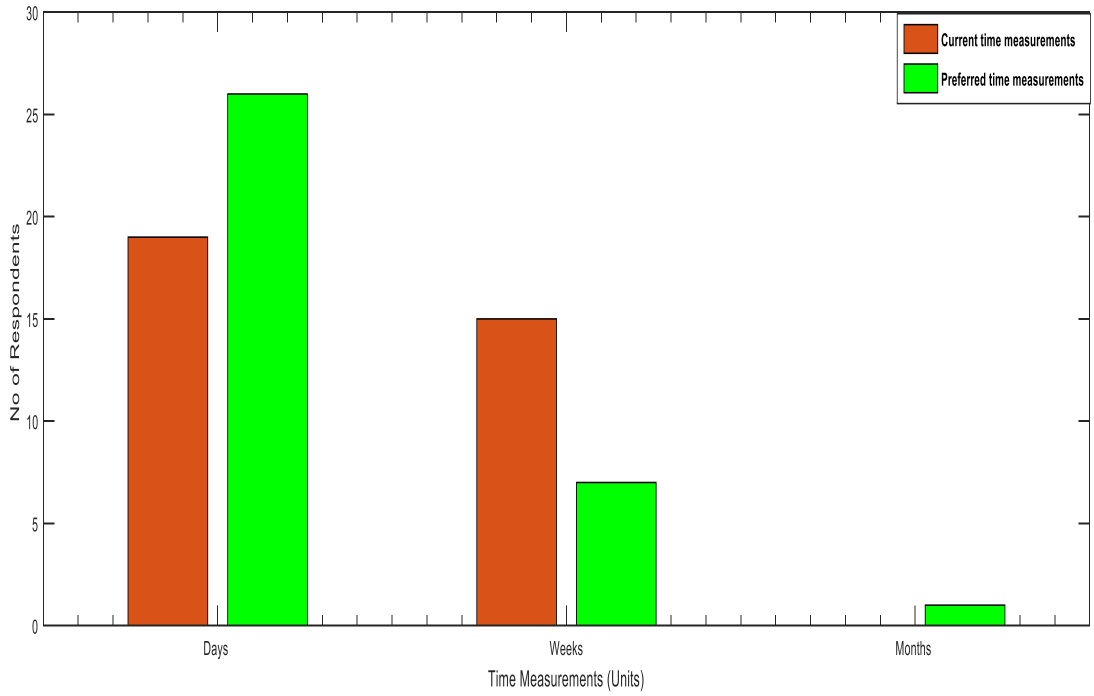


Figure 6.4 Preferences of time measurement units

6.4 Temporal horizon

One of the interview questions asked the interviewees to state to what extent they can allocate a reliable prediction of all registered risk events on a percentage scale (*where 0 is the start and 100 per cent is the project end).* The analysis showed that 44 per cent of them indicated that they are only able to provide a reliable prediction for the first 20 per cent of the project duration, whereas 32 per cent of the participant's responses revealed that they can allocate a reliable prediction for the first 40 per cent of the project duration. However, for the first 60 per cent of the project duration the responses show that only 18 per cent of all participants can assign reliable predictions. The responses show that three per cent of all interviewees said as a reliable prediction they only can predict the first 15 per cent of the project duration. On the other hand, three per cent of all the participated interviewees claimed that they can assign reliable prediction for the whole project duration based on the phases of the risk events occurrence. Figure 6.5, illustrates all participation responses.

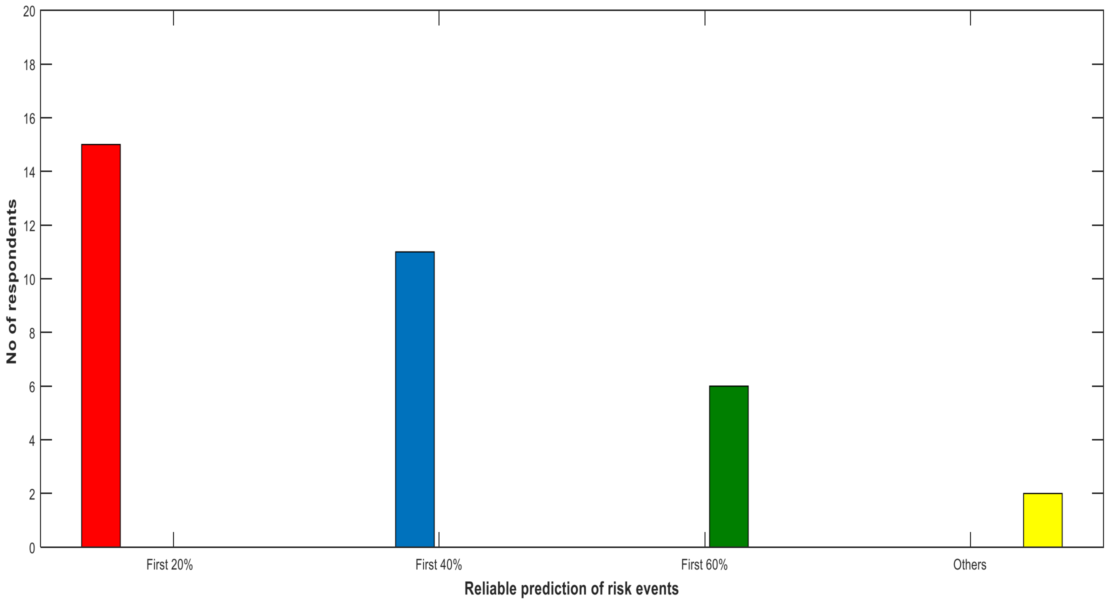


Figure 6.5 Assigning a reliable prediction of risk events

6.5 Mitigation plan of periods

All interviewees were asked about to what extent they consider setting a mitigation plan of periods for each registered risk event to increase the probability of it being mitigated within that period of time. Subsequently all responses were summarised, categorised and divided into three sections as follows.

1- Risk Level

a. ***High level of risk events**:* All participants revealed that they consider having a mitigation plan for periods of all high level of risk events.
b. ***Medium level of risk events:*** Almost all of the interviewees consider having plan for periods of medium level of risk events. Nine per cent of the responses claimed that they only consider having a plan of periods to medium level of risk events depending on its impact on the project as they have different ways of prioritising them. (Interviewee NASM) stated *"I will consider all high level of risk events and some of the medium level of risk events especially the ones that associated with workers injuries".* Where on the other hand (Interviewee HTS) articulated that *"I will be considering all high level of risk events and only medium level of risk events that are more likely to increase and become high level".* The (Interviewee HMP) expressed *"All high level of risk events and some of the medium level of risk events specially the ones that have major impact on the cost of the project would be consider to have mitigation plan of periods".*
c. ***Low level of risk events:*** All participants revealed that all low level of risk events would be mitigated within/during the project activities plan. However, they all would be monitored in case of any changes on its nature as it has been explained by (Interviewee AAPM) *"I normally consider giving time to all high level and medium level of risk events to be mitigated within however, I also consider monitoring all low level of risk events in case they increased to something else".*

2- Risk Events' Nature

An interesting point has been presented by (Interviewee BUAENG) as he states that *"Depending on the nature of risk event itself and how long do we need to mitigate it, however I will consider having mitigation plan of periods for all registered risk events".*

3- Project Phases

All risk events have a time, activity or even a phase where it is more likely to occur. In total nine per cent (9%) of the respondents stated that they will consider having a mitigation plan for periods depending on the risk event's phase/activity within the schedule of the project, for example (Interviewee SAP) stated *"I will be considering all high level of risk events to have mitigation plan of periods and all medium and low level of risk events will be dealt with according to its phase".*

6.6 Mitigation approaches

The mitigation approach is concerned with how risk events would be perceived and the steps taken to address any potential impact should it transpire. The interviews have revealed three different approaches that are implemented by the interviewees as the following.

1- *What comes' first approach?*

The responses showed that 44 per cent of the participants would consider setting up their mitigation plan according to what comes first as they explain that by saying all risk should be dealt with in order to avoid any confusion or blocking themselves with any risks or also to avoid delays on the project scheduled time. As (Interviewee SASM) stated *"I will consider setting up my mitigation plan according to what comes first because I have to stick to the schedule of the project and not to jump from activity to another".* Whereas (Interviewee ABAPM) expressed that *"To avoid any delay in the project and not to block myself with other risk events".*

2- *Risk events' nature approach*

The responses showed that 47 per cent of the participants would consider setting up their mitigation plan according to risk event's nature justifying it by stating all risk events are different in their nature along with their requirements and preparation in order to be appropriately mitigated. (Interviewee AKhPM) stated *" I will consider setting up my mitigation plan according to risk event's nature because some risk events need more time and longer process of preparation to be mitigated than other risk events with a similar level*". Another point has been asserted from (Interviewee BHPENG) who stresses *"Some risk events should be dealt with first even though they are not happening first. This is due to their longer process and time to be mitigated".*

3- *Mixed approach*

The responses revealed that only nine per cent (9%) of all participants would consider setting their mitigation plan by using a combination between the two previous approaches. The reason of choosing both approaches is explained by (Interviewee SVBS) *"With high and medium level of risk events we go for risk event's nature due to their needed requirement and process however with low level of risk events we apply what comes first because their cost is less and also their mitigation time is less".*

6.7 Prioritisation scenarios

Within the same context the interviewees were asked about their responses in a situation of having two risk events with the same level of impact and probability but different time within which they need to mitigate. The interviews have revealed that 56 per cent of all participants would start mitigating the earlier risk event to avoid any delays in the project schedule and get it done which would give them the opportunity to focus on the second risk event and use the experience from the first risk event into the second risk event. Such as (Interviewee LHSM) stated, *"I will start with the earlier risk event to avoid it and then focus in the second risk event".* While (Interviewee AAENG) asserted that *"I will deal with the first risk event and use this experience gained into the second risk event".*

On the other hand, the interview revealed that 35 per cent of all participants would consider looking to the both risk events requirements and preparation and then the decision on what to start with first would be made. For example (Interviewee AKhPM) stated, *"Depending on the requirements of this particular risk event and what it needs. Whether we have time to secure them or to mitigate them or not. Otherwise in case no time to prepare for the first risk event then it is better to consider the second risk event first and not wasting time on the first risk event because there is no point of spending time trying to solve it while we know we cannot make in on time and mitigate it".* While (Interviewee HMP) stated, *"Depends on both risk events what their nature, in which one may need more attention and time while the other one may just need very short time to be mitigated".*

Nevertheless, nine per cent of all participants have shown their intention of starting both risk events on the same time if they were in the same phase otherwise they would start with the earlier risk event, (Interviewee NAPM) stated, *"If they are expected to happen in the same phase then I will start mitigating both of them together otherwise I will start with the earlier risk event".*

6.8 Obstacles

The number of participants who responded to this question of during the interviews was only 28 out of 34 interviewees. The question was asked to investigate what obstacles they have encountered and how they have overcome these obstacles from their experience in previous projects in predicting the time of mitigation of risk events. The responses have revealed different obstacles with different solutions as presented in Table 6.1. Clearly, many of the obstacles that have been encountered by participants could have been mitigated if there was an adequate attention to the timeframe of their occurrences.

6.9 Time Interaction with Probability and Impact

In this section the researcher aimed to investigate the time interaction with probability and impact by asking interviewees on a scale of (very easy- easy- neither- hard- very hard), They were asked on how easy they can predict on a project of 24 months. This section is divided into two sub-sections; each sub-section has four questions of different periods of time throughout the project lifecycle.

Table 6.1 List of obstacles and solutions

Obstacles	Solutions
Unsteady cash flow	Secured payment in advance
Contractor and sub- contractor capabilities	Do more research on their previous project and to get involved in the selection
Alteration orders	Some minor changes that I could deal with them but for major changes no one can do something about it. Minimising the number of changes on the original plan
Changes on market prices	Buying on best current prices
Information	More meetings, get more people involved
Resources availability	Reliable supplier
Manpower skills / availability	The closer we come to the risk event the more accurate estimation we could assign for the required workforce. Understanding their capabilities and strengthening them or work on this basis
Change/different area and restriction, which create different system and procedure	Implement a new method and way of communication and procedure
Beyond control and sudden risk events	Giving (buffer) time for each activity so in case anything that we cannot control we'll have that extra little time to catch up
Our capability against the mitigation requirements	Do more study in some cases which may reveal some hidden information that helps
Other parts of the key actors whom may affect the decision / lack of stakeholders commitment	Better communication / more meeting / having support from top management

A- PROBABILITY

i. The first 6 months of the project duration

The responses show that six per cent of all the participants find it very easy to predict the probability of the registered risk events for the first six months of the project. While 76 per cent of the participants said it is easy to predict the probability of the registered risk events for the first six months of the project. 15 per cent of the responses from the participants revealed that it is neither easy nor hard to predict, whilst only three per cent of the participants responses find it hard to predict the probability of the registered risk events for the first six months of the project. The Figure 6.6 illustrates the percentage of all the participant responses.

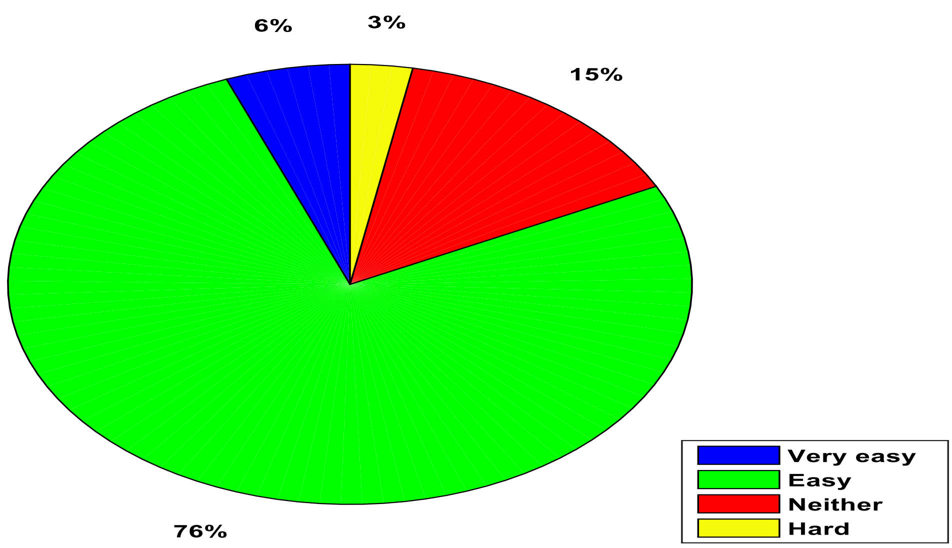


Figure 6.6 Prediction of risk events for first six months of a project

ii. The first 12 months of the project duration

The responses show that 24 per cent of all the participants find it hard to predict the probability of the registered risk events for the first 12 months of the project duration. Whilst 59 per cent of them said it is neither easy nor hard to predict the probability of the registered risk events for the first 12 months of the project duration. However, 18 per cent of the participants responses revealed that they find it easy predict the probability of the registered risk events for the first 12 months of the project. Figure 6.7 illustrates the percentage of all responses for this question.

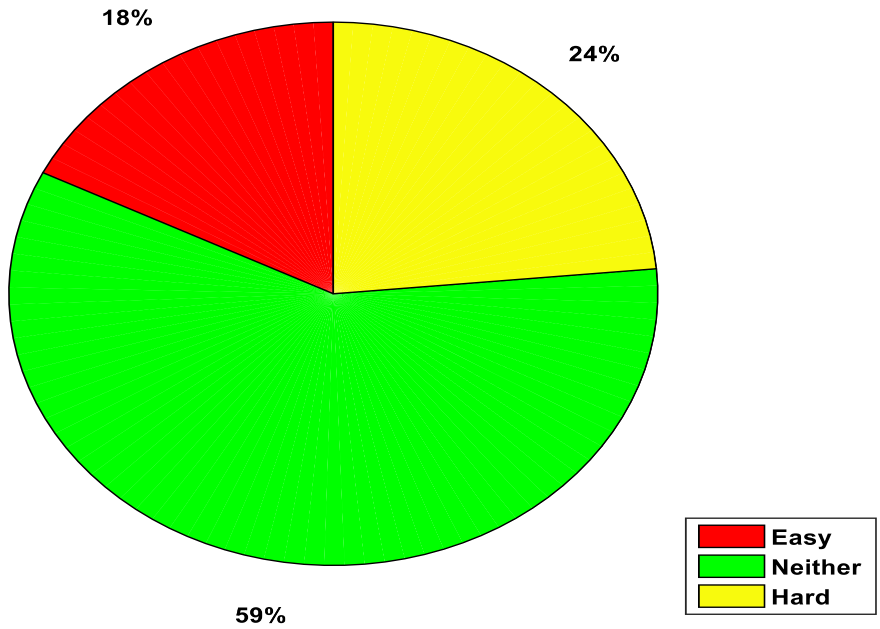


Figure 6.7 Predictions of risk events for first 12 months of a project

iii. The first 18 months of the project duration

The responses for this question show that three per cent of all participants find it easy to predict the probability of the registered risk events for the first 18 months of the project duration. While nine per cent of them said it is neither easy nor hard to predict the probability of the registered risk events for the first 18 months of the project. Furthermore many participant responses (i.e. 85 per cent of the total responses) revealed that it is hard to predict the probability of the registered risk events for the first 18 months of the project. Whereas three per cent of the participant responses express that they find it very hard to predict the probability of the registered risk events for the first 18 months of the project. Figure 6.8 illustrates the percentage of all the responses to this question.

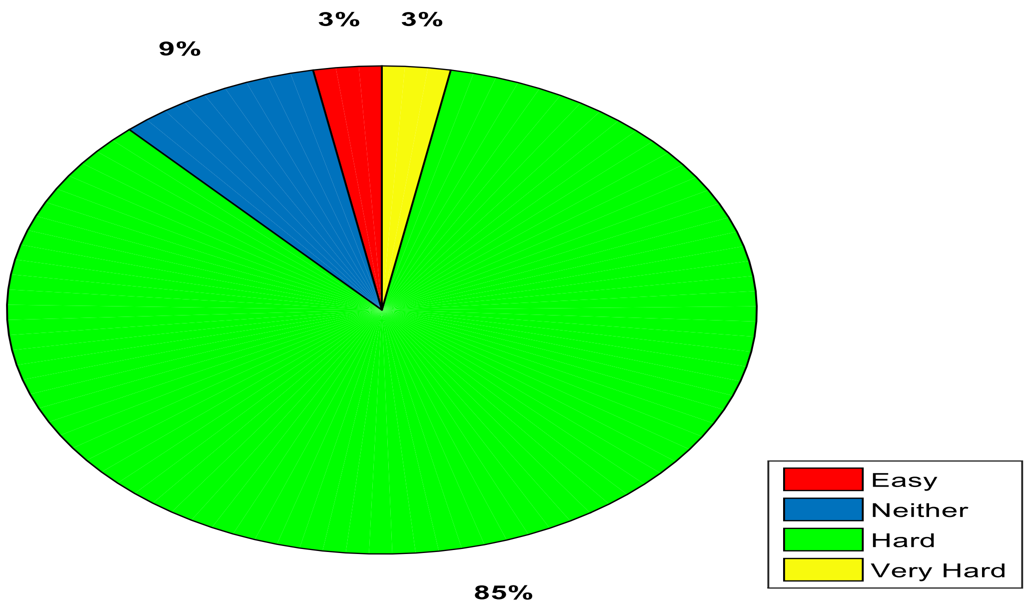


Figure 6.8 Predictions of risk events for first 18 months of a project

iv. The whole 24 months on the project duration

The responses show that three per cent of all participants find it neither easy nor hard to predict the probability of the registered risk events for the whole 24 months of the project duration. Whilst 41 per cent of the participants responded and stated that they found it is hard to predict the probability of the registered risk events for the whole 24 months of the project duration. Furthermore 56 per cent of the participant responses revealed that it is very hard to predict the probability of the registered risk events for the whole 24 months of the project duration. The Figure 6.9 illustrates the percentage of all the participant responses.

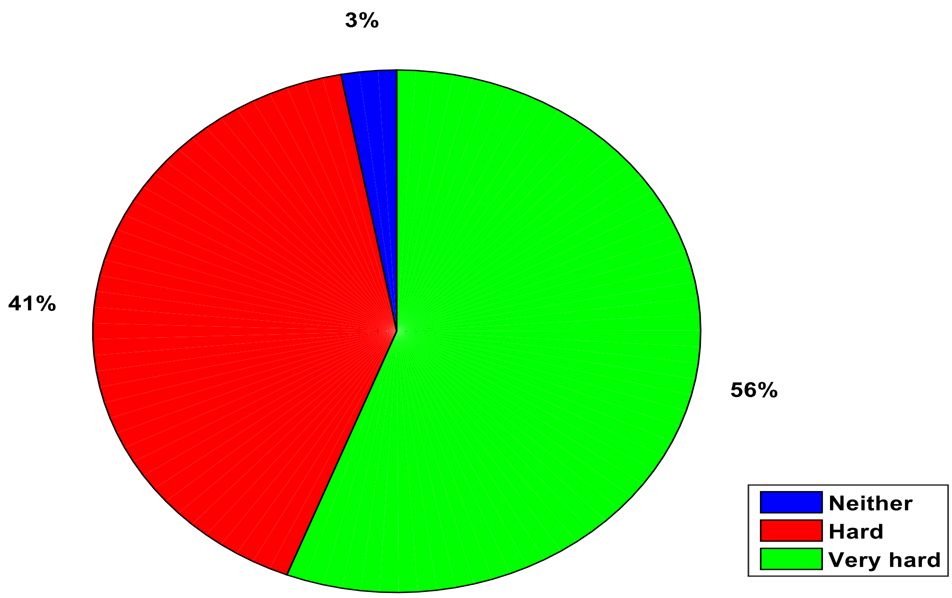


Figure 6.9 Predictions of risk events for 24 months of a project

B- IMPACT

i. The first 6 months of the project duration

The responses to this question show that nine per cent of all participants find it very easy to predict the impact of the registered risk events for the first 6 months of the project. Whilst a large number of participants a total of 76 per cent of participants said that it is easy to predict the impact of the registered risk events for the first six months of the project. Conversely, 12 per cent of the responses from the participants reveal that it is neither easy nor hard to predict the impact of the registered risk events for the first six months of the project. Whereas three per cent of participants' find it is hard to predict the impact of the registered risk events for the first six months of the project. Figure 6.10, illustrates the percentage of all the participant responses to this question.

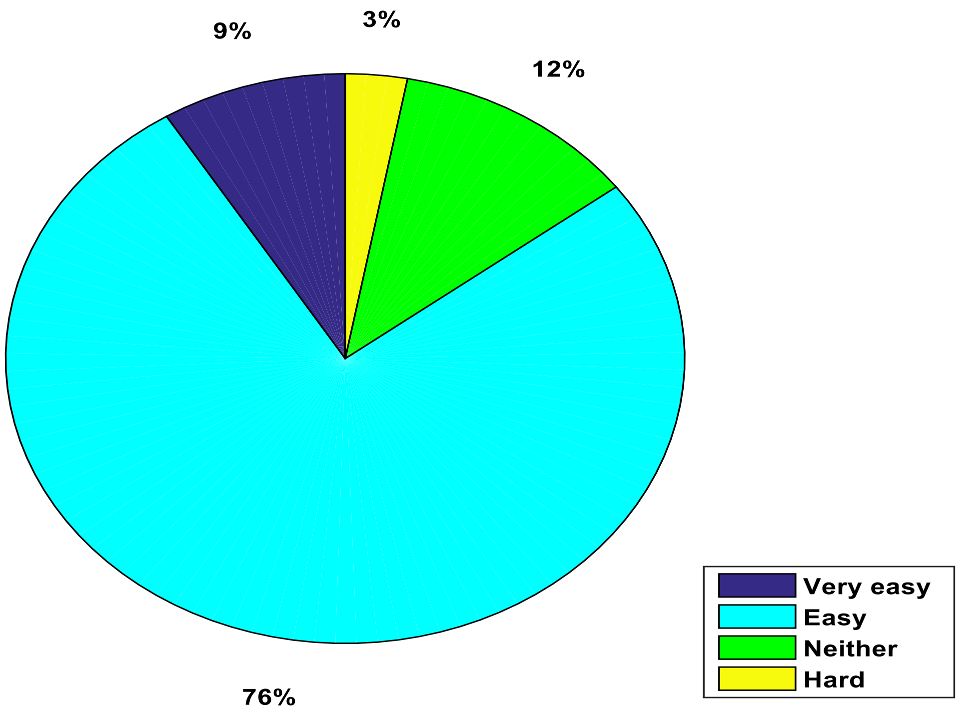


Figure 6.10 Predictions of impact of risk events for first six months of a project

ii. The first 12 months of the project duration

The participant responses show that 32 per cent of all participants find it easy to predict the impact of the registered risk events for the first 12 months of the project. Further, a majority (53 per cent) of participants indicated that it is neither easy nor hard to predict the impact of the registered risk events for the first 12 months of the project. Also, 12 per cent of the participant responses revealed that they find it hard to predict the impact of the registered risk events for the first 12 months of the project, whereas only three per cent of participants' responses indicated that it is very hard to predict the impact of any risk within the first 12 months of the life of a project. Figure 6.11 illustrates the percentage distribution of all the participant responses regarding their ability to predict potential risks and their associated impact within 12 months of the life of a project.

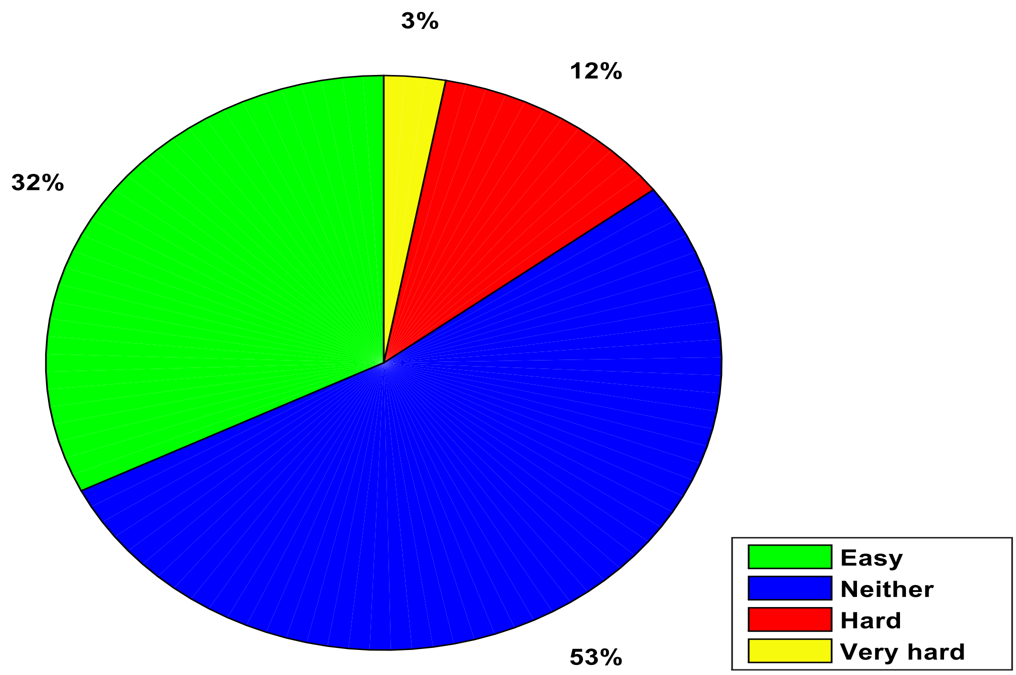


Figure 6.11 Predictions of impact of risk events for first 12 months of a project.

iii. The first 18 months of the project duration

The responses from the participants indicate that nine per cent of all the participants find it easy to predict the impact of the registered risk events for the first 18 months of the project. While 24 per cent of participant's state that it is neither easy nor hard to predict the impact of the registered risk events for the first 18 months of the project. Furthermore, a large number of participants a total of 65 per cent of the participant responses revealed that it is hard to predict the impact of the registered risk events for the first 18 months of the project. Whereas only three per cent of participant's responses affirm that they find it is very hard to predict the impact of the registered risk events for the first 18 months. The Figure 6.12 illustrates the percentage of all the participant responses to this question.

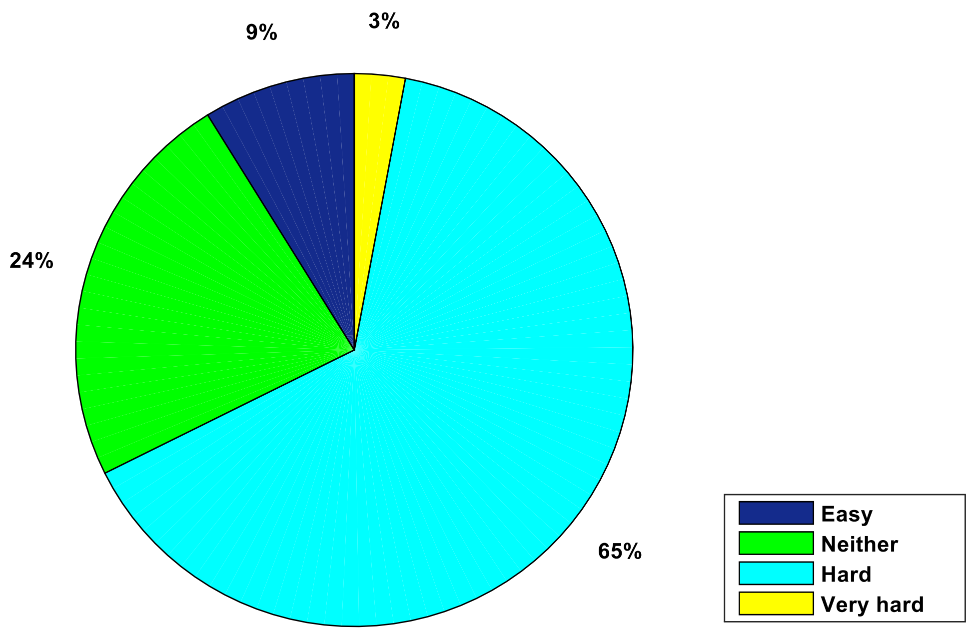


Figure 6.12 Predictions of impact of risk events for first 18 months of a project.

iv. The whole 24 months of the project duration

The participant responses indicate that six per cent of all participants find it easy to predict the impact of the registered risk events for the whole 24 months of the project duration. Whilst only a very small minority of three per cent of the participants responded by saying that it is neither easy nor hard to predict the impact of the registered risk events for the whole 24 months of the project duration. Nevertheless, a majority of the participants responded by 62 per cent of them declaring that it is hard to predict the impact of the registered risk events for the whole 24 months of the project duration. Whereas 29 per cent of participants responded by stating that they find it very hard to predict the impact for the whole 24 months of the project duration. Figure 6.13, illustrates the percentage of all responses for this question.

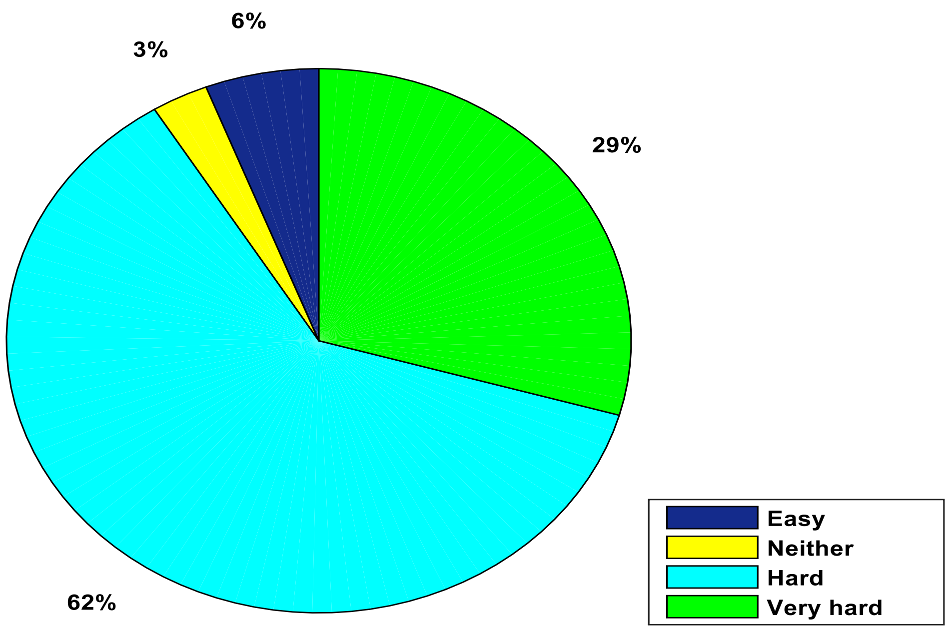


Figure 6.13 Predictions of impact of risk events for the whole 24 months of a project

6.10 Summary

This chapter presented a descriptive analysis of the collected data from 34 participants. The participants' information and background were presented to increase the credibility of the information provided by them. The investigation was conducted to explore the pre-existing concepts and how individual perceive the time dimension of risk (time allowance).

The interviews showed that there is no uniform considerations for the time dimension of risk in setting-up mitigation plan for identified risk events. Consequently, professionals are adopting different approaches in mitigating risks according to their perceptions. Moreover, the findings showed that currently there are three ways differently considered by professionals namely risk level, risk events' nature and project phases. Those three different ways, techniques or philosophies that participants are adopting in perceiving and making decisions related to the time dimension of risk.

Different obstacles with their solutions that have been encountered by practitioners were presented in details. However, many of those obstacles could have been mitigated if there was an adequate attention to the time dimension of risk, which highlights the necessity of establishing a formal concept for the time dimension of risk. Nevertheless, the differences of practitioners' abilities to predict the probability and impact for all identified risk events for different durations of the project are presented. The results have showed that different professionals possess different abilities in providing reliable predictions throughout the project lifecycle, which even increase the necessity of formalising these predictions in order to perform informed decisions.

The significance of the outcomes from the interviews worked as the foundation for further investigation in order to contextualise the nature and characterise the parameters of the time dimension of risk. The next chapter presents a data analysis of the questionnaire.

Chapter 7: Risk Time Dimension Characterisation

7.1 Overview

The results of the questionnaire data analysis are presented in this chapter through analysing the basic characteristics of the respondents as highlighted by the descriptive statistics that was undertaken. This chapter presents the degree of awareness with which professionals estimate risk time dimension for any identified risk event that need to be mitigated. It also presents the sources of information that professionals rely on along with different considered factors on the estimation of the time dimension of risk. The extent to which the time dimension of risk and different risk level for any identified risk event influencing the professionals performed decisions is presented. The study also tried to investigate the possibility of any significant relationship between the characteristics of the sampled professionals and their outcomes and perceptions with regard to risk time dimension.

7.2 General information of participants

This section is to provide background regarding the respondents' experience, and the degrees of implementing risk management in their projects therefore to indicate the degree of reliability of the data provided by them.

The researcher made attempt to investigate in all three organisations/ companies that working in the delivery of project. The Figure 7.1 presents the number of the participants in each organisation/company as they were 48 Clients, 36 Consultants, and 31 Contractors whom have completed the questionnaire. The result of the representative from the different organisation is well balanced since number of all the participants is close. This improves the chances of gaining reliable information from the collected data.

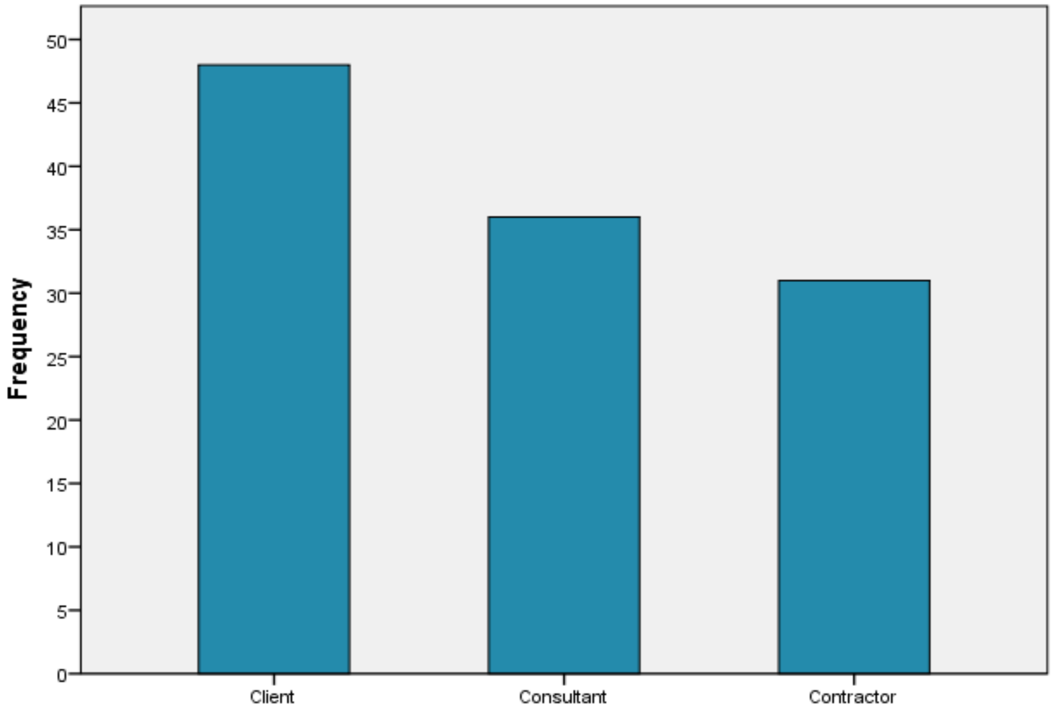


Figure 7.1 Organisation/ Company of the respondents

The Participants were asked to indicate the sectors in which they are working with in the delivery of projects. The breakdown of the responses is shown in the following Figure 7.2.

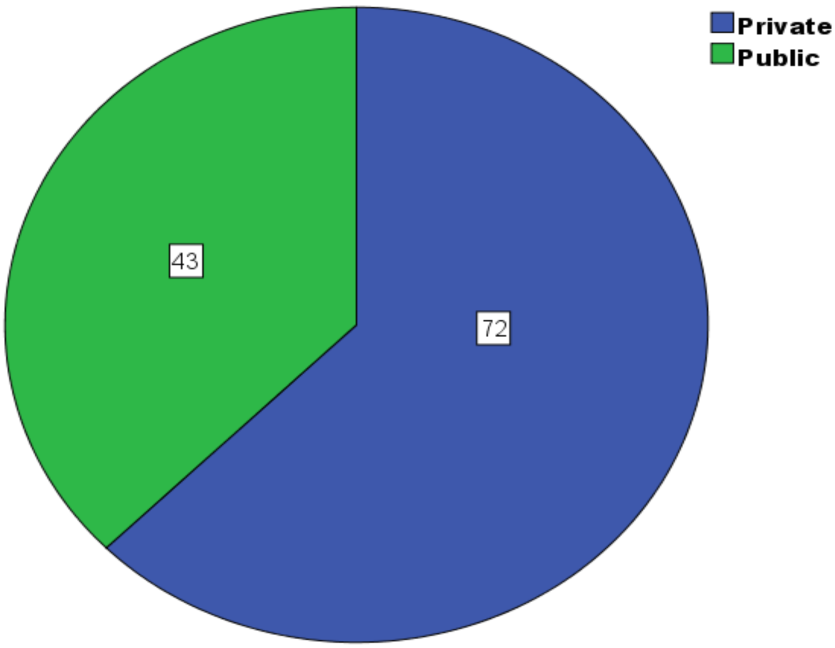


Figure 7.2 Respondents in the different sectors

The responses from the returned completed questionnaires were as presented in the table. It shows that 72 respondents were working in the private sector while 43 participants were from the public sector.

<u>Years of experience</u>

The participants were asked about their level of experience in three different questions to clarify where the different respondents had worked in the past. The respondents were about their years of experience in construction industry, current organisation/company where they are working and experience in their current positions. Figure 7.3, shows the years of experience of participants in the construction industry.

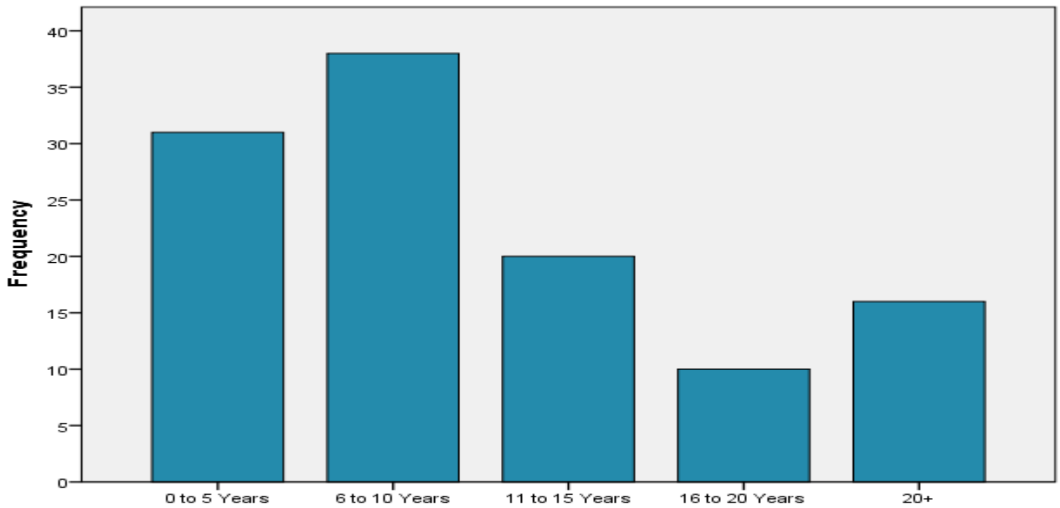


Figure 7.3 Years of experience in construction industry

As it seen from the above figure, there is 41 per cent of respondents have more than 10 years of experience while 32.5 per cent of them with having experience between 6 to 10 years and the remaining 26.5 per cent are with experience falls between 0 to 5 years.

The years of experience for the respondent in the current organisation and current position are shown in Figure 7.4 and 7.5 below.

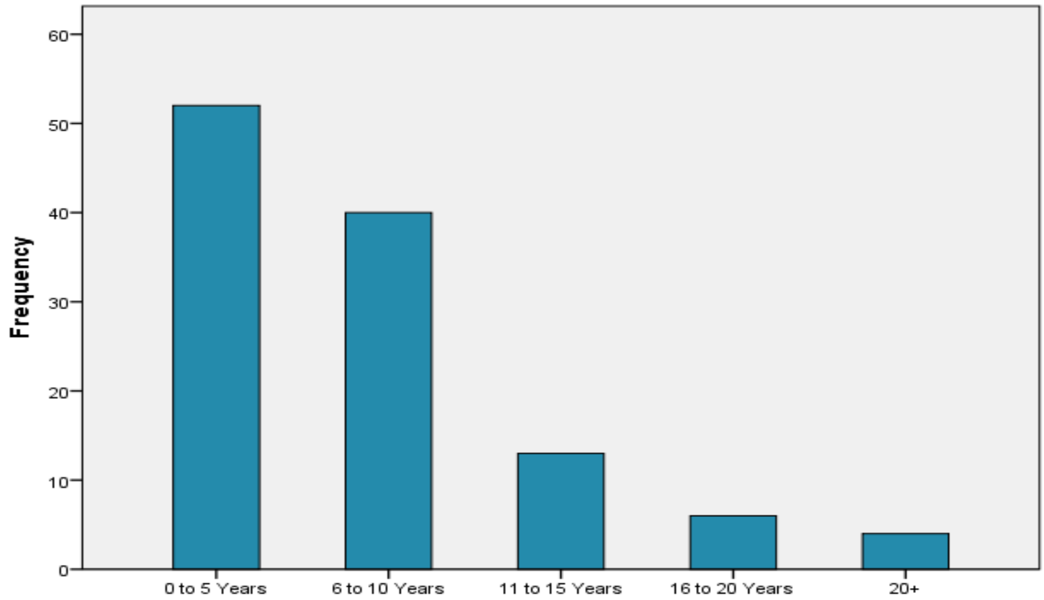


Figure 7.4 Years of experience in current organisation/company

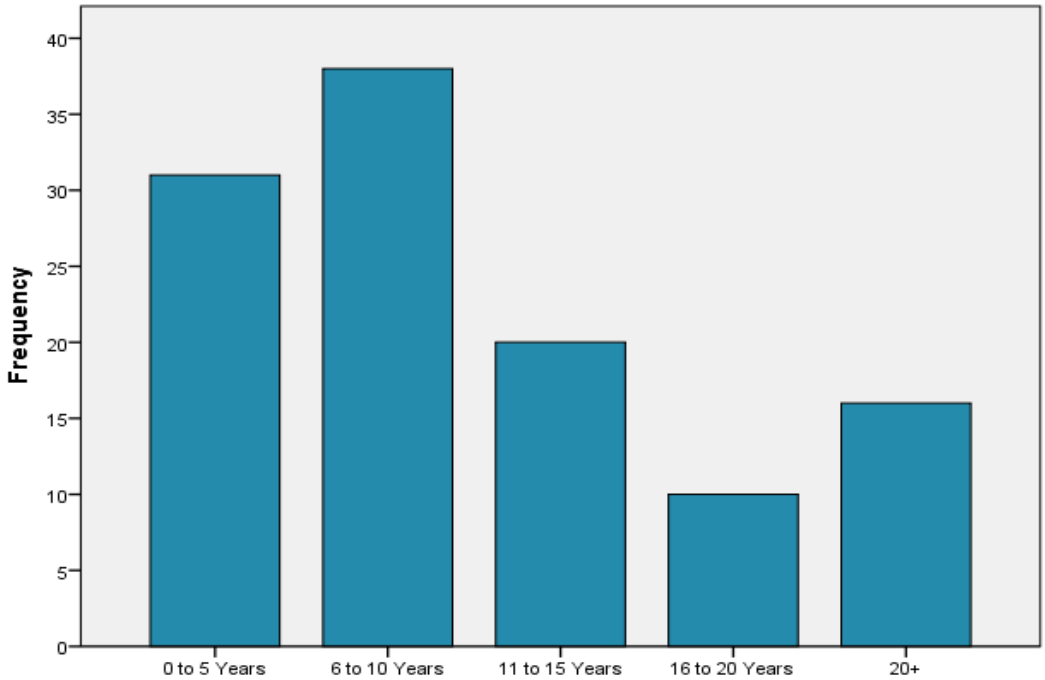


Figure 7.5 Years of experience in current position

Having a great mixture of participants with various years of experience is beneficial in analysing the concept of risk. A concept that is intangible and subjective cannot always be numerically quantified and therefore knowledge and experience of people involved in managing it are so valuable to be evaluated.

Figure 7.6 illustrate the number of projects that have been undertaken by the participant's organisation/company in the last ten years.

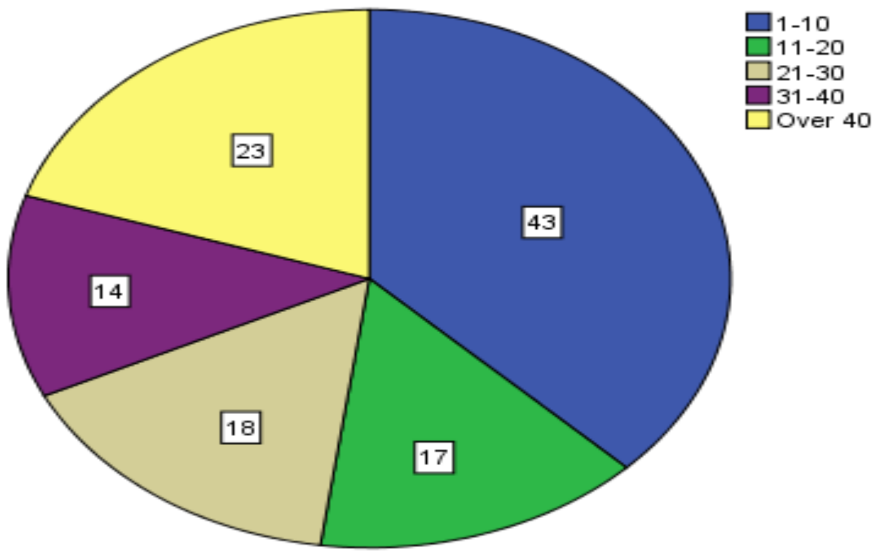


Figure 7.6 Number of projects in the last 10 years

About 37 per cent of the all respondents were working with organisations that had undertaken 1 to 10 projects in last ten years. On the other hand, almost 20 per cent of the organisations in the sample had undertaken over 40 projects in the last ten years.

7.3 Risk management

The participants were asked the give their current status and their opinion about risk management in their projects.

Implementation of risk management

The participants were asked to indicate in an attitudinal scale from one to ten (where 1=never, 2= very rare, 3=Rare, 4=not often, 5=sometimes, 6=often, 7=very often, 8=extremely often, 9=almost always and 10=always), the extent to which they implement risk management in their entire project.

The responses revealed that almost 30 per cent of all respondents were implementing risk management in their entire projects. On the contrary, about 20 per cent of the respondents reported that they used risk management either sometimes or never. This distribution of responses is highlighted in Figure 7.7.

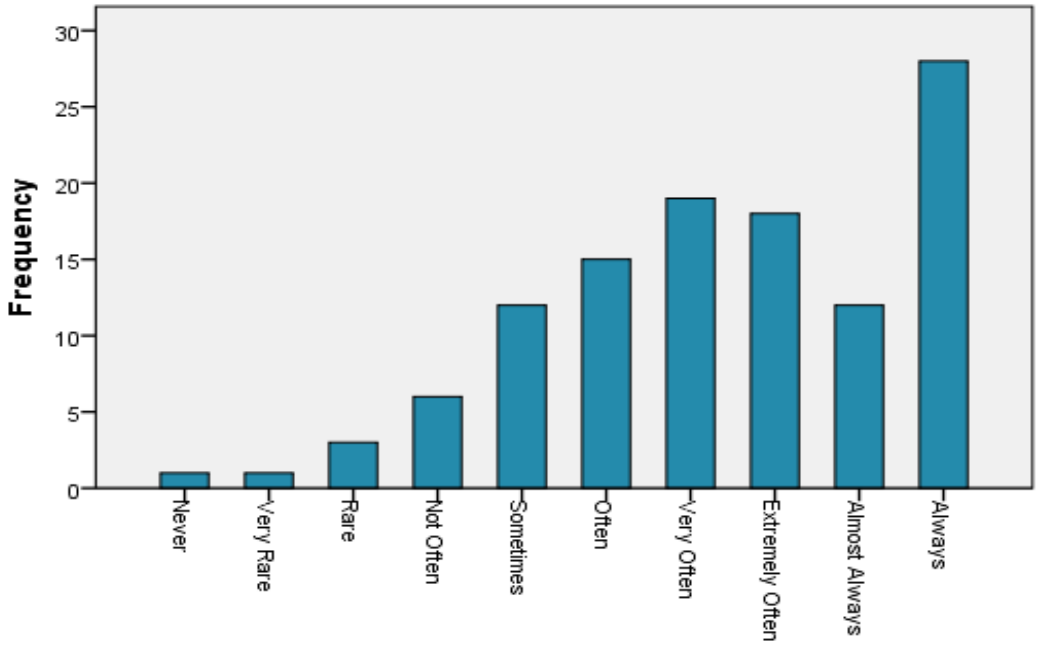


Figure 7.7 Implementation of risk management

Necessity of risks management

The participants were asked about the degree to which they believed implementing risk management in construction projects was necessary. The participants were asked to indicate in an attitudinal scale from one to ten (where 1=not necessary at all, 2= extremely not necessary, 3=very not necessary, 4=not necessary, 5=moderate, 6=I think it is necessary, 7=almost necessary, 8=necessary, 9=very necessary and 10=extremely necessary)

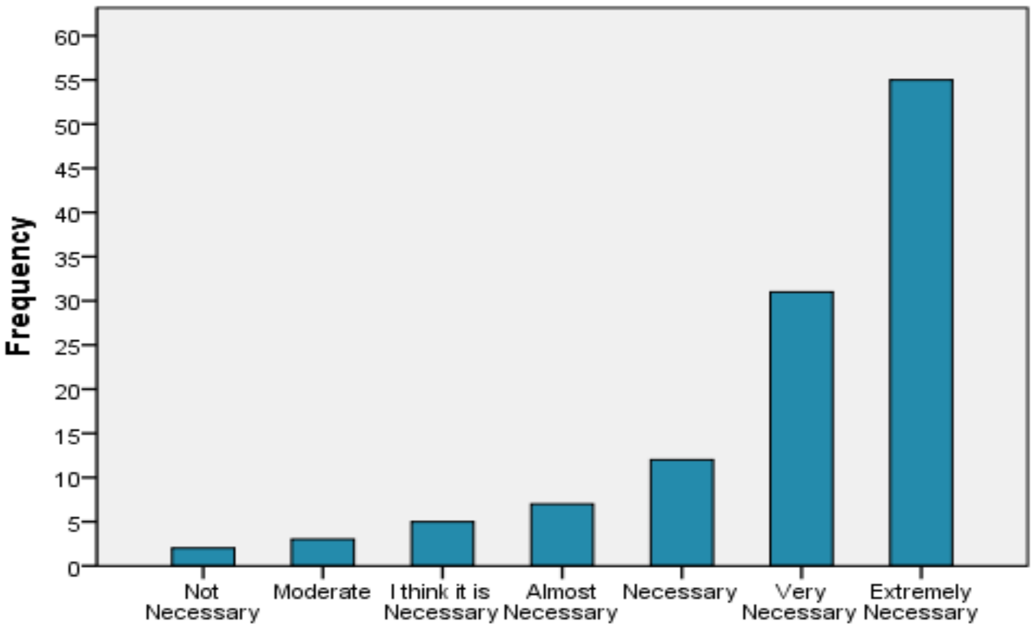


Figure 7.8 Necessity of risk management

As it is illustrated in Figure 7.8, slightly more than four per cent of the respondents think that the necessity of risk management is between moderate and not necessary. However, 47 per cent of the 115 respondents reported that risk management was extremely necessary.

Contribution of risk management

Considering the last question in this section, Figure 7.9 illustrates the participants' point of view about how much risk management has contributed to the success of their projects. The participants were asked to indicate in an attitudinal scale from one to ten (where 1=no contribution at all, 2=almost no contribution, 3=very little contribution, 4= little contribution, 5=moderate, 6=I think it has little contributed, 7=some contribution, 8=quite a lot of contribution, 9= a lot of contribution and 10=extremely contribution)

As indicated in Figure 7.9, there were 24 per cent and 20 per cent participants who stated that risk management has "little contribution" and "some contribution" respectively.

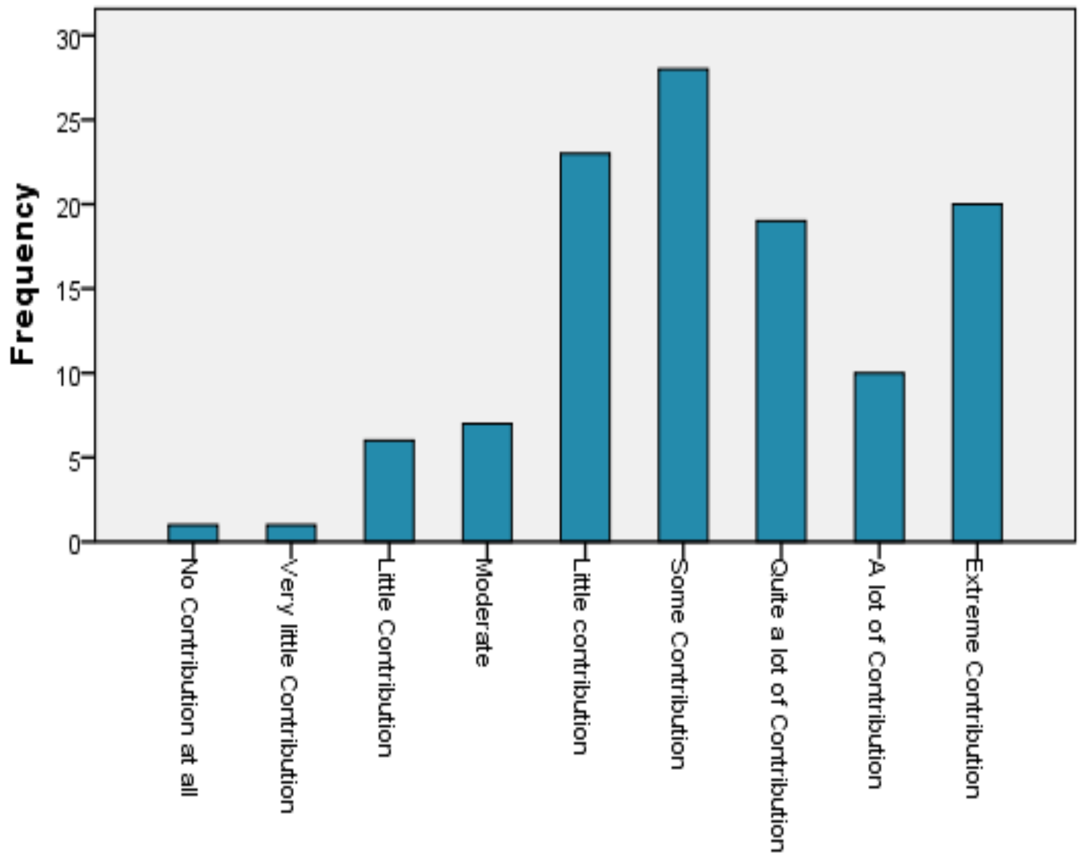


Figure 7.9 Contribution of risk management to the delivery of projects

7.4 Risk time dimension

This section of the questionnaire presents information about how people make time allowance (time dimension) for any identified risk event that has to be mitigated. The respondents were provided with different questions that sought to assess the characteristics of how the different respondents estimated the time dimension of risk.

The participants were asked about how often they estimate the risk time dimension and to indicate that in an attitudinal scale from one to ten (where 1=never, 2= very rare, 3=rare, 4=not often, 5=sometimes, 6=often, 7=very often, 8=extremely often, 9=almost always and 10=always).The findings are illustrated in Figure 7.10. It shows that almost 22 per cent of the respondents stated doing so (very often) while 20 per cent reported (quite often). The third highest response was (always) which was reported by 14 per cent of the sample. In other words, 86 per cent of all participants do not systematically estimate the time dimension of risk. However, only about two per cent revealed that they have (never) estimated the risk time dimension.

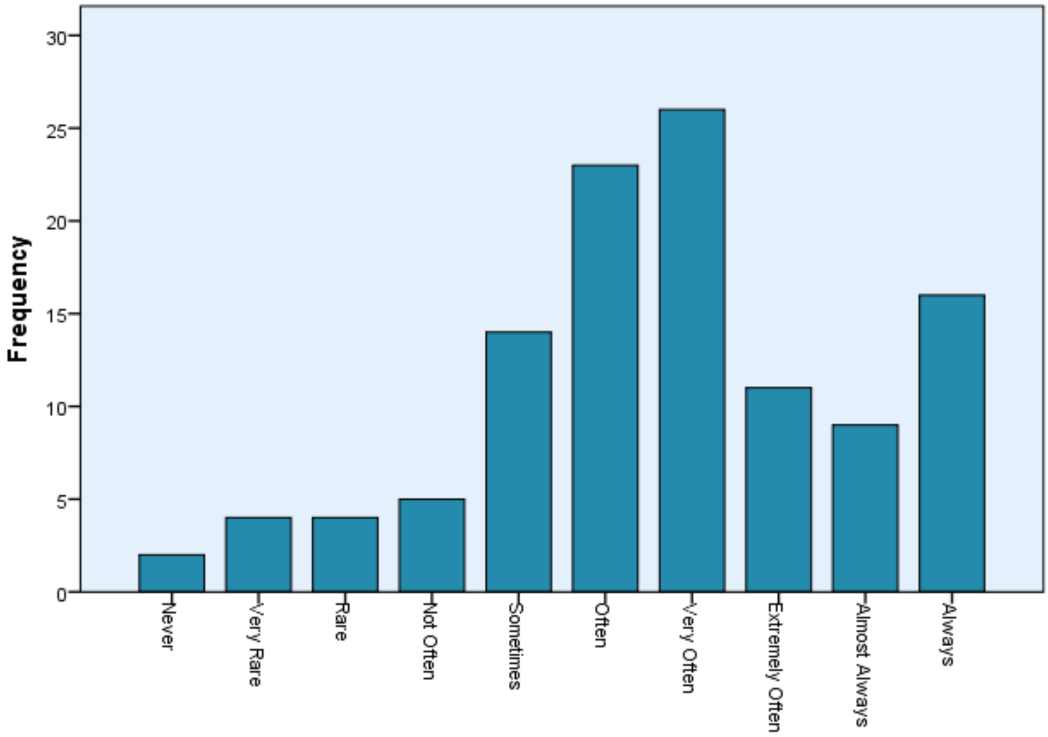


Figure 7.10 Risk time dimension estimation

In order to understand how decision makers estimate the time dimension of risk, the participants were asked to indicate what kind of information they seek. They were also asked to indicate any additional factors they considered in estimating the time dimension and prioritising any identified risk event. Figure 7.11 shows all possible information they request in order to priorities risk events.

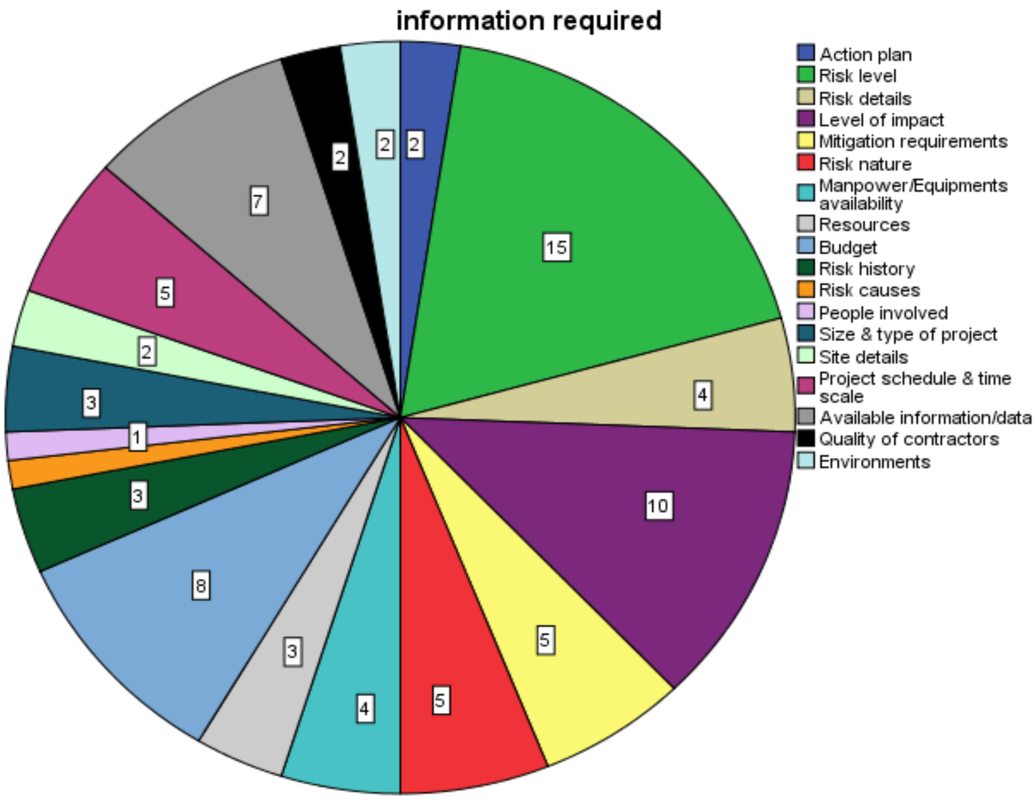


Figure 7.11 Risk time dimension required information

As indicated in the pie chart, the three most common elements were (risk level), (level of impact) and (budget). In order to estimate the time dimension of the most probable risk the respondents look at the level of the risk, the probable impact of the risk and the budget allocated towards risk management and mitigation. Resources and the availability of data about the risks are also main determinate of risk time dimension estimation. Mitigation requirement and project timelines were also identified as the most important factors in risk mitigation.

Table 7.1, presents all additional factors that were presented to the participants and the frequencies of the responses that they gave.

Table 7.1 Additional factors to estimate risk time dimension

Additional factors	Frequency	Additional factors	Frequency
Action plan	14	Quality of contractors	10
Risk level	23	Environments	9
Risk details	9	Time of risk	5
Level of impact	23	Materials	5
Mitigation requirements	11	Politics	2
Risk nature	11	Risk type	9
Manpower/Equipment availability	16	Sequences of related risks	1
Budget	37	People involved	5
Risk history	1	Site details	6
Risk causes	2	Awareness	3
People involved	3	Team work	1
Size and type of project	14	Project schedule	18
Available information/ data	4	Resources	11

As it shown in Table 7.1 above, the three most important elements were similar to the ones in Figure 7.11. This similarity of participant's information aided in combining all responses from Figure 7.11 and Table 7.1 in order to get a clearer picture of the responses provided. This combined information is presented in Table 7.2.

Table 7.2 Combined frequencies of considered factors in estimating the time dimension of risk

Factors	Responses	
	N	per cent
Action plan	16	4.80 per cent
Risk level	38	11.30 per cent
Risk details	13	3.90 per cent
Level of impact	33	9.80 per cent
Mitigation requirements	16	4.80 per cent
Risk nature	16	4.80 per cent
Manpower/Equipment's availability	20	6.0 per cent
Resources	14	4.20 per cent
Budget	45	13.40 per cent
Risk history	4	1.20 per cent
Risk causes	3	0.90 per cent
People involved	9	2.70 per cent
Size and type of project	17	5.10 per cent
Site details	8	2.40 per cent
Project schedule	23	6.80 per cent
Available information/data	11	3.30 per cent
Quality of contractors	12	3.60 per cent
Environments	11	3.30 per cent
Time of risk	5	1.50 per cent
Materials	5	1.50 per cent
Politics	2	0.60 per cent
Risk type	9	2.70 per cent
Sequence of related risks	1	0.30 per cent
Awareness	3	0.90 per cent
Team work	1	0.30 per cent
Total	336	100.00 per cent

From the combined frequencies in Table 7.2, the researcher has categorised the different factors of risk management on of their frequency in the responses. This enabled the different factors to be grouped into three categories (highest attention, medium attention and least attention). Table 7.3 illustrates these categories.

Table 7.3 Allocated categories for all responses

Highest attention Frequencies >20	**Medium attention** Frequencies 11 ≥ 20	**Least attention** Frequencies 1 ≥ 10
Risk level	Action plan	Risk history
Level of impact	Risk details	Risk causes
Budget	Mitigation requirements	People involved
Project schedule	Risk nature	Available information/data
	Manpower/Equipment availability	Environments
	Resources	Time of risk
	Size and type of project	Materials
	Quality of contractors	Politics
		Risk type
		Sequences of related risks
		People involved
		Site details
		Awareness
		Team work

Categorising responses from both questions has provided a better understanding of the risk management practices in the construction industry. It has shown which of the required information and factors have been given more consideration and the ones that have not received adequate attention.

The participants were asked to indicate on an attitudinal scale from one to ten (where 1=never, 2= very rare, 3=rare, 4=not often, 5=sometimes, 6=often, 7=very often, 8=extremely often, 9=almost always and 10=always), how often they prioritised mitigation responses in their projects for any identified risk event. Figure 7.12 shows the responses frequencies gathered from participants

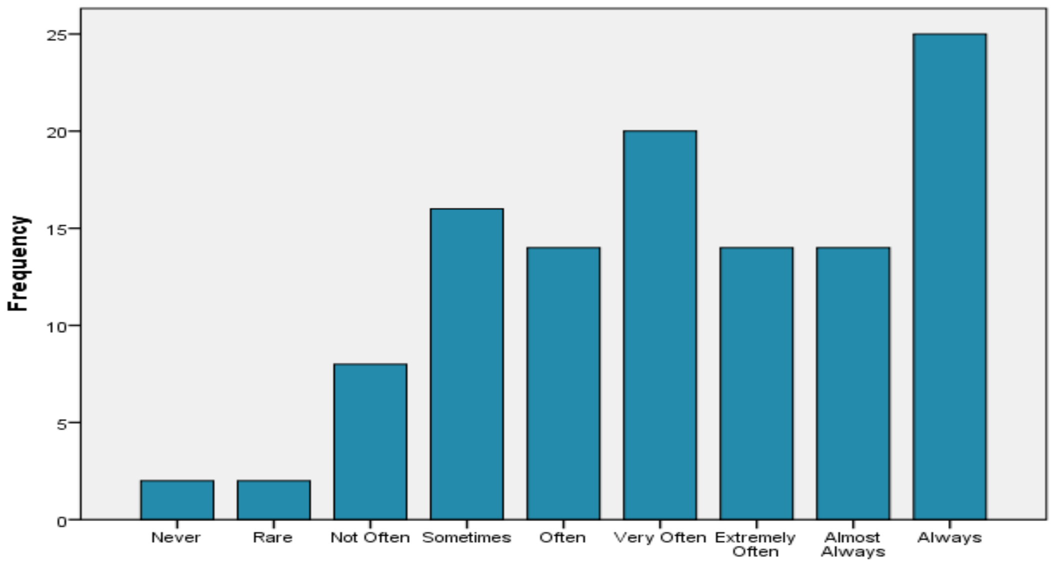


Figure 7.12 Prioritising mitigation responses

Clearly, from the Figure 7.12 above, 22 per cent of the respondents indicated that they always prioritise mitigation responses. In other words, 78 per cent of professionals do not systematically prioritise their mitigation response to risk events according to their time dimension. However, 14 per cent of them stated they prioritised mitigation strategies sometimes in their projects. Twelve per cent of the sample emphasised that they almost always prioritised mitigation responses, which was similar to those reporting the same priorities (extremely often).

Figure 7.13 illustrates the participant's viewpoint on the degree that risk time dimension influences their decisions in the prioritisation of mitigation responses. They were asked indicate on attitudinal scale from 1 to 10 where 10 represented the highest influence. Almost 72 per cent of all respondents reported that time dimension had an influence on their decisions to prioritise mitigation responses between 70 per cent influences and highest influence. Only four per cent reported that time dimension had less than 20 per cent influence on their decisions.

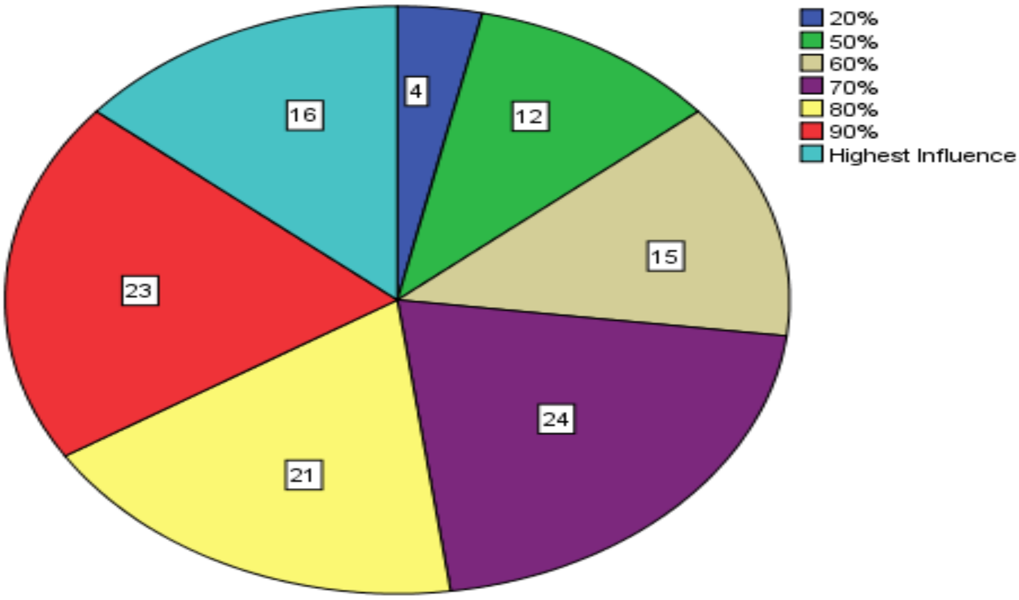


Figure 7.13 Time dimension influences on decisions

People rely on different sources of information in order to make their decisions. The participants were questioned on the most important sources of information that they normally relied on for their decisions. Table 7.4 presents the gathered information from the participants. The most common sources that were reported by participants were personal experience, which accounted for 17.9 per cent. The least common source that participants relied on was application of Mathematical/ Computerised models, which was used by only 12 of the respondents to make their decisions. However, almost 83.7 and 85.9 per cent do not rely or take the available information about a risk event and the risk event's nature, respectively as sources of information.

Table 7.4 Sources of information

		Responses		per cent of Cases
		N	per cent	
Sources	Personal experience	81	17.9 per cent	70.4 per cent
	The risk event's nature	64	14.1 per cent	55.7 per cent
	The risk event's level	63	13.9 per cent	54.8 per cent
	The available information about it	74	16.3 per cent	64.3 per cent
	Mathematical/Computerised Model	12	2.6 per cent	10.4 per cent
	Risk data base	58	12.8 per cent	50.4 per cent
	Personal judgment	34	7.5 per cent	29.6 per cent
	Pulled experience of several risk managers or executives	24	5.3 per cent	20.9 per cent
	External advice or consultant	43	9.5 per cent	37.4 per cent
Total		453	100.0 per cent	393.9 per cent

The reliability of the estimation of the risk time dimension is different from one person to another. Figure 2.14 present the responses from all participants in this regard. They were asked to indicate in an attitudinal scale from one to ten (where 1=not reliable at all, 2= extremely not reliable, 3=very not reliable, 4=not reliable, 5=moderate, 6=i think it is reliable, 7=quite reliable, 8= reliable, 9=very reliable and 10=extremely reliable), the reliability of their estimations of the time dimension of risk..

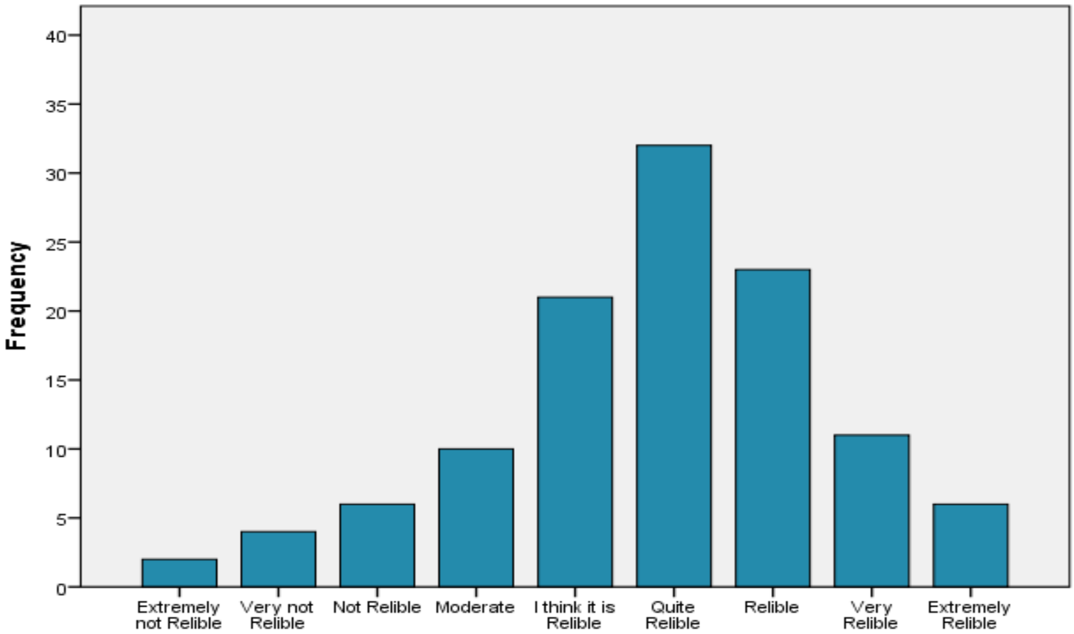


Figure 7.14 Estimation reliability of the time dimension of risk

From the above Figure, almost 27 per cent of all respondents stated that their estimation were (quite reliable) while about five per cent indicating that their estimation were (extremely reliable). On the other hand, only two responses out of 115 participants have indicated that their estimation were extremely not reliable.

The participants were provided with nine sources of information and required to rank them from the most important to the least important resource that the participant would consider in the estimation of the time dimension of risk.

Table 7.5, presents the collected responses from all participants. It shows that the most important source of information is (personal experience) and the second most important source is the (information about the risk event). The least important source of information they would consider is (External advice), and the second least important source is (Mathematical/ Computerised model)

Table 7.5 Resources ranking

Resources	Extremely important	Very important	Important	Quite important	Somehow important	Quite not important	Not important	Very not important	Extremely not important
Personal experience	34	12	14	6	15	10	6	8	4
The risk event's nature	6	25	15	16	8	14	10	8	7
The risk level	12	19	20	14	16	8	2	6	12
The available information about it	18	9	14	16	16	14	6	8	8
Mathematical/ Computerised model	8	4	10	16	12	4	19	18	18
Risk database	9	10	8	9	12	23	18	10	10
Personal judgment	6	18	12	4	17	10	19	11	12
Pulled experience of several managers or executives	4	6	6	14	4	19	17	22	17
External advice	12	4	10	10	9	7	14	18	23

Risk level categories are High, Medium and Low. Participants were asked to indicate which category they would consider in mitigation plan (Noting that they can choose more than one category). Table 7.6 shows the frequencies of the responses to this question.

Table 7.6 Considered risk category frequencies

		Responses		per cent of Cases
		N	per cent	
Risks Category	High risk level	89	43.2 per cent	77.4 per cent
	Medium risk level	95	46.1 per cent	82.6 per cent
	Low risk level	22	10.7 per cent	19.1 per cent
Total		206	100.0 per cent	179.1 per cent

About 10.7 per cent of the respondents indicated their interest in considering Low risk level. High and medium risk level had significantly higher levels of interest from the participants being reported by 43.2 per cent while medium risk level was highlighted by 46.1 per cent.

The degree of which risk level affects decisions on estimating the time dimension of risks in order to mitigate them is presented in Figure 7.15. As it can be seen, there is no clear picture or percentage of the degree in which risk level affects decision. However, the top five most common responses from the respondents indicate that risk level has a significant effect on their risk decisions. The responses indicate that 20 per cent reported 50 per cent effect and 70 per cent.

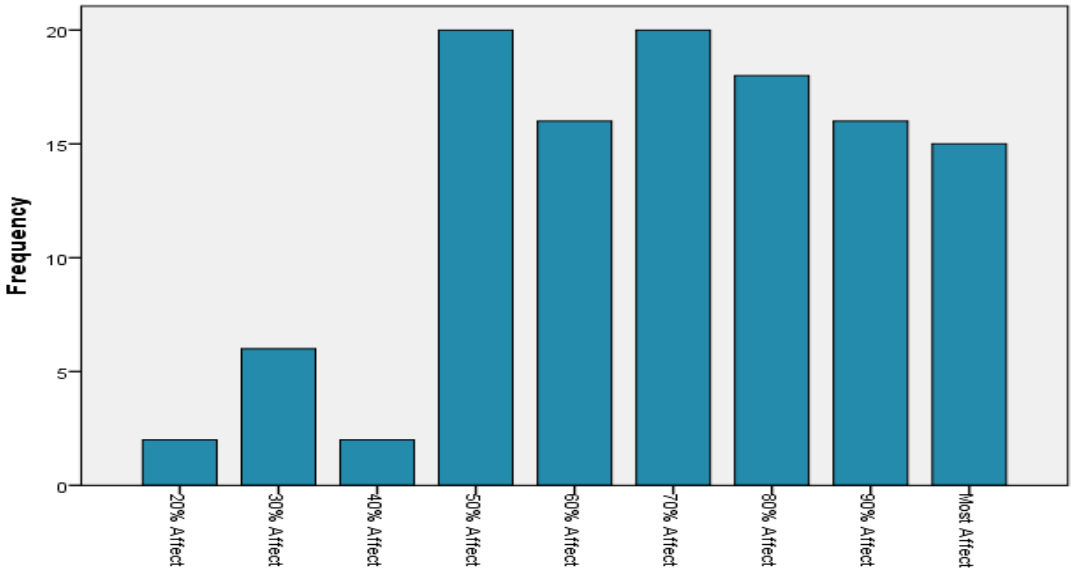


Figure 7.15 Risk level of effect on decisions

There are different Strategies/ approaches that can be considering in setting-up the mitigation plan by decision makers. Participants were asked to specify which strategy/approach they would consider in setting-up their mitigation plan. Table 7.7 presents the responses of all participants. It shows that the two most common approaches are (Risk events' nature) and (The nature of mitigation requirements) with percentage of 36.9 per cent and 33.3 per cent respectively.

Table 7.7 Mitigation approaches frequencies

		Responses		per cent of Cases
		N	per cent	
Strategy	What comes first	16	11.3 per cent	13.9 per cent
	Risk events' nature	52	36.9 per cent	45.2 per cent
	No particular order	20	14.2 per cent	17.4 per cent
	The nature of mitigation	47	33.3 per cent	40.9 per cent
	Laissez faire	4	2.8 per cent	3.5 per cent
	Other	2	1.4 per cent	1.7 per cent
Total		141	100.0 per cent	122.6 per cent

The participants were asked to explain how they establish the order of priority for any identified risk event that has to be mitigated. Only 43 of 115 participants answered the question. Table 7.8, presents the mentioned factors that they would look at in order to establish their decisions.

Table 7.8 The establishment of the order of priority

	Frequency	per cent
Risk level	12	27.90 per cent
Risk details	1	2.30 per cent
Level of impact	5	11.60 per cent
Mitigation requirements	6	14 per cent
Risk nature	4	9.30 per cent
Manpower/ Equipment's availability	1	2.30 per cent
Resources	2	4.70 per cent
Budget	1	2.30 per cent
People involved	1	2.30 per cent
Project schedule	1	2.30 per cent
Available information/data	2	4.70 per cent
Environments	1	2.30 per cent
Time of risk	3	7 per cent
Risk type	3	7 per cent
Total valid responses	43	100 per cent
Missing	72	
Total	115	

The majority of the responses show that the risk level is the most important factor that is considered while the second one is mitigation requirements. Level of impact that the risk has on operations or success of the project was the third most important factor in the sample.

Finally, the participants were required to indicate how sufficient they thought it was their estimation of the time dimension of any identified risk event. They were required to indicate that in an attitudinal scale from one to ten (where 1=not sufficient at all, 2= extremely not sufficient, 3=very not sufficient, 4=not sufficient, 5=moderate, 6=I think it is sufficient, 7=quite sufficient, 8= sufficient, 9=very sufficient and 10=extremely sufficient). Figure 7.16 shows that the majority of respondents (51 per cent) considered their estimations are up to 50 per cent sufficient. However, about 17 percent of participant considered it to be (quite sufficient) while 16 per cent reported it being (sufficient). About ten per cent of the respondents thought it was very sufficient while six per cent reported extremely sufficient. Less than 20 per cent of the sample reported moderate or low levels of sufficiency.

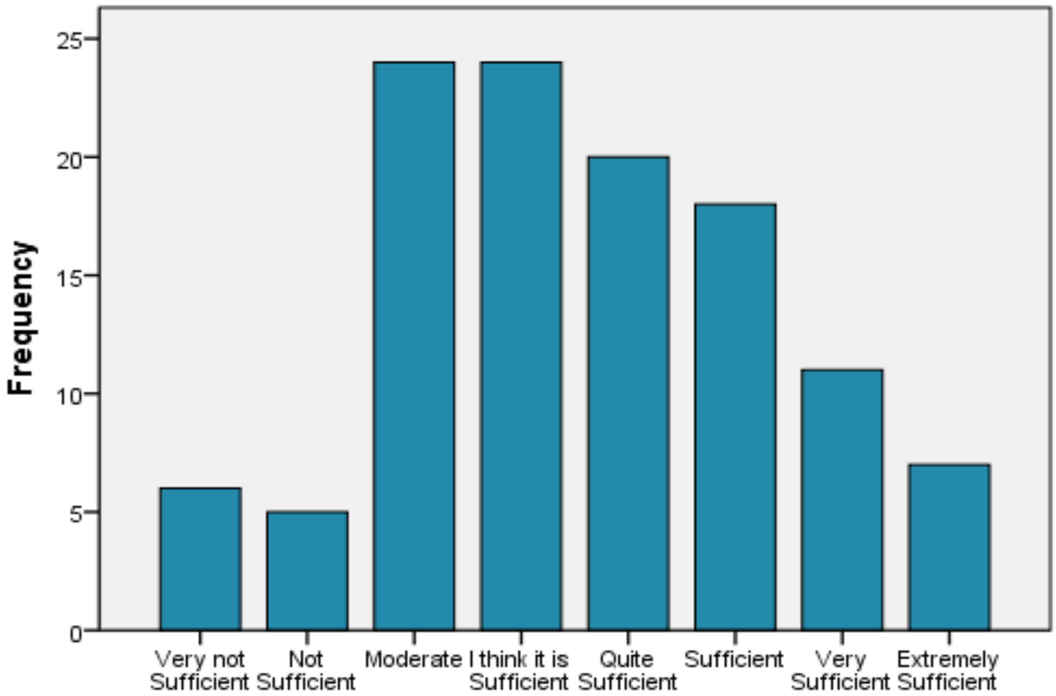


Figure 7.16 Estimation sufficiency of risk time dimension

7.5 Data normality test

In the collection of data which can be quantified, it is important to determine whether the collected data follows some form of distribution that can help better understand the nature of the data itself. Thode (2002) highlighted the importance of testing for the normality of data during quantitative analysis as it provides the foreground for conducting further statistical analyses on the data. Normal distribution is a common phenomenon in statistics and is used often for describing the distribution of data where the graphical presentation of data depicts a symmetric bell curve. Moreover, the normality of data can be assessed either numerically or graphically (Thode, 2002). In this study, there is no prior assumption for the distribution of data and hence it is important to assess data normality through both techniques

Within the questionnaire, some of the questions are open-ended and hence cannot be assessed properly through statistical analysis. The questions which can be tested properly through statistical analysis include questions 9, 12, 13, 15, 18 and 21. Therefore, the normality of data will also be assessed through these questions. The normality of data also assesses whether the data are parametric or non-parametric, which is an important attribute of data. Conducting the test of normality on this data, the following Table 7.9 is achieved:

Table 7.9 Normality tests for questions 9, 12, 13, 15, 18 and 21

	Kolmogorov-Smirnova			Shapiro-Wilk		
Question	Statistic	df	Sig.	Statistic	df	Sig.
Estimating the time dimension of risk	0.125	114	.000001	0.946	114	.000001
Prioritising mitigation responses	0.133	114	.0001	0.926	114	.0001
Time dimension of risk influence decision in prioritising mitigation responses	0.134	114	.001	0.917	114	.001
Reliable estimation of the time dimension of risk	0.169	114	.00001	0.950	114	.00001
Risk level effect the estimation of the time dimension of risk	0.115	114	.001	0.946	114	.001
Sufficiency of required time estimation for mitigating risk events	0.205	114	.001	0.956	114	.001

Table 7.9, presents the Komogorov-Smirnova and Shapiro-Wilk tests for normality and they present the distribution of the data. Based on a statistical significance less than 0.05 for the Shapiro-Wilk test, it can be determined that the data item deviates significantly from a normal distribution. In this case, the statistical significance for all questions is less than 0.05 thus suggesting that the normality of data cannot be established as it significantly deviates. Based on the non-normal nature of the data, it can be determined that the dataset is nonparametric. Due to the distribution of the data in this manner, any test that requires the assumption of normal distribution of data cannot be applied to this dataset and hence the researcher will have to make use of nonparametric tests for correlation.

7.6 Associations between variables

The responses indicate that the sample was significantly diverse with most of the participants being clients in the organisations. The clients accounted for about 42 per cent of the sample while the consultants made up 31 per cent while contractors were 27 per cent of the study participants. Another important element of the study was the distinction between private and public companies. Most of the projects were undertake by organisations in the private sector accounting for 62.6 per cent of the sample. A closer look at the sample indicates that most of the respondents were highly experience in the industry as well as having been in the organisation for more than five years. A significant proportion of the sample (43) indicated that their companies had undertaken ten or fewer projects in the past ten years. Only 23 per cent of the organisations had undertaken more than 40 projects while 55 of them had been involved in more than 20 projects over the same period.

The focus on the project was on the application of risk management in the different organisations involved in the construction industry. About 30 per cent of the sample indicates that they were undertaking risk management practices in their organisations while 20 per cent of them indicated very little consideration of risk management reporting implementation in some situations or never. This aligned with the perceptions of the respondents about the necessity of risk management in their operations. Forty seven per cent of the sample reported that risk management is extremely relevant and important to their operations. The study sought to understand how different respondents and organisations consider the relevance of risk management in their operations and the outcomes it has in producing beneficial outcomes for them. Relationship between dimensions and element of risk management and the respondents were considered in order to make conclusions about the contributing factors.

7.7 Factors influencing the application of risk management

In order to assess the different element that may affect the application of risk management in the construction industry, chi-square tests were applied. The test of association was used to assess whether the type of respondent significantly influenced their willingness to use risk management. The aim of this test was to determine whether the type of respondent would influence how often they applied risk management. While the clients reported the highest proportion of respondents indicating that they always used risk management, the chi-square test of association presents a different case shown in Table 7.10.

Table 7.10 Chi-Square tests of type of respondents and risk management implementation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.730[a]	18	.542
N of Valid Cases	115		

The chi-square statistic for the relationship was 16.73, $p = 0.542$. This indicates that the association was not significant and the likelihood of using risk management was not related to the type of respondents. This indicates most of the behaviour of respondents to use risk management strategies is similar across professional borders. Spearman's rank correlation was also applied to assess whether there was a correlation between the type of respondents and risk management implementation. The correlation presented in Table 7.11 is also shown to be insignificant because it has a p value of .391.

Table 7.11 Symmetric measures of type of respondents and risk management implementation

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Spearman Correlation	.081	.096	.862	.391[c]
N of Valid Cases		115			

Another possible factor that may influence the application of risk management is the level of experience that an individual has in the industry. In this case, experience is likely to influence the perceptions that individuals have about risk management. This is because increased experience may increase the effectiveness of an individual in responding to risks hence it may lower the need for risk management. A quick look at the data indicates that individuals with less than five years' industrial experience were the largest proportion that reported as always using risk management. The chi-square test of association was applied to assess whether the difference was significant between the applications of risk management based on experience of the respondents.

Table 7.12 Years of experience in construction industry * Implementation of risk management Cross tabulation

		Implementation of risk management										Total
		Never	Very Rare	Rare	Not Often	Sometimes	Often	Very Often	Extremely Often	Almost Always	Always	
Years of experience in construction industry	0 to 5 Years	1	0	1	3	4	3	4	4	2	9	31
	6 to 10 Years	0	0	1	2	6	2	6	9	5	7	38
	11 to 15 Years	0	0	0	0	1	7	3	2	3	4	20
	16 to 20 Years	0	1	0	0	1	0	2	0	2	4	10
	20+	0	0	1	1	0	3	4	3	0	4	16
Total		1	1	3	6	12	15	19	18	12	28	115

The cross tabulation indicates that there may be an association between the application of risk management in projects and the experience that the respondents had in the industry. However, using the chi-square test of association indicates that the chi-square statistic for the association was 42.74, p= .204 as shown in Table 7.13.

Table 7.13 Chi-Square tests of Years of experience in construction industry * Implementation of risk management

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	42.744[a]	36	.204
N of Valid Cases	115		

This means the expected relationship is not supported by the available data. As a result, the level of experience of different individuals in the industry does not significantly influence the application of risks management strategies. Similarly, the rank correlation coefficient does not show any relationship between the occurrences of the two variables.

7.8 Perceptions about the necessity of risk management

The perception of the respondents about the relevance of risk management was considered in the analysis. The focus of the assessment was to determine the factors that influence the perceptions of professionals in the construction industry about risk management. Cross tabulation was undertaken between the necessity of risk management, number of projects in the last ten years, the contribution of risk management to project success, and experience in the industry. A cursory look at the data indicates that most of the respondents considered risk management very necessary or extremely necessary. Chi-square statistic for the relationship shows that the necessity of risk management was a matter of individual professional judgment as opposed to the number of projects undertaken. With the chi-square being considered insignificant, this means having a large number of projects or experience does not necessarily increase the perception of risk and the strategies adopted to mitigate them.

It is also clear from the chi square statistics that there is no significant correlation between the levels of experience in the industry or organisation with the perceptions that professional have about the necessity of risk management. This indicates that experience in the industry does not act as a mitigating factor for the fear of loss in projects. A major issue that was considered in the analysis was the relationship between the perceptions of the respondents about the importance of risk management. This was compared with the perceptions of the respondents about the contribution of risk management to project success. Most respondents reported that risk management had a significant contribution to the success of their projects. They also reported that risk management was a highly relevant element of project management.

The cross tabulation is indicated in the Table 7.14, and it shows the strong association between risk management relevance and its contribution to project success.

Table 7.14 Cross tabulation of Contribution of risk management to the delivery of projects and Necessity of risk management

Crosstab										
		Contribution of risk management to the delivery of projects								Total
		No Contribution at all	Very little Contribution	Little Contribution	Moderate	I think it has Contributed	Some Contribution	A lot of Contribution	Extreme Contribution	
Necessity of risk management	Not Necessary	1	0	0	0	0	0	0	1	2
	Moderate	0	0	1	1	0	1	0	0	3
	I think it is Necessary	0	0	1	1	3	0	0	0	5
	Almost Necessary	0	0	0	1	2	2	2	0	7
	Necessary	0	1	2	1	0	3	3	0	12
	Very Necessary	0	0	1	2	8	10	5	0	31
	Extremely Necessary	0	0	1	1	10	12	9	19	55
Total		1	1	6	7	23	28	19	20	115

The chi-square statistic presented in Table 7.15 for the two variables is 124.02, which is significantly high with a p-value of .003. The high significance of the chi-square statistic indicates that the two variables are strongly related. In effect, the respondents who perceived risk management positively in terms of its contribution to their overall project success also considered it a necessity in their project management activities in the construction industry.

Table 7.15 Chi-Square Tests of Contribution of risk management to the delivery of projects and Necessity of risk management

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	124.025[a]	48	.003
N of Valid Cases	115		

7.9 Time dimension

The issue of estimating the time dimension of risk is a major element in the success of a project. It determines the capacity of an organisation to respond to the needs of the projects within the allocated time. Different factors are considered in determining the time risk dimension. The strategies applied in determining the risk time dimension in order to successfully complete a project should have a significant influence on the perceptions of project practitioners about the accuracy of the risk time dimension estimation. This element was tested in the study using a cross tabulation and chi-square test of association. The results of the cross tabulation indicate that the most common factor in risk time estimation was the level of risk that the organisation faced followed by mitigation requirements and the potential level of impact of a risk event on project. However, these factors were not related to either high or low sufficiency of estimation. This element is clearly shown by the cross Table presented and the chi-square statistics. This may indicate that the outcomes of the time risk estimation for a project are not related to the factors that are applied in estimating the risk.

Spearman's rank correlation was applied in the study to assess whether experience in the industry was significantly associated with the priorities that the respondents made. In this case, the focus was to determine whether individuals with varying levels of experience in the industry were likely to consider prioritising risk events differently. The analysis indicates that such a relationship was not observed in the current study.

Table 7.16 Correlation between years of experience in construction industry with prioritising mitigation responses

			Years of experience in construction industry	Prioritising mitigation responses
Spearman's rho	Years of experience in construction industry	Correlation Coefficient	1.000	.122
		Sig. (1-tailed)	.	.097
		N	115	115
	prioritising mitigation responses	Correlation Coefficient	.122	1.000
		Sig. (1-tailed)	.097	.
		N	115	115

The correlation coefficient in Table 7.16 indicates that the coefficient for the two variables was 0.122. This indicates a weak positive relationship between the two variables. However, looking deeper into the analysis indicates that the association is not significant because the p-value > .05 at .097. This measurement indicates that the relationship between the two variables is not significant and therefore, it cannot conclude that the level of experience has a significant correlation with the strategies adopted for estimating the risk time dimension risk and eventually prioritising mitigation responses accordingly.

7.10 Correlation testing

There are a number of different types of correlation coefficients that can be used for assessing the similarities in trends between data items. The purpose of assessing correlation is to discover relationships between the collected data and while the correlation coefficients do not suggest connections, they do indicate which the likelihood of data items to behave in a certain manner in relation to a certain value of another data item. Through correlations, it can be better understood whether respondents were likely to answer on a higher scale to two answers. Based on these correlation coefficients, the researcher can also analyse similar patterns in the data. For this, the Pearson product moment correlation and Spearman's rank order correlation are used most popularly, where the Spearman test is used when the data is not normally distributed while, the Pearson test is used when the data is normally distributed. Both Spearman's and Pearson correlation coefficient measure the direction and strength of the association between a set of variables on different intervals. The correlation test draws a best fit line through a set of variables and the Pearson coefficient explains how much the data points deviate from this line. The Pearson correlation requires four assumptions, which include data intervals, linear relationship, no significant outliers and normal distribution. However, due to the inability of achieving the fourth assumption (normal distribution), the Pearson test cannot be applied in the case of this set of data and hence the Spearman test will be considered as more appropriate. The Spearman rank order correlation is considered to be more suitable for nonparametric data and it has two main assumptions, which include ordinal variables, which means that the variables must be measured on intervals and the relationship between variables should be monotonic such that the direction of the relationship does not change at different levels of the data. Based on this, the Spearman test was conducted and the results are presented in Table 7.17.

Table 7.17 Spearman Rank Order Correlation Test

		Sufficiency of required time estimation for mitigating risk events (Q21)	Risk level effect the estimation of the time dimension of risk (Q18)	Reliable estimation of the time dimension of risk (Q15)	Time dimension of risk influence decision in prioritising mitigation responses (Q13)	Prioritising mitigation responses (Q12)	Estimating the time dimension of risk (Q9)
Sufficiency of required time estimation for mitigating risk events (q21)	Correlation Coefficient	1.000	.066	.318**	.531**	.544**	.231*
	Sig. (2-tailed)		.480	.001	.000	.000	.013
	N	115	115	115	115	115	114
Risk level effect the estimation of the time dimension of risk (Q18)	Correlation Coefficient	.066	1.000	.340**	.367**	.156	.024
	Sig. (2-tailed)	.480		.000	.000	.096	.801
	N	115	115	115	115	115	114

Reliable estimation of the time dimension of risk ((Q15)	Correlation Coefficient	.318**	.340**	1.000	.393**	.460**	.205*
	Sig. (2-tailed)	.001	.000		.000	.000	.029
	N	115	115	115	115	115	114
Time dimension of risk influence decision in prioritising mitigation responses (Q13)	Correlation Coefficient	.531**	.367**	.393**	1.000	.625**	.269**
	Sig. (2-tailed)	.000	.000	.000		.000	.004
	N	115	115	115	115	115	114
Prioritising mitigation responses (Q12)	Correlation Coefficient	.544**	.156	.460**	.625**	1.000	.461**
	Sig. (2-tailed)	.000	.096	.000	.000		.000
	N	115	115	115	115	115	114
Estimating the time dimension of risk (Q9)	Correlation Coefficient	.231*	.024	.205*	.269**	.461**	1.000
	Sig. (2-tailed)	.013	.801	.029	.004	.000	
	N	114	114	114	114	114	114
**. Correlation is significant at the 0.01 level (2-tailed).							
*. Correlation is significant at the 0.05 level (2-tailed).							

Table 7.17 presents the correlation coefficients along with the statistical significance of the reporting. Although a number of reported correlations are statistically significant, the stronger correlations are worth analysing as they indicate a greater similarity in data trends. Firstly, question 21 is strongly correlated to questions 12 and 13. Questions 12 and 13 are focused on the frequency of use for mitigation responses along with the degree to which this influences the decision. Therefore, this suggests that respondents who used mitigation responses to identified risk events more often were also likely to believe that the estimation of required time for mitigating the risk was sufficient. Similarly, questions 12 and 13 are also strongly correlated to each other, and this correlation can be explained through the linked nature of the two questions where the first one asks the respondent regarding the frequency of use and the second one asks about the influence of time allowance for risk mitigation on decisions. Therefore, this suggests that if a respondent was likely to make use of risk mitigation for an event, he/she was also more likely to have his decision influenced by the time allowance for risk mitigation. The rest of the reported correlations are mostly weak, however it is important to note that none of the reported correlations are negative. This is because the range value for each of questions is between 1 and 10. The weak relationships are also between the range of 0.2 to 0.4, and the relationships weaker than this are reported to be statistically insignificant.

7.11 Reliability testing

In order for the data analysis to be held valid, it is also important to determine the reliability of the data. This is done through testing which can represent the internal consistency of the data. The appropriateness of reliability testing is in the case where the answers in a data set are reported on a certain scale and in that case the tests can determine whether the scale for the answers can be considered as reliable. Morgan et al. (2012) suggest the use of the Cronbach's alpha test for determining the reliability of data as the test looks at how closely related the data items are within a group. In this research the Cronbach's Alpha value of 0.766 which indicates a high level of consistency for the scale used within the data and hence supporting the claim that the data collected is reliable. Since this test were conducted for questions 9, 12, 13, 15, 18, and 21, the attitudinal scale applied in this study was between 1 and 10 points, and hence this suggests that this scale was effective in measuring the results. Furthermore, it is also important to analyse this reliability based on the impact of each of the questions on the reliability of the scale. Table 7.18 presents the Item-Total statistics of the data.

Table 7.18 Item-total statistics of the dataset

Question	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Estimating the time dimension of risk (9)	35.68	46.557	.398	.266	.765
Prioritising mitigation responses (12)	35.12	39.011	.708	.596	.672
Time dimension of risk influence decision in prioritising mitigation responses(13)	34.87	42.363	.715	.590	.679
Sufficiency of required time estimation for mitigating risk events (21)	35.22	48.828	.501	.395	.736
Risk level effect the estimation of the time dimension of risk (18)	35.32	50.784	.295	.293	.786
Reliable estimation of the time dimension of risk (15)	35.55	48.037	.500	.290	.735

An important item in Table 7.18 is the last column which presents the Cronbach's Alpha if item deleted and hence this shows if any of the data items is having a negative effect on the overall reliability of the scale. The Table shows that the Cronbach's Alpha in all other cases is lower except for question 18 where the Cronbach's Alpha is 0.786 if the question is removed from the analysis, which is higher than the overall value of 0.766. This suggests that the inclusion of this question has had a negative impact on the reliability of the scale; however the effect is not too large. Pallant (2013) suggests that a Cronbach's Alpha value below 0.50 is unacceptable and a value between 0.65 and 0.80 is normally considered to be good. Based on this, the collective Cronbach's Alpha of 0.766 is quite good as it is in the higher range for reliability. Therefore, the data show that the scale is reliable within these closed-ended quantitative questions.

7.12 Summary

This chapter presented detailed explanations and descriptive analysis for the collected data through the main survey (questionnaire). The analyses have shown the different considerations that are adopted by professional in the construction projects in making decisions on the application of risk time dimension. The consideration of risk management has been highlighted as one of the most important aspect in their work. Most of the respondents felt that risk management is highly relevant to their operations and success in undertaking their construction project. Within this context, the analyses have revealed that different approaches are currently used in estimating varied types of risks. Despite the application of different approaches, the level of awareness in the concept of risk time dimension is significantly varying amongst professionals and this has been reported by the respondents despite their level of experience or other factors including sector and type of organisation.

The analysis also revealed that 86 per cent of professionals do not systematically estimate the risk time dimension in their projects. However, only about 15 per cent of their estimations reliability is above 90 per cent. Moreover, the analysis revealed that 78 per cent of professionals do not formally prioritise their mitigation responses to risk events according to their time dimension.

On the other hand, 72 per cent of professionals are significantly influenced by the time dimension of risk between 70 up to 100 per cent on performing decisions related to prioritising their mitigation responses. Moreover, the analysis showed that the risk level of any identified risk event has a considerable influence ranging between 50 up to 100 per cent on professionals estimations for the time dimension of risk. Clearly, this is due to their different risk attitudes as some individuals tend to be more risk-seeker while others are risk-averse or risk neutral. Therefore, the degree to which the risk time dimension and the risk level have an influence on professionals' decisions is greatly linked to their risk tendency.

Due to the absence of a formal concept for the risk time dimension and non-uniform attention amongst professionals, the analyses revealed that different professionals in construction projects rely on different sources of information in establishing their estimation for the time dimension or risk. Nevertheless, the most heavily considered factors in the estimation of risk time dimension are risk level, level of impact, budget, and the project schedule. Other factors such as politics, people, site details, environment, and risk history among others were not considered heavily in the analysis.

Next chapter presents the indicatives outcomes that were extracted from the data analysis. It also explains in details how these indicators were used in the development of the assessment matrix. Moreover, the process of the validation of the outcomes and the assessment matrix are presented.

Chapter 8: Results and Development

8.1 Overview

This chapter presents and validates the questionnaire results. Detailed descriptions and definitions of the indicators of professionals' awareness and decision classifications that emerged from the questionnaire data are provided in this chapter. Moreover, this chapter combines the professionals' awareness and decision classification indicators in order make sense of the outcomes and provide clarity. Later in this chapter an assessment matrix is proposed based on the outcomes of the questionnaire, as well as detailed descriptions and interpretations.

8.2 Indicators of professionals' awareness of the time dimension of risk

The level of awareness of the importance of the time dimension of risk varies from one person to another. The survey conducted in this study aimed to investigate and establish practitioners' level of awareness of the time dimension of risk. The three main indicators for categorising the awareness level were incorporated into an attitudinal scale from one to ten, where one was the lowest level of awareness, and ten was the highest. The indicators were as follows.

1. How often did you estimate the time dimension of any identified risk event?

This is an indicator of to what extent practitioners are aware of, appreciate, and believe in the importance of the time dimension of risk, and whether or not they take action according to the degree of their appreciation. The more often they estimated the time dimension of risk, the more they appreciated the importance of its implementation.

Table 8.1 Estimating the time dimension of risk

		Frequency	per cent	Valid per cent	Cumulative per cent
Valid	1-Never	2	1.7	1.8	1.8
	2-Very Rare	4	3.4	3.5	5.3
	3-Rare	4	3.4	3.5	8.8
	4-Not Often	5	4.3	4.4	13.2
	5-Sometimes	14	12.0	12.3	25.4
	6-Often	23	19.7	20.2	45.6
	7-Very Often	26	22.2	22.8	68.4
	8-Extremely Often	11	9.4	9.6	78.1
	9-Almost Always	9	7.7	7.9	86.0
	10-Always	16	13.7	14.0	100.0
	Total	114	97.4	100.0	
Missing	0	1	.9		
	System	2	1.7		
	Total	3	2.6		
Total		117	100.0		

2. *How often do you prioritise mitigation responses for any identified risk event?*

The prioritisation of mitigation responses can only be sufficient and realistic if the timing of the risk event is estimated, and a prioritisation plan is put in place accordingly. The more effort the participants made in prioritising mitigation responses, the more aware they were of the importance of the time dimension of risk. The prioritisation of mitigation responses to any identified risk event was found to be directly linked to the timing of the risk. Therefore, this constitutes the second indicator that can be used to assess practitioners' level of awareness of the time dimension of risk.

Table 8.2 Prioritising mitigation responses

		Frequency	per cent	Valid per cent	Cumulative per cent
Valid	1-Never	2	1.7	1.7	1.7
	3-Rare	2	1.7	1.7	3.5
	4-Not Often	8	6.8	7.0	10.4
	5-Sometimes	16	13.7	13.9	24.3
	6-Often	14	12.0	12.2	36.5
	7-Very Often	20	17.1	17.4	53.9
	8-Extremely Often	14	12.0	12.2	66.1
	9-Almost Always	14	12.0	12.2	78.3
	10-Always	25	21.4	21.7	100.0
	Total	115	98.3	100.0	
Missing	System	2	1.7		
Total		117	100.0		

3. *How reliable were your estimations for the required time for mitigating the identified risk events?*

The reliability of the estimation of the time dimension of risk is another indicator by which to assess awareness levels. In this case, the more reliable the estimation of the time dimension of risk, the more aware the participant was aware of the time dimension of risk and relevant information in order to make reliable decisions.

Table 8.3 Reliable estimation of the time dimension of risk

		Frequency	per cent	Valid per cent	Cumulative per cent
Valid	2-Very Rare	2	1.7	1.7	1.7
	3-Rare	4	3.4	3.5	5.2
	4-Not Often	6	5.1	5.2	10.4
	5-Sometimes	10	8.5	8.7	19.1
	6-Often	21	17.9	18.3	37.4
	7-Very Often	32	27.4	27.8	65.2
	8-Extremely Often	23	19.7	20.0	85.2
	9-Almost Always	11	9.4	9.6	94.8
	10-Always	6	5.1	5.2	100.0
	Total	115	98.3	100.0	
Missing	System	2	1.7		
Total		117	100.0		

8.2.1 Parameters of awareness categories

This study proposes three main categories for categorising practitioners' awareness, namely: high, medium, and low. These categories represent and reflect the degree of practitioners' awareness on the importance of the time dimension of risk for any identified risk event.

High awareness, estimating the time dimension of risk to all identified risk events. In other words, despite the fact that currently there is no basis of formality, however, estimating the time dimension of risk for more than 70 per cent of all identified risk events, reflect a high degree of appreciation and awareness on its importance.

Medium awareness, estimating the time dimension of risk for all major and selected risk events, in a range between more than 30 per cent up to 70 per cent of all identified risk events. This reflects a medium awareness in which the time dimension of risk is only estimated for all major and other subjectively important risk events.

Low awareness, never or only estimating the time dimension of risk for some selected (subjectively) risk events and below 30 per cent of all identified risk events. The parameters of these categorisations are presented as follows.

Table 8.4 Parameters of the main awareness categories

Categorisation Parameters	
Low (L)	$0 < L \geq 3$
Medium (M)	$3 < M \geq 7$
High (H)	$7 < H \geq 10$

8.3 Indicators of professionals' decision classification

Individuals make different decisions in the same situation, because people have different states of mind and perceive things differently. A survey was carried out in this research in order to understand how people decide upon the time allowances for any identified risk event that needs to be mitigated. The survey consisted of two questions, where responses were given in the form of a scoring on an attitudinal scale from one to ten, to classify decisions made regarding risk events according to respondents' perception of, or attitude toward, risk. These two questions function as indicators through which to classify professionals' decisions.

1. To what extent does the time dimension of risk influence decisions made in regard to prioritising mitigation responses?

The degree to which decisions are influenced by the time dimension of risk would explain the nature of the decisions made. For instance, optimistic decisions would not be influenced, or be very minimally influenced by the time dimension of risk. Optimistic decisions tend to be more confident, and thus are not affected or influenced by factors such as the availability of information, or the time dimension of risk. Neutral decisions are influenced by the time dimension of risk to a reasonable degree. These decisions are the most favourable decisions, because they consider factors such as available information, including the time dimension of risk, objectively and to a reasonable degree - they are not excessively influenced by these factors. Pessimistic decisions are strongly influenced by the time dimension of risk. These types of decisions tend to be unsure, and are excessively influenced by available information, including the time dimension of risk.

Table 8.5 Time dimension of risk's influence on decisions when prioritising mitigation responses

		Frequency	per cent	Valid per cent	Cumulative per cent
Valid	2-Very Rare	4	3.4	3.5	3.5
	5-Sometimes	12	10.3	10.4	13.9
	6-Often	15	12.8	13.0	27.0
	7-Very Often	24	20.5	20.9	47.8
	8-Extremely Often	21	17.9	18.3	66.1
	9-Almost Always	23	19.7	20.0	86.1
	10-Always	16	13.7	13.9	100.0
	Total	115	98.3	100.0	
Missing	System	2	1.7		
Total		117	100.0		

2. *To what extent does the risk level affect decisions on estimating the time dimension of risk?*

The effect that level of risk has on the estimation of the time dimension of risk can also be considered an indicator for classifying decisions. For instance, optimistic decisions are, by nature, challenging decisions that are not influenced, or very minimally influenced, by risk level. This may lead to the underestimation of the information available when estimating the time dimension of risk. Neutral decisions are the most rational decisions because they are influenced to a reasonable degree by all of the available information, including risk level. Pessimistic decisions are greatly affected by risk level which exaggerating the required time to high risk level and underestimating the medium and low risk level.

Table 8.6 The effect of risk level on the estimation of the time dimension of risk

		Frequency	per cent	Valid per cent	Cumulative per cent
Valid	2-Very Rare	2	1.7	1.7	1.7
	3-Rare	6	5.1	5.2	7.0
	4-Not Often	2	1.7	1.7	8.7
	5-Sometimes	20	17.1	17.4	26.1
	6-Often	16	13.7	13.9	40.0
	7-Very Often	20	17.1	17.4	57.4
	8-Extremely Often	18	15.4	15.7	73.0
	9-Almost Always	16	13.7	13.9	87.0
	10-Always	15	12.8	13.0	100.0
	Total	115	98.3	100.0	
Missing	System	2	1.7		
Total		117	100.0		

8.3.1 Decision classification definitions

Optimistic: this is the behaviour of the practitioner when they accept risks if they think there is a potential opportunity in them. They enjoy the challenge of dealing with risks; however, this may sometimes cause excessive losses. Also known as risk seeking or risk taking.

Normative (Neutral): this is the behaviour of the practitioner when they deal with risks objectively. They analyse risks using various techniques and then make informed decisions.

Pessimistic: this is the behaviour of practitioners who are not comfortable mitigating risks. They usually deal with risks by trying to avoid them, unless they are unavoidable. This position is also known as risk averse.

8.3.2 Decision classification parameters

The proposed parameters for the decision classification in relation to the time dimension of risk in this study are presented in Table 8.7. In this research the decision classifications related to the time dimension of risk represent and reflect the degree to which the time dimension of risk and risk level influencing performed decisions.

Optimistic decision; means that the degree to which the time dimension of risk influencing performed decisions is below 30 per cent. In other words, individuals in this class tend to make decisions without adequately considering the risk time dimension for any identified risk events.

Normative decision; means that the degree to which the time of risk influencing performed decisions is more than 30 per cent and up to 70 per cent. In other words, the time dimension of risk is being taken reasonably into account and considered in making decisions.

Pessimistic decision; means that the degree to which the time of risk has an influence on performed decision is above 70 per cent. In other words, individuals in this class tend to make decisions that are excessively influenced by the time dimension of risk.

Table 8.7 Decision classification parameters

Classification Parameters	
Optimistic (O)	$0 < L \geq 3$
Normative (N)	$3 < M \geq 7$
Pessimistic (P)	$7 < H \geq 10$

8.4 Combination of awareness and decision classification indicators

A combination of the indicators explained in the previous sections is the most suitable approach to bring clarity to, and make sense of, the collected data. Moreover, the combined indicators will reveal the current deviations in professionals' awareness and their decisions in relation to the time dimension of risk.

8.4.1 Awareness

Figure 8.1 shows the decision classification, alongside the scale for practitioners' awareness of the time dimension of risk. In reality it can be seen that a small proportion of the decisions were made in optimistic manner, which is approximately four per cent Whereas, the data shows that approximately 47 per cent of decisions were made in a pessimistic manner, across various levels of awareness of the time dimension of risk. However, the remaining 48 per cent of the decisions could be classified as normative, regardless of the awareness of the time dimension of risk.

Figure 8.1 also provides a scale of the practitioners' awareness of the time dimension of risk, which shows that approximately ten per cent of all participants had a low awareness of the time dimension of risk. The results further indicate that approximately 55 per cent of participants had a medium level of awareness, and approximately 34 per cent reported a high level of awareness.

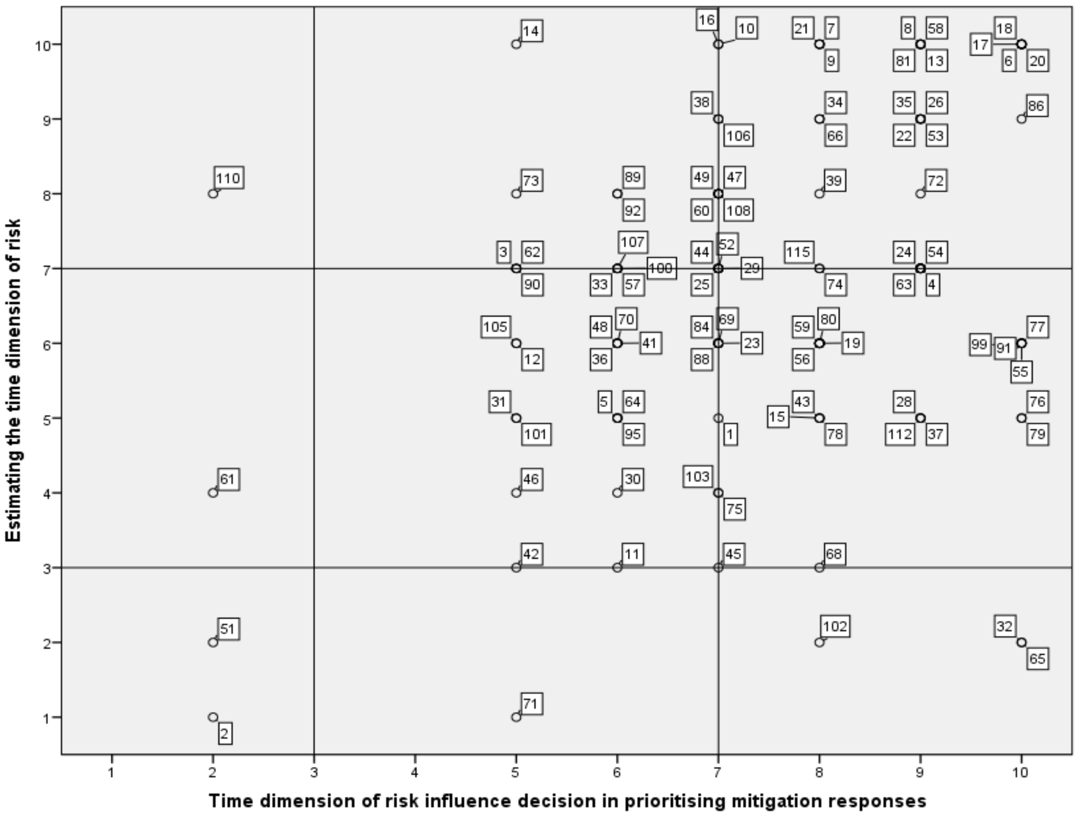


Figure 8.1 The level of awareness of time dimension estimation and the class of its influence decisions on prioritising mitigation responses

Figure 8.2, shows that a small proportion of the decisions were made in optimistic manner, which is about six per cent, despite the levels of awareness. The data collection results further show that approximately 43 per cent of decisions were made in a pessimistic manner, across various levels of awareness of the time dimension of risk. However, the remaining 50 per cent of the decisions were classified as normative, regardless of awareness of the time dimension of risk.

Figure 8.2 also provides a scale of the practitioners' awareness of the time dimension of risk, which it shows that approximately nine per cent of all participants had a low awareness of this concept, approximately 57 per cent had a medium level of awareness, and, finally, approximately 33 per cent reported a high level of awareness.

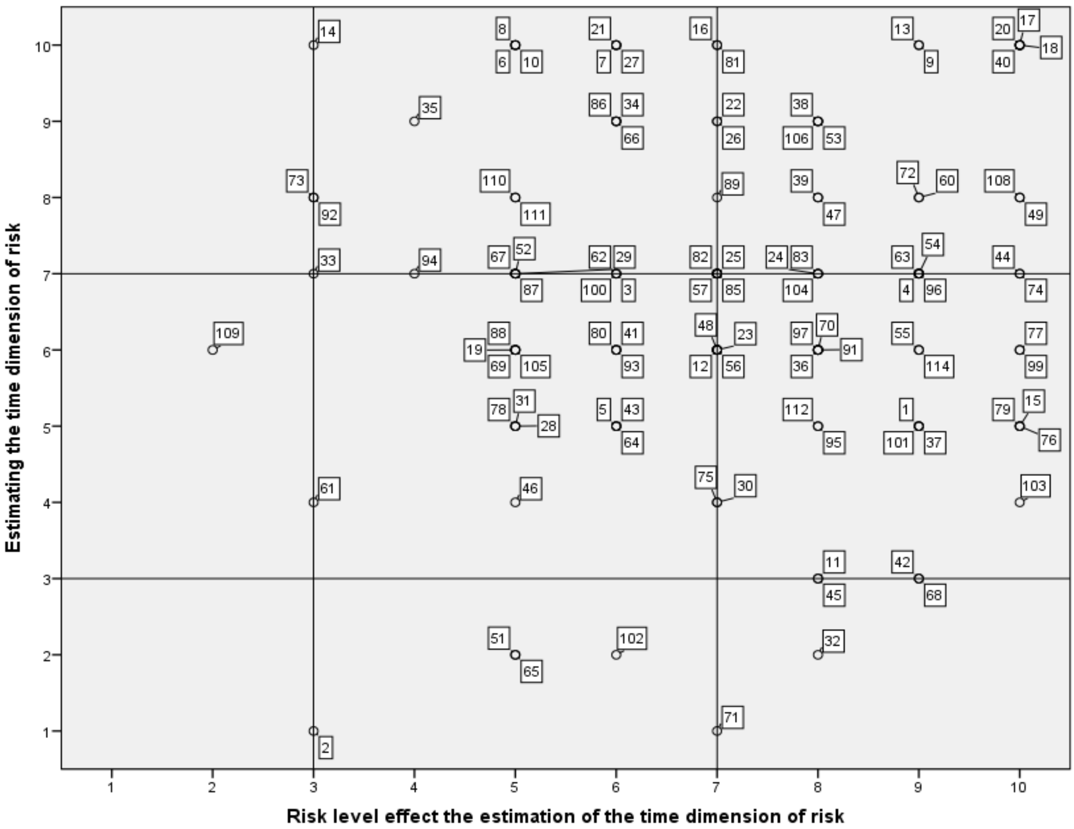


Figure 8.2 The level of awareness on time dimension estimation and the class of the risk level influences decisions on time estimation

8.4.2 Prioritisation

Figure 8.3 shows how practitioners prioritised mitigation responses according to the time dimension of risk. In reality a small proportion of the decisions were made in optimistic manner, which is about four per cent indicate that they were optimistic decisions across the different levels of prioritisation awareness. In addition, the collected data show that approximately 47 per cent of decisions were made in a pessimistic manner across the various levels of awareness of the time dimension of risk. The remaining 47 per cent of the decisions were classified as normative, regardless of the awareness of the time dimension of risk.

Figure 8.3 provides a scale of the practitioners' prioritisation of mitigation responses according to the time dimension of risk, which shows that approximately four per cent of all participants had a low awareness of prioritising mitigation responses according to the time dimension of risk. The results also show that approximately 55 per cent of participants had a medium level of awareness, and approximately 40 per cent reported a high level of awareness.

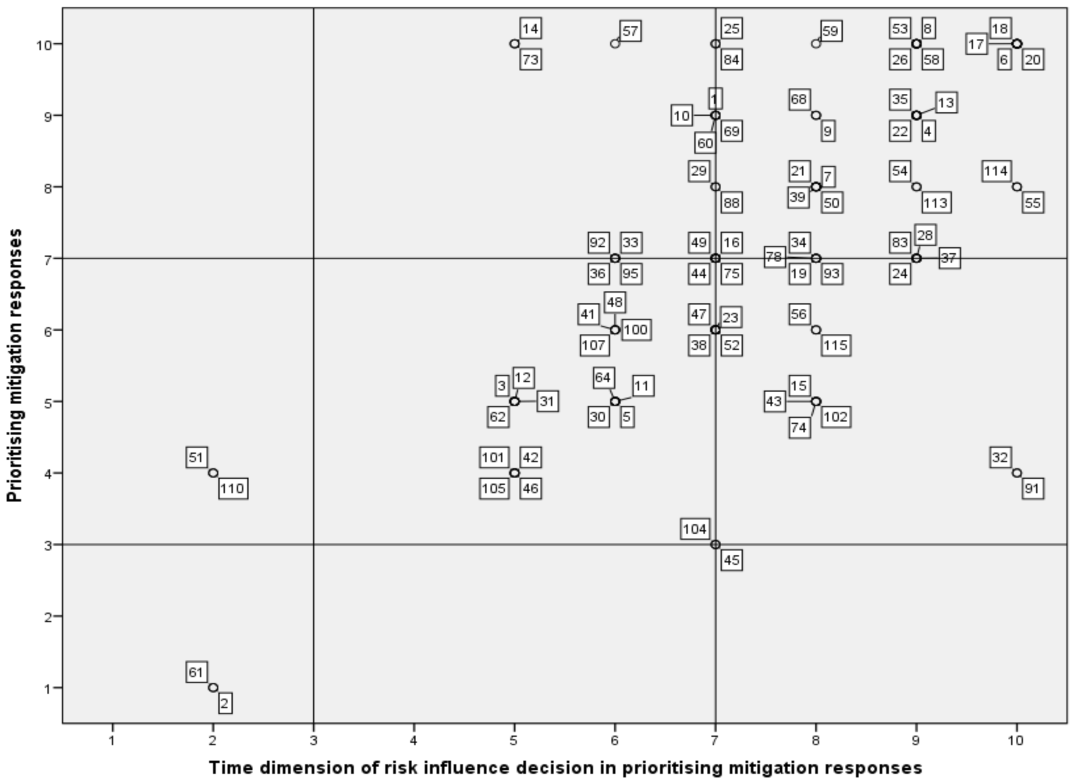


Figure 8.3 The level of awareness of prioritising mitigation responses and the categories of risk time dimension influences decisions on prioritising mitigation responses

For the second prioritisation indicator, Figure 8.4, reveals that a small proportion of the decisions were optimistic, which is about eight per cent, across different levels of awareness. The data also show that approximately 41 per cent of decisions were made in a pessimistic manner, across the various levels of awareness of the time dimension of risk, and the remaining 51 per cent of the decisions could be classified as normative, regardless of the awareness of the time dimension of risk.

Figure 8.4 also provides a scale of the practitioners' awareness of the time dimension of risk, which shows that approximately four per cent of all participants had a low awareness of the time dimension of risk. The results also show that approximately 55 per cent of participants had a medium level of awareness, and finally approximately 41 per cent reported a high level of awareness.

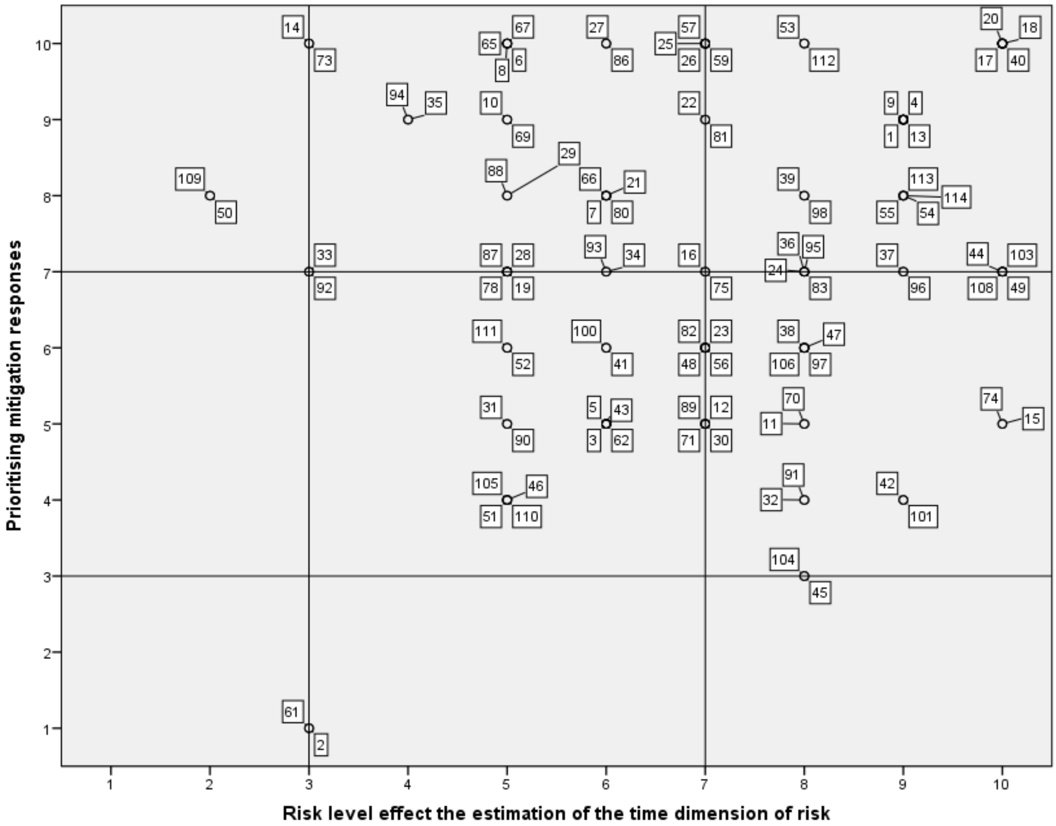


Figure 8.4 The level of awareness of prioritising mitigation responses and the categories of risk level affecting decisions on estimating the time dimension

8.4.3 Reliability

Figure 8.5 shows the reliability of practitioners’ decisions when estimating the time dimension of risk. A small proportion of the decisions were optimistic, which is about four per cent, despite the levels of decision reliability. In addition, approximately 52 per cent of decisions were made in a pessimistic manner, across various levels of decision reliability on the time dimension of risk. However, the remaining 44 per cent of the decisions could be classified as normative, regardless of the reliability of decisions relating to the time dimension of risk.

Figure 8.5 also provides a scale of the reliability of practitioners’ decisions in estimating the time dimension of risk, which revealed that approximately seven per cent of all participants had a low level of decision reliability when estimating the time dimension of risk. The results also show that approximately 60 per cent of participants had a medium level of decision reliability, and, finally, approximately 32 per cent demonstrated a high level of reliability.

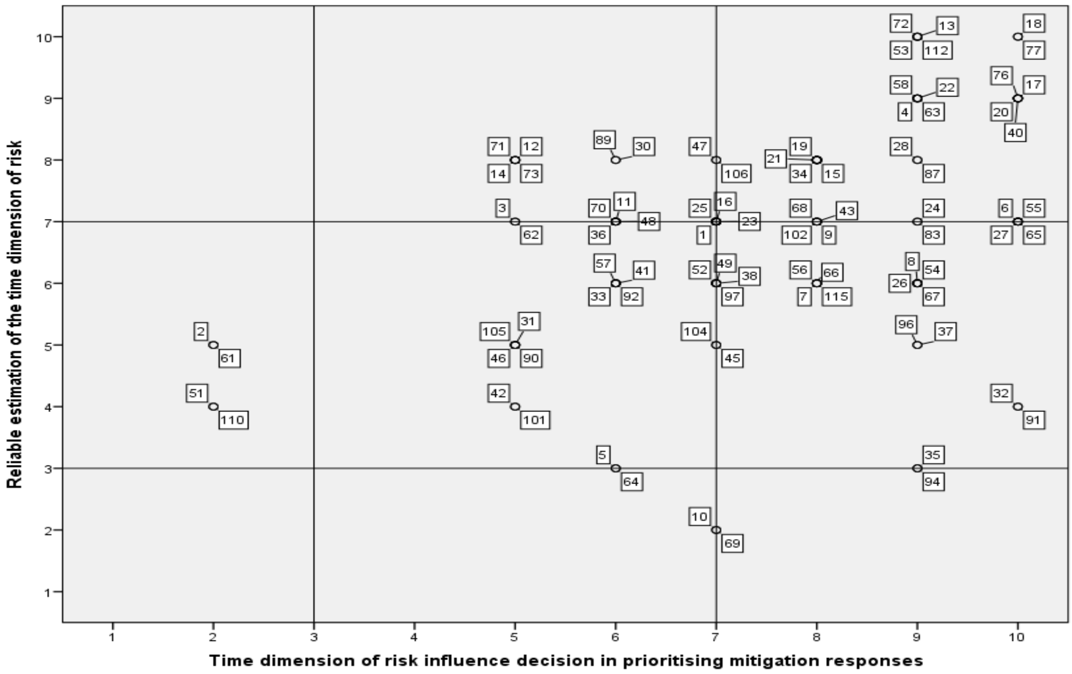


Figure 8.5 The level of estimations' reliability of the time dimension of risk and the class of decisions in prioritising mitigation responses influenced by time dimension.

In the second indicator, practitioners' decisions' reliability in estimating the time dimension of risk. Figure 8.6, reveals that a small proportion of the decisions were optimistic decisions, which is about eight per cent, across different levels of decision reliability. Furthermore, approximately 42 per cent of the decisions were made in a pessimistic manner, across the various levels of decision reliability on the time dimension of risk. However, the remaining 50 per cent of the decisions could be classified as normative, regardless of the level of the decisions' reliability in estimating the time dimension of risk.

Figure 8.6 also provides a scale of the practitioners' decision reliability when estimating the time dimension of risk, which shows that approximately six per cent of all participants had a low level of decision reliability with regard to the time dimension of risk. The results also show that approximately 58 per cent of participants had a medium level of decision reliability, and, finally, approximately 36 per cent demonstrated a high level of decision reliability.

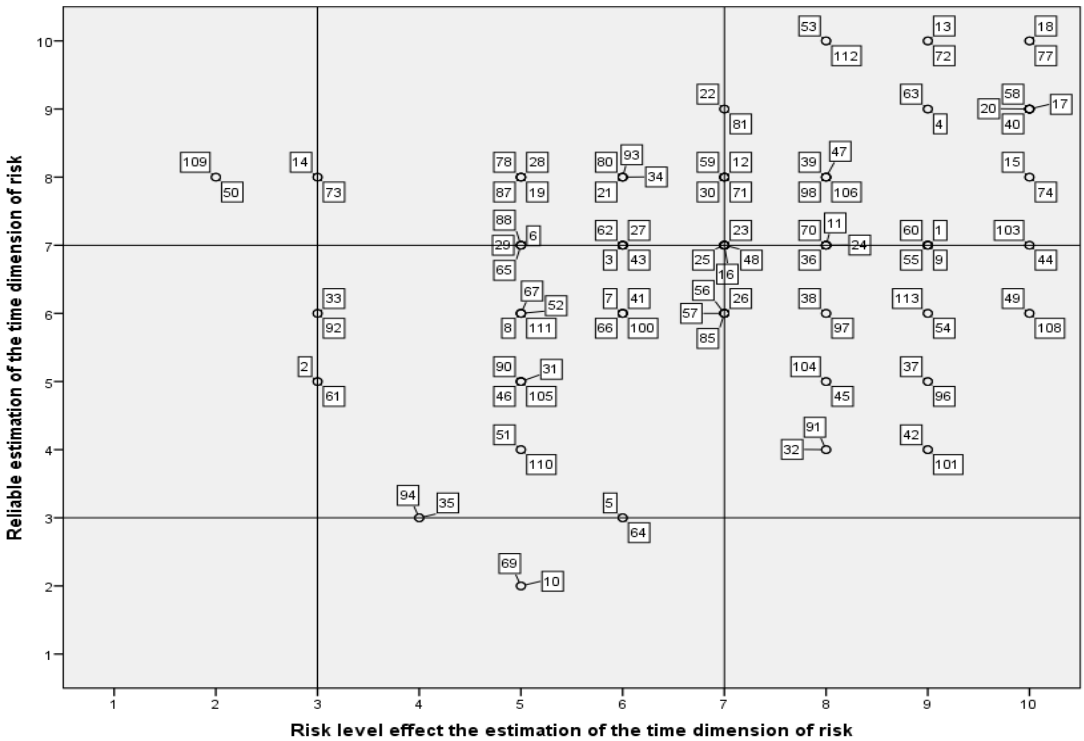


Figure 8.6 The level of estimation reliability of the time dimension of risk and the class of decisions in estimating risk time dimension affected by the risk level

8.5 The development of the assessment matrix

The findings from collected data have revealed five indicators in which three of these indicators can perform as scalar of the practitioner’s awareness on the time dimension of risk in construction projects and the other two indicators are to classify practitioner’s decisions in accordance with risk perception classifications. The researcher has formulated and proposed a matrix using the five indicators in order to have a clear and practical tool that can help in scaling the practitioners’ awareness and classifying decisions performed by practitioners related to the time dimension of risk in their projects in the construction industry.

8.5.1 The purpose of the assessment matrix

The assessment matrix is proposed to address the key research questions related to the time dimension of risk in order to achieve the aim of the research. The assessment matrix objectives are as follows.

1. To assess the level of practitioners' awareness on the time dimension of risk. This consequently can be used in the improvement of the risk management practice in the construction industry.
2. To classify practitioners' decisions related to the time dimension of risk in accordance with the common risk attitude classification.
3. To provide a basis for establishing professionals' perceptions eccentricities in regards to the time dimension of risk and its associated decisions.

8.5.2 The assessment matrix

In this study, the matrix proposed combines the scale of awareness of the time dimension of risk, with the classification of practitioners' decisions, in order to arrive at a clear evaluation. The developed assessment matrix consists of nine categories; each category identifies a certain level of awareness along with a specified decisions class. The assessment matrix presents a holistic picture and categorisations of the current professionals' perceptions eccentricities. In other words, it enables professionals to determine the current central of gravity of their perceptions associated with the time dimension of risk and provides the opportunity for them to moderate every eccentric perception according to its deviated degree. Figure 8.7 presents the assessment matrix, which investigates level of awareness and classifies decisions related to risk.

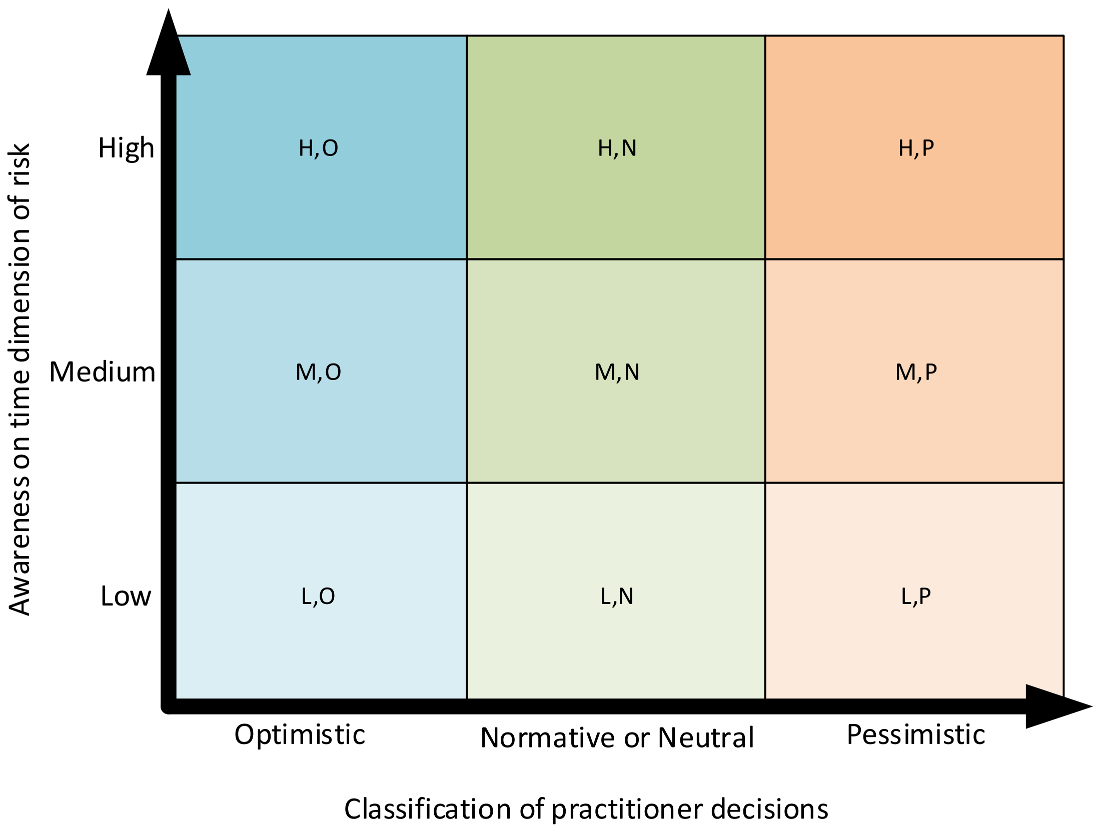


Figure 8.7 The matrix for awareness of the time dimension of risk and decision classification

8.5.3 Descriptions and interpretation of the matrix

The Table below presents the descriptors assigned to the categories used in interpreting the matrix.

Table 8.9 Descriptions of the matrix categories (Awareness)

Positions	**Description**
High awareness	All identified risk events have associated timeframes formally estimated and documented (supported by records).
Medium awareness	All major identified risk events have associated timeframes formally estimated, but are not documented (supported by records).
Low awareness	Identified risk events have no associated (or informally) estimated timeframes and are rarely or never documented (supported by records).
Optimistic	Uncertainty is embraced and decisions can be made quickly in light of limited sources of information.
Normative	Uncertainty is rationalised and decisions are made objectively, taking available information into account.
Pessimistic	Uncertainty is avoided and decisions are stayed until all related information is available.

Table 8.10 Descriptions of the matrix categories (Prioritisation)

Positions	Description
High prioritisation	All identified risk events are prioritised formally according to their estimated timeframes and documented (supported by records).
Medium prioritisation	All major identified risk events are prioritised formally according to their estimated timeframes, but are not documented (supported by records).
Low prioritisation	Identified risk events are not (or informally) prioritised according to their estimated timeframes and are rarely or never documented (supported by records).
Optimistic	Uncertainty is embraced and decisions can be made quickly in light of limited sources of information.
Normative	Uncertainty is rationalised and decisions are made objectively, taking available information into account.
Pessimistic	Uncertainty is avoided and decisions are stayed until all related information is available.

8.6 The validation of the assessment matrix

This section provides an explanation and clarification of the assessment matrix validation process, which was accomplished by asking practitioners to comment on a number of issues relating to the matrix. Among others, these issues consisted of awareness level validation as well as definitions/ descriptions of each category and variables. Other issues included validation of the decision classifications, and their definitions/descriptions and constraints. The validation of the results of this research also are presented and explored within this section.

8.7 Validation approach

According to Pidd (1997), the concept of validation is a confirmation upon that the developed framework/model is a representation of the real world, or part of it. In addition, validation is used to establish whether the behaviour of the model/framework is similar to the actual scenario under the same conditions (Miser, 1993; Pidd, 1997). However, it has been argued that this is only appropriate for quantitative models/frameworks, and may not be suitable for interpretive models/frameworks where, for example, numerous scenarios of the epistemology of science can play a key role.

According to Pidd (1997), the historical and social perspectives suggest that a model will be effective when it is recognised by the neighbouring expert and scientific community. However, no common criteria have been set for validation, and as such, any validity decision depends upon the situation in which the proposed model/framework is adopted, and the phenomenon being modelled (Miser, 1993). It is possible to validate qualitative models/frameworks by means of a qualitative approach through interviews and survey methods, highlighting the benefits and weaknesses of the model in the validation process (Smith, 1993). Nevertheless, Oberkampf and Trucano (2008) studied various definitions of validation, and specified that the concept can be defined as “a process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the mode”.

According to Church (1983), the word ‘validation’ suggests that a judgement is made by a competent person or recognised body. In scientific studies, the validation phase consists of determining whether the aim of the research has been achieved (Block, 2001). For this particular study, the validation of the developed assessment matrix was performed through interviews and thus, the validation process was completed by obtaining practitioners’ judgements and comments. The participants in the validation interviews were practitioners who had not been involved in the data collection; as such, they had no clear direction or expectation with regard to the assessment matrix, and they were asked about their understanding of its applicability in their projects. The argument made by Miser (1993) and Pidd (1997) is that valuable and accurate understandings of validation emphasise the possible utilisation of models as a method of validation, which leads to some researchers considering validation pertaining to the practical use of model/framework. The selection of experts to pass judgment on the model, as well as the design of the validation interviews themselves, play an essential role in obtaining utilitarian and practical opinions.

8.8 Validation process and results

This section presents the results from the validation interviews. Thirteen interviews were conducted with different professionals working on projects in the Kuwaiti construction industry. The interview questions were divided into three sections, as follows.

A. Background and general information.
B. Test and validate the individual categories of the developed assessment matrix for scaling awareness and classifying decisions on the time dimension of risk.
C. Validate the indicative outcomes of the data collected from the main survey.

Section A

<u>Background and general information</u>

Thirteen professionals from various organisational levels and backgrounds were interviewed. This section of the interview questions was designed with the intention of increasing the credibility of the information provided by participants. Table 8.11 provides details regarding the participants' areas of specialisation and organisational level, as well as information about the sector and organisation type in which they worked, and their number of years' experience.

Table 8.11 Background and general information about participants

Area Of Specialisation	Organisational Level	Organisation Type	Sector	Years of experience
Surveyor	Project Manager	Contractor	Public	Over 20
Architect	Architect	Client	Public	6 to 10
Civil Engineer	Civil Engineer	Contractor	Public	11 to 15
Planner	Planner	Contractor	Private	0 to 5
Surveyor	Consultant	Consultant	Public	16 to 20
Civil Engineer	Site Manager	Consultant	Public	11 to 15
Civil Engineer	Site Manager	Contractor	Public	6 to 10
Structural Engineer	Structural Engineer	Client	Public	0 to 5
Mechanical Engineer	Mechanical Engineer	Contractor	Public	0 to 5
Construction Management	Project Manager	Client	Public	Over 20
Civil Engineer	Site Manager	Client	Private	0 to 5
Civil Engineer	Civil Engineer	Client	Private	0 to 5
Architect	Project Manager	Client	Private	6 to 10

Section B

In this section, participants were asked to carefully read the provided descriptors assigned to the categories used for interpreting the matrix. The interviewer asked the interviewees to ask questions at any point during the interview. In this part of Section B, five interviewees made comments, primarily about the description of one position, namely ‘Medium awareness: All major identified risk events have associated timeframes formally estimated but not documented (supported by records)’. The participants suggested including ‘(not always)’, as in reality some of them identify all major risk events and estimate their timeframe, but do NOT document or support this with records. The researcher took this comment into account, and made the relevant change to the matrix descriptions.

Table 8.12 Validated Descriptions of the Matrix categories (Awareness)

Positions	**Description**
High awareness	All identified risk events have associated timeframes formally estimated and documented (supported by records).
Medium awareness	All major identified risk events have associated timeframes formally estimated but are not always documented (supported by records).
Low awareness	Identified risk events have no associated (or informally) estimated timeframes, and are rarely or never documented (supported by records).
Optimistic	Uncertainty is embraced and decisions can be made quickly in light of limited sources of information.
Normative	Uncertainty is rationalised and decisions are made objectively, taking available information into account.
Pessimistic	Uncertainty is avoided and decisions are stayed until all related information is available.

Table 8.13 Validated Descriptions of the Matrix categories (prioritisation)

Positions	Description
High prioritisation	All identified risk events are prioritised formally according to their estimated timeframes and documented (supported by records).
Medium prioritisation	All major identified risk events are prioritised formally according to their estimated timeframes but are not always documented (supported by records).
Low prioritisation	Identified risk events are not (or informally) prioritised according to their estimated timeframes, and are rarely or never documented (supported by records).
Optimistic	Uncertainty is embraced and decisions can be made quickly in light of limited sources of information.
Normative	Uncertainty is rationalised and decisions are made objectively, taking available information into account.
Pessimistic	Uncertainty is avoided and decisions are stayed until all related information is available.

The interviewees were then asked to indicate which of the categories reflected the key decisions made related to the time dimension of risk in their organisations or projects. For this task they were allowed to select more than one category. Table 8.14 shows their responses.

Table 8.14 Predominant decisions related to risk time dimension in participants' organisation of projects

		Responses		Cases
		N	Per cent	(per cent)
Decisions Categories	High, Optimistic (H,O)	2	2.8	15.4
	Medium, Optimistic (M,O)	1	1.4	7.7
	Low, Optimistic (L,O)	1	1.4	7.7
	High, Normative (H,N)	13	18.1	100.0
	Medium, Normative (M,N)	13	18.1	100.0
	Low, Normative (L,N)	7	9.7	53.8
	High, Pessimistic (H,P)	13	18.1	100.0
	Medium, Pessimistic (M,P)	13	18.1	100.0
	Low, Pessimistic (L,P)	9	12.5	69.2
Total		72	100.0	553.8

All participants selected (H,N), (M,N), (H,P) and (M,P) to describe the key decisions made in their organisations or projects. Just two participants stated that their organisations or projects have made (H,O) type decisions in their key decisions. One participant indicated that (M,O) was one of the most predominant decision categories they used. In addition, one participant only mentioned (L,O) category decisions. However, seven respondents stated that (L,N) decisions were made in their organisations or projects. On the other hand (L,P) decisions were highlighted as being predominant decision types by nine participants.

Section C

Awareness

The purpose of this section was to validate the outcomes from the data collected in this research. The participants were provided with two figures with shaded areas representing the predominant state of professionals who participated in the main survey of this research. The participants were then asked to position themselves in Figure 8.8 in terms of how they estimate the time dimension of risk.

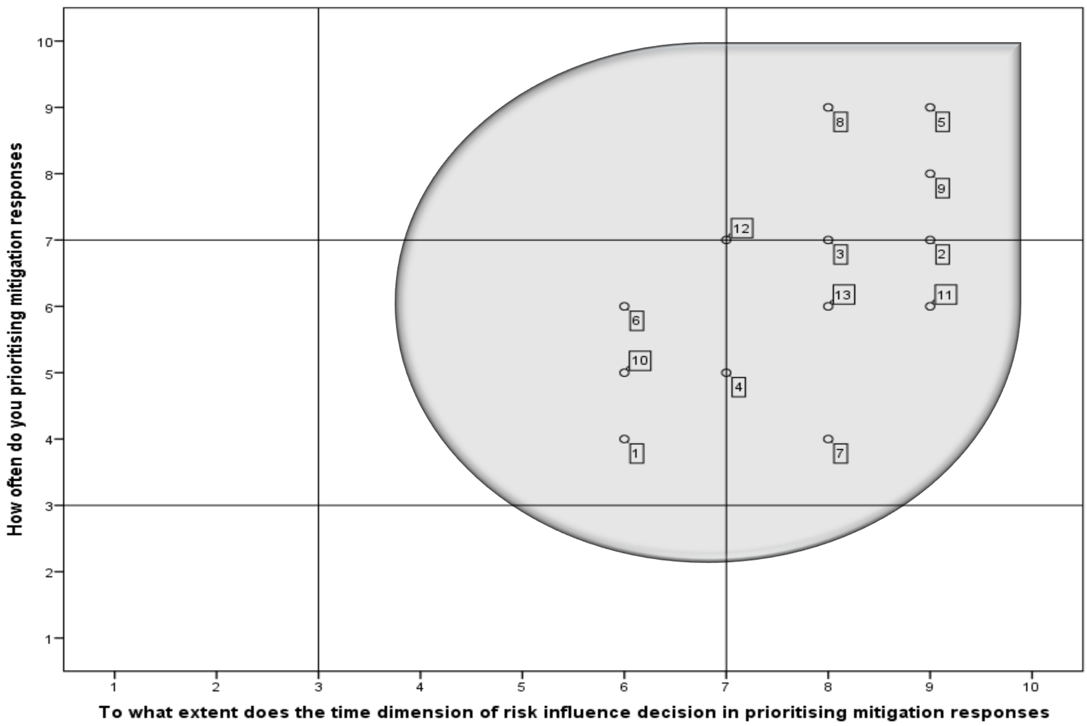


Figure 8.8 Validated indicative outcome of awareness level and decision classification

The graph shows that all participants are located within the shaded region; this represents the predominant region under the outcome indicators from the findings in the main survey. Figure 8.8 thus confirms the findings obtained in the main analysis, as 61 per cent of respondents revealed that their decisions were usually made in a pessimistic manner, irrespective of awareness level. In addition, 39 per cent of respondents stated that their decisions linked to the time dimension of risk were more rationalised; 23 per cent of respondents indicated that they had a high level of awareness concerning the time dimension of risk; and, 77 per cent of respondents indicated that their awareness of the time dimension of risk was ‘medium’.

In terms of estimating the time dimension of risk, the researcher asked the participants, for identified risk events, out of every 100 decisions that they made in a project, what proportion of their decisions would fit in each category. Table 8.15 presents the results.

Table 8.15 Proportions of professionals decisions (Awareness)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
High, Normative (H,N)	13	15	10	25	16.15	5.460
Medium, Normative (M,N)	13	30	10	40	29.62	8.771
Low, Normative (L,N)	1	0	10	10	10.00	.
High, Pessimistic (H,P)	13	20	10	30	18.46	8.263
Medium, Pessimistic (M,P)	13	10	30	40	34.23	4.935
Low, Pessimistic (L,P)	1	0	10	10	10.00	.
High, Optimistic (H,O)	0					
Medium, Optimistic (M,O)	0					
Low, Optimistic (L,O)	0					
Valid N (listwise)	0					

The findings indicate that all decisions undertaken by the interview participants were different. None of the participants indicated that they made any optimistic decisions, at all levels. The Medium, Pessimistic group had the largest mean, followed by the Medium, Normative group. The High, Pessimistic and High, Normative categories had mean= 18.46, and mean =16.15 respectively. The Low, Pessimistic and Low, Normative categories both had means of 10.

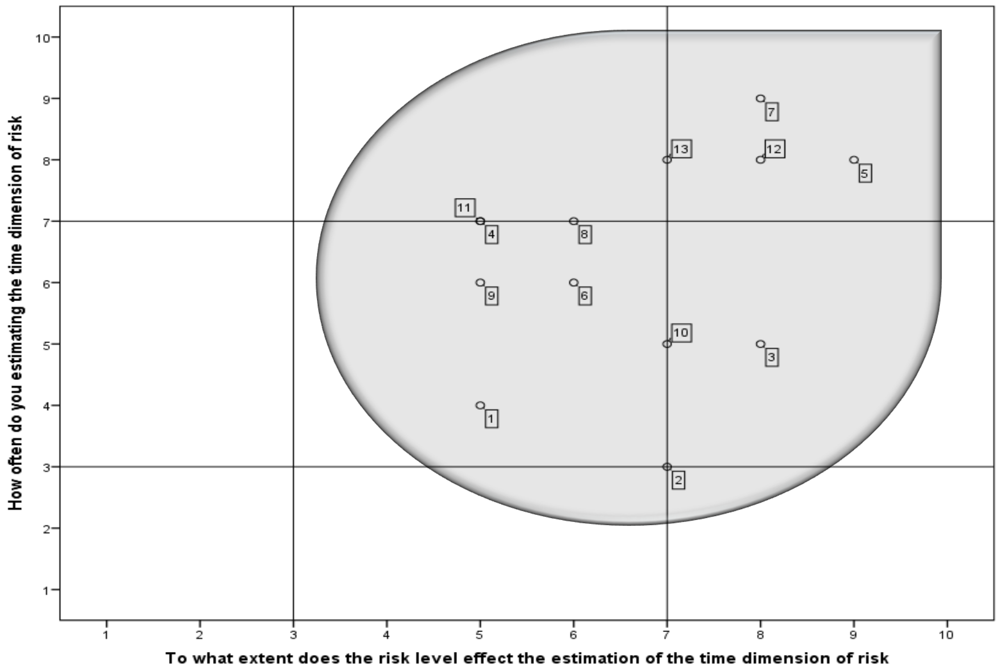


Figure 8.9 Validated indicative outcome of awareness level and decision classification

The graph above shows that all participants are located within the shaded area, representing the predominant area from the indicative outcome. Approximately 30 per cent of participants considered that their decisions tended to be made in a pessimistic manner, regardless of awareness level. While 70 per cent of the participants indicated that their decisions regarding the time dimension of risk were more rationalised, only 30 per cent of participants considered that they had a high level of awareness of the time dimension of risk. Finally, 61 per cent of participants indicated that their awareness of the time dimension of risk was ‘medium’, and eight per cent of the participants said that they had a low level of awareness of the time dimension of risk.

<u>Prioritisation</u>

The purpose of this section was to validate the outcomes from the data collected in this research. The participants were provided with two figures with shaded areas representing the predominant state of the professionals who participated in the main survey undertaken for this research. The participants were asked to position themselves in Figure 8.10 in terms of how they prioritised mitigation responses according to the time dimension of risk.

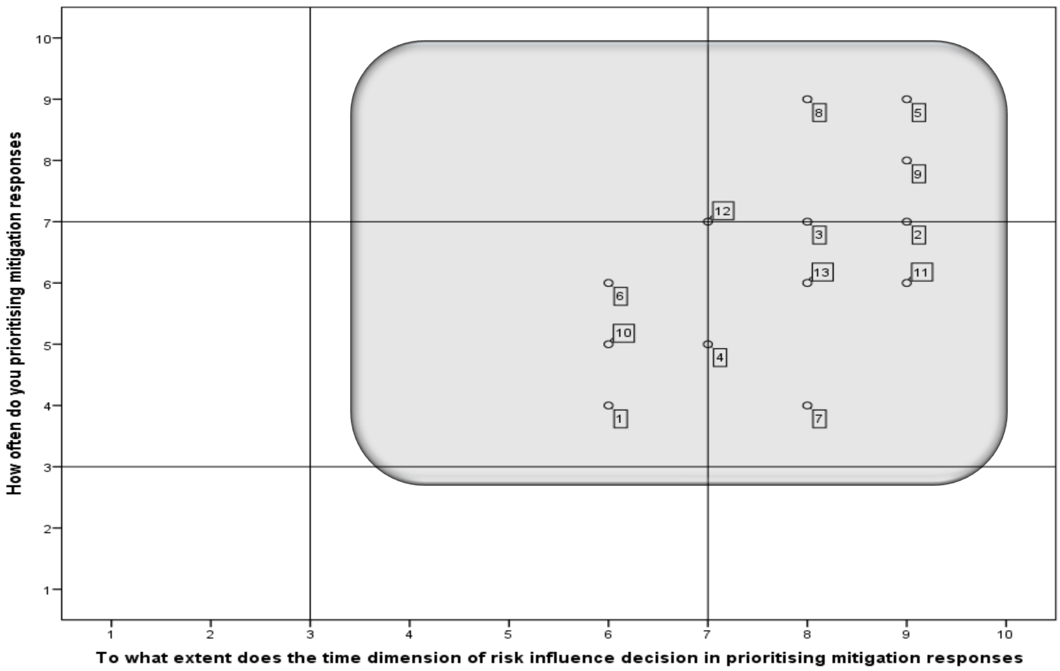


Figure 8.10 Validated indicative outcome of prioritisation level and decisions' classification

All of the participants located themselves within the shaded area, representing the predominant area from the indicative outcome from the results of the main survey analysis. The graph shows that 61 per cent of participants considered that their decisions tended to be pessimistic when prioritising mitigation responses according to the time dimension of risk, regardless of their awareness level; 39 per cent indicated that their decisions related to the prioritisation of mitigation responses were more rationalised; 23 per cent of all participants considered that they had a high degree of awareness of the prioritisation of mitigation responses; and 77 per cent indicated that their awareness of the prioritisation of mitigation was 'medium'.

In terms of prioritising mitigation responses, the researcher asked the participants out of every 100 decisions that they made on projects, what proportion of their decisions would fit in each category. Table 8.16 presents the results.

Table 8.16 Proportions of the professionals' decisions (Prioritisation)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
High, Normative (H,N)	12	20	10	30	15.83	6.686
Medium, Normative (M,N)	13	30	10	40	26.15	7.679
Low, Normative (L,N)	3	0	10	10	10.00	.000
High, Pessimistic (H,P)	12	20	10	30	20.00	7.385
Medium, Pessimistic (M,P)	13	30	20	50	35.38	9.674
Low, Pessimistic (L,P)	3	0	10	10	10.00	.000
High, Optimistic (H,O)	0					
Medium, Optimistic (M,O)	1	0	10	10	10.00	.
Low, Optimistic (L,O)	0					
Valid N (listwise)	0					

All decisions made by participants were different. However, only one participant indicated that they made ‘Medium, Optimistic’ decisions. All participants indicated that their decisions varied between the remaining classifications, at different levels. The ‘Medium, Pessimistic’ category had the highest mean of 35.38, followed by the ‘Medium, Normative’ category, with a mean of 26.15. The High, Pessimistic and High, Normative categories had means of 20.00, and 15.83 respectively. The Low, Pessimistic and Low, Normative categories both had means of 10.

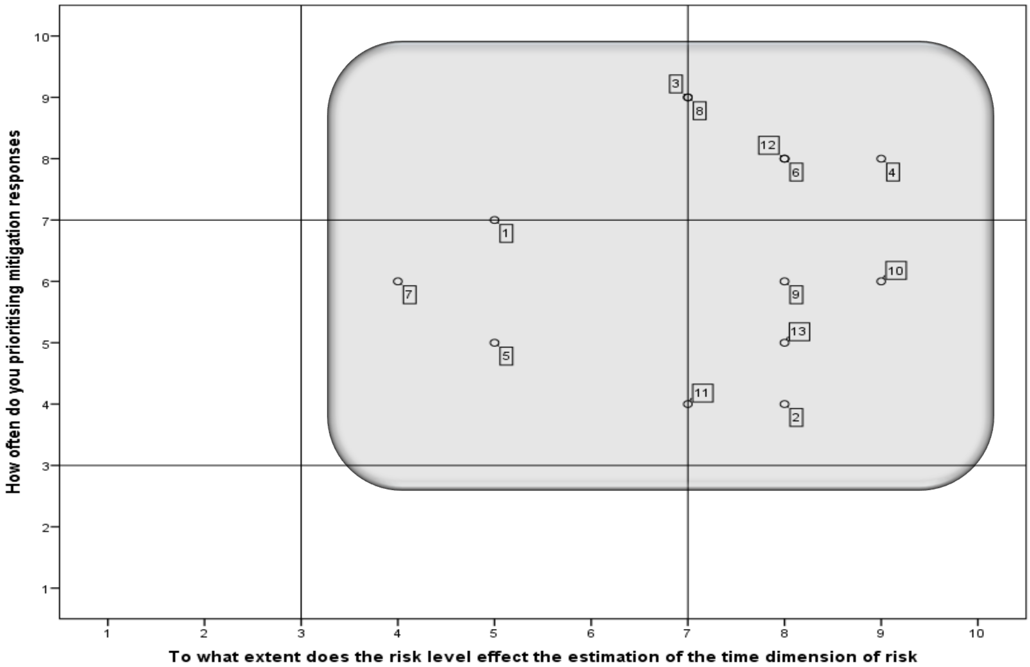


Figure 8.11 Validated indicative outcome of prioritisation level and decisions' classification

Approximately 53 per cent of participants considered that their decisions tended to be pessimistic when prioritising mitigation responses according to the time dimension of risk, regardless of their awareness level. Moreover, 46 per cent indicated that their decisions related to the prioritisation of mitigation responses were more rationalised. On the other hand, only 38 per cent of all participants considered that they had a high degree of awareness of the prioritisation of mitigation responses according to the time dimension of risk, whereas 61 per cent indicated that they considered their awareness of the prioritisation of mitigation to be ‘medium’.

Reliability

The purpose of this section was to validate the outcomes from the data collected in this research. The participants were provided with two figures featuring a shaded area representing the predominant state of professionals who participated in the main survey undertaken in this research.

The participants were asked to position themselves in the Figure 8.12 in terms of the reliability of their decisions when estimating the time dimension of risk.

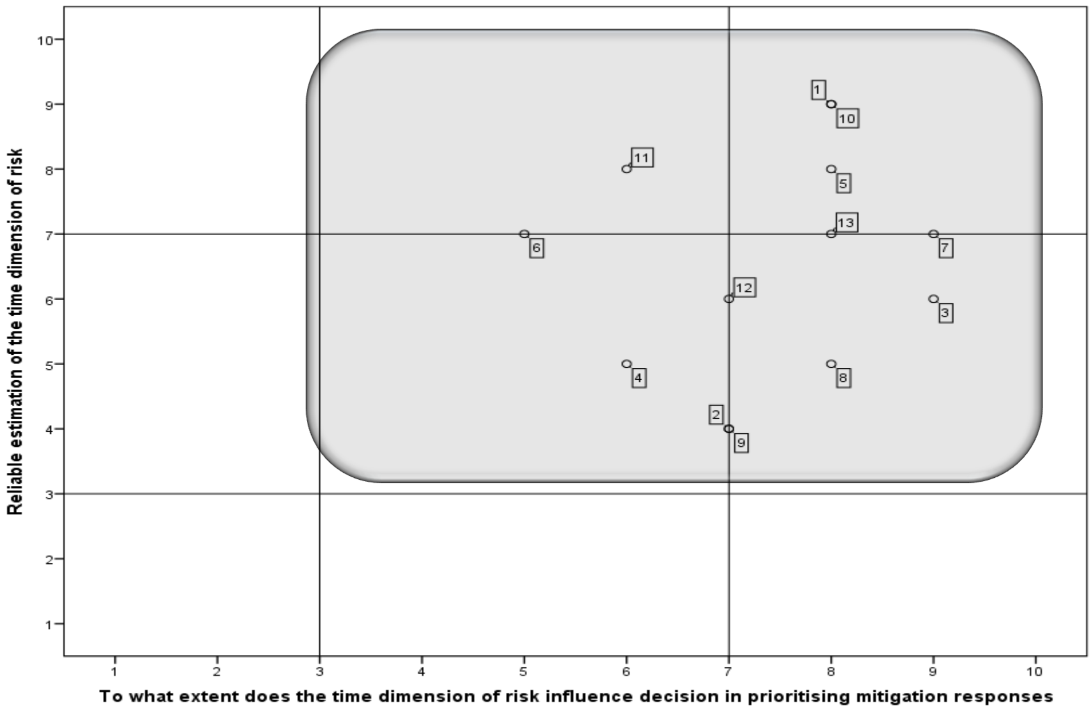


Figure 8.12 Validated indicative outcome of decisions' reliability level and decisions' classification

Approximately 53 per cent of participants considered that their decisions tended to be pessimistic when estimating the time dimension of risk, regardless of their reliability level. Moreover, 46 per cent indicated that their decisions related to the estimation of the time dimension of risk were more rationalised. On the other hand, only 30 per cent of all participants considered that their decisions had a high level of reliability in estimating the time dimension of risk, whereas 70 per cent indicated that the reliability of their decisions when estimating the time dimension of risk was 'medium'.

In terms of the reliability of their estimations of the time dimension of risk, the researcher asked the participants, out of every 100 decisions that they made on a project, what proportion would fit into each category. Table 8.17 presents the results:

Table 8.17 Proportions of professionals' decisions (Reliability)

	N	Range	Minimum	Maximum	Mean	Std. Deviation
High, Normative (H,N)	13	20	10	30	15.38	7.763
Medium, Normative (M,N)	13	20	20	40	26.54	6.887
Low, Normative (L,N)	5	0	10	10	10.00	.000
High, Pessimistic (H,P)	13	30	10	40	21.54	9.871
Medium, Pessimistic (M,P)	12	40	10	50	32.92	9.643
Low, Pessimistic (L,P)	2	0	10	10	10.00	.000
High, Optimistic (H,O)	1	0	10	10	10.00	.
Medium, Optimistic (M,O)	0					
Low, Optimistic (L,O)	0					
Valid N (listwise)	0					

The results show that all decisions made by participants were different. However, only one of the participants indicated that they made 'High, Optimistic' decisions. All participants indicated that their decisions varied between the remaining classifications, at different levels. The ‘Medium, Pessimistic’ category had the highest mean of 32.92, followed by the ‘Medium, Normative’ category, with a mean of 26.54. The ‘High, Pessimistic’ and ‘High, Normative’ categories had means of 21.54 and 15.38 respectively. The ‘Low, Pessimistic’ and ‘Low, Normative’ categories both had means of 10.

The results in Figure 8.13 reveal that all of the participants located themselves within the shaded area, which represents the predominant area from the indicative outcome from the results of the main survey analysis. This Figure confirms the results of the main data analysis in this research. It also shows that approximately 53 per cent of participants considered that their decisions tended to be pessimistic when estimating the time dimension of risk, regardless of their reliability level. Moreover, 46 per cent indicated that their decisions relating to the estimation of the time dimension of risk were more rationalised. On the other hand, only 30 per cent of all participants considered that they made highly reliable decisions when estimating the time dimension of risk, whereas 70 per cent indicated that they considered the reliability level of their decisions when estimating the time dimension of risk to be ‘medium’.

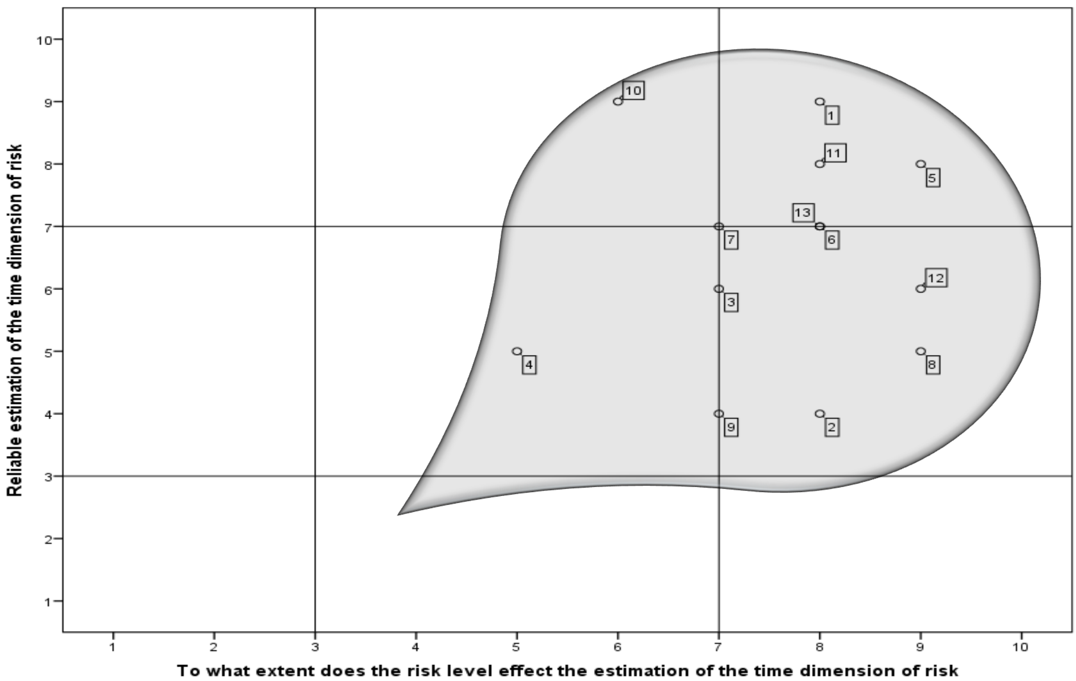


Figure 8.13 Validated indicative outcome of decisions’ reliability level and decisions’ classification

8.9 Implications of the assessment matrix

The use of the assessment matrix and its implementation by professionals in construction project would not instantly transform risk management practice into one which was fully improved, it would, nevertheless, provide a significant step towards transforming and improving the way of how professionals manage risk in construction.

The significance of the assessment matrix relies on its simplicity and practicality. It was designed in a simplified way that would categorise professionals' perception eccentricities in risk time dimension and also would allow determining the central of gravity of professionals' current perceptions. However, this can be carried out by an average person using (fitting by eye) technique rather than a mathematical and/or sophisticated tool.

Despite the fact that, the assessment matrix was developed for a very easy way of implementation, it is expected that professionals who will implement the developed assessment matrix in their projects would appreciate the complex nature of how individuals' perceptions on risk and their risk attitude influencing and differentiating their estimations for the time dimensions of risk along with their performed decisions. Therefore, after categorising professionals' perceptions within the assessment matrix categories, professionals should take into account to consider each eccentric perception separately and work on its degree of eccentricity aiming to moderating and reallocating it to the best desired category.

The assessment matrix is more descriptive than suggestive tool. Thus, the results of its adaptation should provide the opportunity to enhancing the way of how risk is currently managed in construction.

8.10 Boundaries and exceptions for the use of the matrix

The assessment matrix is only applicable for the three common risk attitudes namely; Risk-seeking (optimistic), Risk-neutral (normative) and risk-averse (pessimistic). However, the assessment matrix is not applicable for the remaining two extremist risk attitudes; risk-addicted and risk-paranoid due to the following reasons.

(1) a person with risk-addicted attitude tends to be over optimistic and/or adventurer towards uncertainty to the extent of performing a decision without considering any available information.

(2) a person with risk-paranoid attitude tent to be over pessimistic and/or protective towards uncertainty to the extent of not performing a decision until all relative information are available, thus he/she may takes time longer than expected.

Both those exceptional and rare risk attitudes are not considered or applicable for the use of the assessment matrix because they are either performing uninformed decision or never perform a decision.

8.11 Summary

The chapter has described the process of creating the five indicators, and established the structure and content of the assessment matrix. The findings confirmed that all decisions undertaken by the professionals regarding the time dimension of risk were different. Moreover, a very small proportion of the participants indicated that they made optimistic decisions, at all levels. The 'Medium, Pessimistic' group had the largest mean, followed by the 'Medium, Normative' group. The 'High, Pessimistic' and 'High, Normative' categories had means of 18.46 and 16.15, respectively. The 'Low, Pessimistic' and 'Low, Normative' categories both had means of 10.

The findings show that 61 per cent of professional' decisions tended to be pessimistic when prioritising mitigation responses according to the time dimension of risk, regardless of their awareness level. However, 39 per cent their decisions relating to the prioritisation of mitigation responses were more rationalised.

On the other hand the analysis shows that 23 per cent of professionals considered themselves to have a high degree of awareness of the prioritisation of mitigation responses while, 77 per cent of professionals considered their awareness of the prioritisation of mitigation was 'medium'.

The next chapter presents a discussion of the research findings, and explain the results of the study and data collected in light of the literature review and the background to the study.

Chapter 9: Discussion

9.1 Overview

This chapter discusses the empirical findings in reference to the earlier literature review. It begins by summarising the findings of the literature review, in order to highlight the gaps that were identified and motivated the present research. It will then explore the current consideration of the time dimension of risk, highlighting the advantages of the proposed concept. A discussion of the attributes of the appreciation of the time dimension of risk will be presented, and the influences of the time dimension of risk on decisions will be explained. Finally, the development of the assessment matrix and its expected improvements will be explored, along with an assessment of the matrix's advantages.

9.2 Summary of the findings from the literature review

This section presents the key findings of the literature reviewed in this research. The researcher identified a clear lack of literature linking individual risk and time perceptions to the current process of risk management. Many studies have been conducted aiming to enhance risk management performance in construction projects; however, there is still no evidence of uniform attention by risk management practitioners toward the time dimension of risk, which is the missing piece that completes the full picture of risk management. Clearly, the differences in the way that decision-makers, such as professionals in construction projects, think about, perceive, and/or react to risk events have a significant influence on the decisions made within their projects. Currently, there is a gap in risk management that takes these differences into account; however, this represents an opportunity to fill this gap to enhance its practice.

The findings from the literature review also showed that individuals perceive time differently. Risk attitude governs the way that individuals respond to risk events, according to their personality, characteristics, experience level, awareness level, and risk attitude classification; these are just a few factors that cause individuals to respond to the same situation differently. On the other hand, individuals' abilities to forecast near and distant future events according to their time orientation also vary. The time orientation of individuals supports the necessity of team work and involving more people in the decision-making process, so that there is a mix of not just different opinions but also different abilities when forecasting the time dimension of risk events.

9.3 Current considerations of the time dimension of risk

The findings from the exploratory interviews revealed that there is a time dimension of risk, and that individuals understand this differently. The evidence shows that currently there are three different methods of creating a mitigation plan for any identified risk events. Mitigation plans are currently set-up according to one of the following: (i) risk level; (ii) risk event behaviour; and (iii) project phase. The risk level method can be divided into three different sub-types, as follows: (a) high risk level; (b) medium risk level; and (c) low risk level.

On the other hand, the evidence also revealed the different mitigation approaches that are currently adopted. The findings showed that there are three different approaches that are adopted to mitigate identified risk events. These three approaches are: (1) what comes first; (2) nature of the risk event; and (3) a mixed approach. A detailed explanation of these approaches has been given Chapter Six.

Despite the differences in the consideration of the time dimension of risk, the evidence collected in this study confirmed the existence of a time dimension of risk. This evidence helped to guide the researcher in formulating the descriptions for the assessment matrix, which consist of nine different categories, in order to provide a comprehensive picture that brings clarity and encompasses all possible meanings.

9.4 Advantages of an appropriate risk time dimension

The implementations of an appropriate and uniform time dimension for all identified risk events would have potential advantages. These are some of the advantages.

- Enables practitioners to distinguish between risk events.

- Increases the attention on each risk event, according to the time dimension.
- Creates a better awareness on **what** to mitigate and **when.**
- Increases the reliability of risk management by making rationalised decisions.
- Creates opportunities for minimising the allocated contingency sum.

9.5 Attributes of the appreciation of the time dimension of risk

The findings of this research have highlighted the various levels of individual appreciation and awareness of the time dimension of risk. Logically, the amount of effort that an individual makes in relation to something provides an indication of the level of his/her appreciation of it. Similarly, the more effort that professionals make in seeking to bring together all available information, and taking account of all possible factors that could affect the estimation of the time dimension of risk before making decisions, the higher their awareness of the importance of the time dimension of risk, as well as their capabilities in making optimal decisions.

The data collected also revealed the many factors that different individuals consider in the process of estimating the time dimension of risk. These factors were then categorised according to the level of attention they were given (High, Medium, Low), as shown in Table 7.4. Individuals have different interests, thoughts, mind-sets, and interpretations of reality; these differences are what differentiate their abilities to make decisions based on different amounts of or sources of information. Having said that, making successful decisions often require consideration of all possible factors and information that can be acquired within a reasonable time frame. Therefore, when it comes to estimating the time dimension of risk, it is necessarily to bring together all possible information that are analysed and projected from all involved professionals, based on their perceptions, in order to make successful decisions.

9.6 The influence of the time dimension of risk on decisions

The findings of this research revealed that the time dimension of risk has a significant and direct influence on the decisions made by professionals. The reason for this influence lays in the fact that people experience and perceive the passage of time differently, based on their experiences, personality, and, most importantly, their risk attitude (see Figure 7.12). In this study, professionals described the different degrees of influence that the time dimension of risk had on their decisions.

The results suggested new avenues of classifying decisions related to risks based on their degree of influence. For instance, the less influence the time dimension of risk has on a decision, the more this decision can be classified as risk-seeking or Optimistic. Similarly, the more influence the time dimension of risk has on a decision, the more this decision can be classified as risk-averse or pessimistic. Therefore, in order to make rationalised decisions, the time dimension of risk should exert a reasonable degree of influence on individuals, so that all possible and available information is taken into account, though not over-considered, before making a decision.

9.7 Development of the assessment matrix for improving risk management in the construction industry

The findings of this research provided the necessary knowledge to develop an assessment matrix for improving the performance of risk management in construction projects. The findings revealed rich information related to the time dimension of risk, such as different mitigation approaches, different abilities in forecasting risk events throughout the project lifecycle, and the different sources of information that professionals rely on in the process of making decisions related to risks, to name a few. These factors are discussed in more detail in Chapters Six and Seven.

The findings from the data collected from both the exploratory interviews and the main questionnaire survey provided guidelines that helped to develop the proposed assessment matrix for improving the performance of risk management. The assessment matrix consists of two axes, where the Y axis is concerned with measuring professionals' awareness of the time dimension of risk, and the X axis is concerned with classifying the decisions made in accordance with the common risk attitude classification. The assessment matrix is explained in detail in Chapter Eight.

Validation of the developed assessment matrix was an important stage in this research, in order to ensure the workability and practicality of the assessment matrix. The feedback from selected professionals was used to validate the improvement assessment matrix through validation interviews conducted within construction projects in the State of Kuwait. The concept of validation is dependent on the view that the model is representative of the real world, or part of it (Pidd, 1997). The validation interviews comprised of three sections, which covered the backgrounds of and general information about the participants, the validation of the assessment matrix concept and descriptions, and the validation of the indicative outcomes from the collected data. The interviews took the form of open discussions to enrich the validation, and then responses to set questions. As a result, the assessment matrix was found to be simple, understandable and have relative clarity. The overall feedback was mostly positive, and a few comments were taken into consideration.

9.8 Potential advantages of the assessment matrix

A- Awareness of the time dimension of risk

Knowing the level of individuals' awareness of the time dimension of risk should provide the opportunity to identify the degree to which their awareness should be improved. This should lead to enhancement in the overall performance of risk management.

B- Decision classification

Different state of decisions in a certain situation can lead to substantial failures. Therefore, identifying and becoming aware of the class of decisions that individuals make in relation to risk event should help to rationalise future decisions, which should ultimately improve decisions that are exercised by professionals.

Chapter 10 Conclusion and Recommendations

10.1 Overview

This chapter presents the conclusions of the study and recommendations for future research related to the context of professionals' perception eccentricities in risk time dimension. The achievements of the research objectives are also discussed in this chapter in order to highlight the contributions to the body of knowledge of this research. This chapter further explains the limitations of the research and provides recommendations for further research based on the limitations of this study.

10.2 Achievement of research aim and objectives

The overarching aim of this research was *to investigate and establish the eccentricities in professionals' perceptions of the time dimension of risk, and to incorporate this knowledge into a new complementary tool for enhancing the management of risk in construction.*

In order to achieve this aim the following set of objectives were pursued.

Objective 1: ***To describe the nature and context of project delivery in the State of Kuwait along with the key capabilities for managing risk in construction.***

The study established that Kuwait as a key international oil producer has been striving towards a more diversified income base for its economy, to ensure a reduction in its current dependency on revenues generated by the oil industry. As a consequence, the Kuwaiti government has become a source of encouragement by allocating a substantial budget and initiating large foundational ventures that can help the country to diversify its income.

Historically, the private sector had been economically ineffective in its contribution national output, and this led the Kuwaiti government initiating a progressive fiscal divergence programme that aims to activate and energise the private sector. A 30 billion KD National Development Plan (NDP) was sanctioned by the Kuwaiti parliament in February 2010, which essentially provides a plan for making the country a business, finance and services centre for the Gulf region by 2030. To this end, the Kuwaiti government has put into place many strategies and laws, such as Foreign Direct Investment, PPP, and BOT to encourage the private sector and international investors to invest in Kuwaiti industries.

Construction in Kuwait represents the third largest and most successful industry in the country, and therefore the government has allocated a substantial budget for its development. Many large-scale projects are under construction, and more are planned (NDP). This growth of the construction in Kuwait will be supported by local and foreign investments in infrastructure and the transport system.

Kuwait's Vision 2035 programme is recognised as a strong factor in mobilising investment. This plan has the target of improvements across all modes of transportation, such as railways, roads and airports, in the country, thus deals with the establishment of the groundwork needed. It has been declared by the CIC that investment in different sectors, such as healthcare facilities, educational institutes and the expansion of housing schemes has benefited the construction sector in Kuwait. Therefore, it is clear that these extensive plans will transform the construction industry in Kuwait and as a consequent would have a direct effect on society and individual lives within the region, and for this reason it is vital to ensure successful delivery.

Objective 2: ***To identify the essential theories and fundamental principles associated with the current and established notions of risk and its management in/outside construction.***

The comprehensive literature review has revealed that within the construction industry, the philosophy of risk analysis and management is mainly based upon principles and methodologies that have originated from the method of operational research established in the 1960s, with project risk management currently emphasising PRM to minimise project losses. This scenario has led to the development of a typical risk management procedure, which commonly includes risk identification, measurement and mitigation.

Despite the numerous studies that have been conducted on this subject, the absence of a formal consideration for the timeframe within the process of risk management is still standing, which consequently leads to sub-optimal decisions being made. Many researchers have endeavoured to provide the best answer to the question of how to deal with risk in construction. With the aim of improving risk management, most past studies have sought to assess the significance of participants in the whole project in an effort to minimise risks, recognise risks, analyse risks qualitatively and quantitatively, reduce risk through optimisation methods, and respond to risk. However, the perceptions of individuals estimating the timeframe within which risk events should mitigated and the degree of its influence on performed decisions is still inadequately considered.

Objective 3: ***To identify different perceptions on time from various disciplines and industries.***

The reviewed literature revealed that Individuals perceive time differently. Risk attitude governed the way that individuals respond to risk events according to their personality, characteristics, experience, awareness, risk attitude classifications (to name few), these factors what make individuals respond to the same situation differently. Moreover, individuals' abilities in forecasting near and distant future according to their time orientation are also different. Time orientation of individual's support the idea of the necessity of team work and getting more people involved in decision making process to have a mixture of not just different opinions but also different abilities in forecasting the time dimension of risk events.

Individuals such as professionals in construction projects build their decisions according to many different factors and these decisions normally fall in one of the common risk attitudes classification (risk-averse, risk neutral and risk-seeker).

The importance of time in the implementation of a project, especially during the planning, scheduling, and execution stages, explained the necessity of understanding and considering time as a key influential factor in the process of implementing risk management in construction, which should be taken into account. Therefore the time dimension of risk concept was established to fill the cap that link individuals' perceptions to the current practice of risk management.

<u>**Objective 4:**</u> ***To investigate and establish the scale of awareness and eccentricities on the part of key decision makers in construction industry on the time dimension of risk to lead to a common risk perception classification.***

Two sets of investigations were performed in this research. The findings from the exploratory interviews and the questionnaires are as the following.

<u>*Interview findings*</u>

Analysis of the interview sessions revealed that there are an existing non-uniformed considerations and responses for the time dimension of risk in setting-up the mitigation plan for identified risk events.

The analysis also revealed that there are three different ways that are adopted by professionals in perceiving and making decisions related to the time dimension of risk in mitigating identified risk events. These different ways are; the risk level of the event; the nature of the risk event and project phase of the risk event.

The analysis also revealed that, professionals are adopting three different approaches in mitigating risks according to their perceptions. These three mitigation approaches are; what comes' first approach; risk events' nature approach and mixed approach.

The analysis showed that professionals in construction reflect different abilities in providing reliable predictions for the time dimension of risk of the identified risk events.

<u>*Questionnaire findings*</u>

The findings revealed that different professionals consider different factors in their estimations for the time dimension of risk. It was found that amongst many different types of factors, the four most commonly sought were risk level, level of impact, budget and project schedule.

The findings also revealed the different sources of information that professionals relied on when making decisions as follows; personals experiences; the risk events' nature; the risk level of the risk event; the available information about it; mathematical/computerised model; risk data base; personals judgment; pulled experience of several risk managers or executives and external advice or consultant. However, the analysis showed that the most important source employed by the professionals was personal experience, followed by information about the risk event. The least important source of information they would consider was external advice, and the second least important source was a mathematical/computerised model.

Within this context, the finding revealed that 36 and 44 per cent of professionals do not take into account or rely on the available information about a risk event and the risk event's nature, respectively as sources of information when making their decisions.

Furthermore, the analysis revealed that 86 per cent of professionals do not systematically estimate the risk time dimension in their projects. However, only about 15 per cent of their estimations reliability is above 90 per cent. Moreover, the analysis revealed that 78 per cent of professionals do not formally prioritise their mitigation responses to risk events according to their time dimension. Additionally, 72 per cent of professionals are significantly influenced by the time dimension of risk between 70 up to 100 per cent on performing decisions related to prioritising their mitigation responses. On the other hand, the analysis showed that the risk level of any identified risk event has a considerable influence ranging between 50 up to 100 per cent on professionals estimations for the time dimension of risk. Clearly, this is due to their different risk attitudes as some individuals tend to be more risk-seeker while others are risk-averse or risk neutral.

<u>Objective 5:</u> ***To develop an assessment tool that identifies polarity in practitioners' decisions on time dimension of risk in accordance with the common risk perception classification.***

The developed assessment matrix comprises nine different categories, with each category specifying a certain level of awareness combined with the decision class, the categories are: (High, Optimistic), (Medium, Optimistic), (Low, Optimistic), (High, Normative), (Medium, Normative), (Low, Normative), (High, Pessimistic), (Medium, Pessimistic), and (Low, Pessimistic).

The assessment matrix presents a holistic picture of the categorisations of the awareness level and decisions classifications in order to provide a diagnostic for establishing the eccentricities in the estimation of the time dimension of risk.

<u>Objective 6:</u> ***To test and validate the proposed solution for risk management in construction.***

The results of the validation interviews revealed that the practicality, appropriateness and clarity of the assessment matrix categories and descriptions were very understandable. The validation results also confirmed that the current predominant area of decisions and level of professionals' awareness fell across four categories, namely: (High, Normative), (Medium, Normative), (High, Pessimistic) and (Medium, Pessimistic).

The assessment matrix is a tool that holds a potential for enhancing the professionals' decision-making process in relation to managing risk in construction. It is expected that the professionals who implement the assessment matrix will appreciate the complex nature of individuals' different perceptions of risk events, and how the assessment matrix helps to capture those differences to ultimately improve risk management practice in the construction industry.

10.3 Contribution to the body of knowledge

This research makes a significant contribution to the existing body of knowledge on the subject of individuals' perception of the time dimension of risk in construction. The main contributions of this research are as follows.

- The research has led to a new concept to the current notion on risk management to emerged, namely *the time dimension of risk*. This concept has been explored to provide a link between the risk and time perceptions of construction professionals and their current practice of risk management.
- This research has led to the development of a scale for the measurement and categorising the different levels of professionals' awareness of the time dimension of risk and also providing classifications of decisions made in relation to the time dimension of risk.
- The findings from this research contribute to the literature on the Kuwaiti construction industry as it provides an exclusive assessment of professionals' level of awareness and classify their decisions regarding the time dimension of risk. It also provides an opportunity for developing similar contribution to construction within the Gulf region and beyond.
- The developed assessment matrix holds the potential for a transformative impact on how risk managed in construction by providing a diagnostic for establishing the eccentricities in the estimation of risk time dimension for professionals.

10.4 Research limitations

Despite the significant contributions this study makes to the body of knowledge on managing risk in construction, the following limitations should be acknowledged:

- Although this research has provided a comprehensive assessment and classification of professionals' levels of awareness and their decisions in construction in the State of Kuwait, it is important that, for projects in different countries or industries, relevant additions and/or adjustments are taken into account.

- There are limited publications concerning risk management in the construction industry in the State of Kuwait
- The investigation of the perception of the time dimension of risk was limited to just seven professionals involved in decision-making in Kuwaiti construction projects.

10.5 Recommendations

According to the research limitations mentioned in section 10.4. Some of the addressed relevant issues which require further investigations are recommended as the following.

For policy makers

Essentially the current approach for their decisions presents inadequacy in covering things related to risk. Thus, they could benefit from incorporation of the assessment matrix in moderating the decisions that are exercised by their officials on risks. However, it might be useful to consider adjusting the assessment matrix on the bases of their geographical context rather than a generic context.

For research

Further investigation is required with other different individuals whom have direct or indirect influence on the decision-making process beyond professionals at the construction project level.

Further investigation on the differences between professionals' perceptions and whether their position or/and background has an impact on their estimation for the time dimension of risk.

Although this research was conducted in construction industry, further researches in different industries are required to test the applicability of the developed assessment matrix.

Further exploration is required to provide options for incorporating the assessment matrix in the current procedure, and enhancing how the time dimension is addressed as well as moderating performed decisions.

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Appendices

Appendix A-

Conference paper

Smart, Sustainable and Healthy Cities

The First International Conference of the CIB Middle East & North Africa Research Network CIB-MENA 2014. December 14-16, 2014.

Abstract

The concept of risk management in construction industry has become increasingly important over the last few decades. Currently, risk management in construction industry is considered as a system intended to identify and quantify all potential risks likely to affect a project so that appropriate decision can be made in managing such risks. The identification and quantification of significant risks that require mitigation relies on the perception of the individual responsible for making the decisions to which the risk relates. An important aspect of the perception is the degree of awareness of the time dimension for the risks the decision makers address. The aim of the research on which this paper is based is to establish the degree of awareness for time dimension of the risks they mitigate in the delivery of construction projects. The current phase of the study involves the development of a conceptual model which will form the platform for establishing the perception of the time dimension of risk. Substantial effort has been made to successfully identify, classify, and evaluate essential literature both within and out with construction. The findings from literature related to risk management in construction showing that various perceptions belonging to individuals have a strong influence in the process of risk management in construction industry. Moreover, the techniques and methods of implementation of risk management in this industry do not address in a correct manner the perceptions of risk time dimension. So, it is highly recommended to assess the awareness of the individuals who make decisions on the time dimension of risk as well as setting a conceptual model on it thus the performance of risk management in this industry can be improved. The result of this paper will build a bridge between the variances of the individual's perception of risk time dimension and the current practice of risk management in construction which will lead to enhance the performance of risk management in construction industry.

Keywords: Risk management, Risk time dimension, Risk perception, Risk management in construction**.**

Appendix B –

B.1 Interview Questions

Introduction to the interview

Project title:

Actor perception of risk time dimension in construction industry

This research is intended to model actor perception of risk time dimension and to incorporate that an alternative framework for managing risk in construction. Therefore the objectives of this interview are

1- To investigate and establish the scale of awareness on the part of key decision makers in construction industry on the time dimension of risk.

2- To establish how the time perception can be modelled and taken advantage of to provide more effective and integrated management of all risks associated with the delivery of projects

Your participation in this interview and the information gathered will be very useful in the analysis of this research.

The interview should take less than an hour. The research is purely for academic purpose and information from you will be confidential. Brief quotations from the interview may be used in my thesis but will not be attributed to you individually and your anonymity will thus be maintained.

Should you require further information please do not hesitate to contact me

Yours sincerely,

Rashid Aldaiyat - PhD Candidate

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Phone No: +447722222272 / +96599884586

Confidentiality of the data

The information obtained as part of this project will be treated and will not be made available to anyone else. The interview will be recorded and stored in a voice recorder, the recordings and any notes or transcripts that you provide will be coded to safeguard your anonymity. Results and analysis of interviews will be written up in research thesis and journal paper but the will be anonymised so that individual participant cannot be identified. All data will be stored securely and accessed solely by researcher. You are free to ask for your data to be withdrawn from the study and be destroyed at any time.

Are you willing to participate in this interview?

Interviewee………………….

Date……………….

Section A:

Background and General Information

1. Which of the following organisation/company and sector you are working with in the delivery of projects?

Client / public	Consultant / public	Contractor / public
Client (private)	Consultant / private	Contractor / private
Other (*please specify*)		

2. Which of the following best describes your position in your current organisation?

Project manager	Consultant	Site manager	Engineer
Surveyor	Planner	Architect	Other (*please specify*)

3. How many years of experience do you have in the following

Construction industry		Current company/organisation		Your current position	

Section B

Time Dimension of Risk

The purpose of these questions is to investigate the awareness of the time dimension of risk events as well as determining the boundaries and parameters of the time factor.

Time units

4. What type of time measurements do you currently use in setting up your risk mitigation plan for all registered events?

Days	Weeks	Months	Other (*please specify*) ………..

5. What type of time measurements would you prefer to be used in risk mitigation plan?

Days	Weeks	Months	Other (*please specify*) ………..

Time Boundaries

6. Scaling a project duration in percentage from 0 to 100 per cent (*where 0 is the start and 100 per cent is the project end*):

   a. What percentage of the project can you allocate a reliable prediction for registered risk events you address?

The first 20 per cent of the project duration		The first 40 per cent of the project duration		The first 60 per cent of the project duration		Other (*Please specify*)	

7. To what extent do you consider setting risk mitigation plan of periods for each registered risk event to increase the probability of it being mitigated within?

   ……………………………………………………………………………………………………….

8. Based in your experience, Supposing a project has several risk events registered with high priority:

   a. What Would you set your risk mitigation plan according to

What comes first	Risk event's nature	Other (*please specify*) ………..

Please explain why? ………………………………………………………………………

b. What would be the treatment of two risk events with the same Impact and Probability but different time of occurrence within which you need to mitigate?

………………………………………………………………………………………

9. Based in your experience, what are the obstacle(s) that you have encountered on previous projects in forecasting the required time of mitigation for risk events?

………………………………………………………………………………………

a. How did you overcome these obstacle(s)?

……………………………………………………………………………..

Time Interaction with Probability and Impact

10. Suppose you have a construction project of 24 months duration, on scale of very easy to very hard please answer the following questions

a. **Probability**

i. How easy can you predict the probability of occurrence of the registered risk events for the first 6 months of the project?

Very easy	Easy	Neither	Hard	Very hard

ii. How easy can you predict the probability of occurrence of the registered risk events for the first 12 months?

Very easy	Easy	Neither	Hard	Very hard

iii. How easy can you predict the probability of occurrence of the registered risk events for the first 18 months of the project?

Very easy	Easy	Neither	Hard	Very hard

iv. How easy can you predict the probability of occurrence of the registered risk events for the 24 months of the project?

Very easy	Easy	Neither	Hard	Very hard

b. **Impact**

i. How easy can you predict the potential impact of the registered risk events for the first 6 months of the project?

Very easy	Easy	Neither	Hard	Very hard

ii. How easy can you predict the potential impact of the registered risk events for the first 12 months of the project?

Very easy	Easy	Neither	Hard	Very hard

iii. How easy can you predict the potential impact of the registered risk events for the first 18 months of the project?

Very easy	Easy	Neither	Hard	Very hard

iv. How easy can you predict the potential impact of the registered risk events for the 24 months of the project?

Very easy	Easy	Neither	Hard	Very hard

Closing

11. What are the other significant supplementary factors that may play a dominant role and need to be considered in which risk mitigation can be more effective?

…………………………………………………………………………………………..

Thank you for your participation.

B. 2 Informed consent form

Actor perception of risk time dimension in construction industry

INFORMED CONSENT FORM

(To be completed after Participant Information Sheet has been read)

The purpose and details of this study have been explained to me. I understand that this study is designed to further scientific knowledge and that all procedures have been approved by the Loughborough University Ethics Approvals (Human Participants) Sub-Committee.	Yes ☐	No ☐
I have read and understood the information sheet and this consent form.	Yes ☐	No ☐
I have had an opportunity to ask questions about my participation.	Yes ☐	No ☐
I understand that I am under no obligation to take part in the study.	Yes ☐	No ☐
I understand that I have the right to withdraw from this study at any stage for any reason, and that I will not be required to explain my reasons for withdrawing.	Yes ☐	No ☐
I understand that all the information I provide will be treated in strict confidence and will be kept anonymous and confidential to the researchers unless (under the statutory obligations of the agencies which the researchers are working with), it is judged that confidentiality will have to be breached for the safety of the participant or others.	Yes ☐	No ☐
I agree to participate in this study.	Yes ☐	No ☐
I agree that the bodily samples taken during this study can be stored for future research	Yes ☐	No ☐
If No to above, I confirm that the bodily samples taken during this study can only be used for this study and should be disposed of upon completion of the research October 2016	Yes ☐	No ☐

Your name ________________________________

Your signature

Signature of investigator ________________________________

Date ________________________________

B. 3 Participation information template

Project Title

ACTOR PERCEPTION OF RISK TIME DIMENSION IN CONSTRUCTION INDUSTRY

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What is the purpose of the study?

This research is intended to model actor perception of risk time dimension and to incorporate that an alternative framework for managing risk in construction. Therefore the objectives of this interview are

1- *To investigate and establish the scale of awareness on the part of key decision makers in construction industry on the time dimension of risk.*

2- *To establish how the time perception can be modelled and taken advantage of to provide more effective and integrated management of all risks associated with the delivery of projects*

Who is doing this research and why?

This study is part of a Student research project supported by Loughborough University.

Are there any exclusion criteria?

N/A

What will I be asked to do?

N/A

Once I take part, can I change my mind?

Yes. After you have read this information and asked any questions you may have we will ask you to complete an Informed Consent Form, however if at any time, before, during or after the sessions you wish to withdraw from the study please just contact the main investigator. You can withdraw at any time, for any reason and you will not be asked to explain your reasons for withdrawing. However, once the results of the study are aggregated/published/dissertation has been submitted (expected to be by October 2016) it will not be possible to withdraw your individual data from the research.

Will I be required to attend any sessions and where will these be?

N/A

How long will it take?

This interview should not take more than an hour

What personal information will be required from me?

General background and some information from your experience in construction industry

Are there any risks in participating?

N/A

Will my taking part in this study be kept confidential?

The information obtained as part of this project will be treated and will not be made available to anyone else. The interview will be recorded and stored in a voice recorder, the recordings and any notes or transcripts that you provide will be coded to safeguard your anonymity.. You are free to ask for your data to be withdrawn from the study and be destroyed at any time.

I have some more questions; who should I contact?

The investigator will be more than happy to answer your questions

What will happen to the results of the study?

Results and analysis of interviews will be written up in research thesis and journal paper but the will be anonymised so that individual participant cannot be identified. All data will be stored securely and accessed solely by researcher

What if I am not happy with how the research was conducted?

If you are not happy with how the research was conducted, please contact Ms Jackie Green, the Secretary for the University's Ethics Approvals (Human Participants) Sub-Committee:

Ms J Green, Research Office, Hazlerigg Building, Loughborough University, Epinal Way, Loughborough, LE11 3TU. Tel: 01509 222423. Email: J.A.Green@lboro.ac.uk

The University also has a policy relating to Research Misconduct and Whistle Blowing which is available online at http://www.lboro.ac.uk/committees/ethics-approvals-human-participants/additionalinformation/codesofpractice/ .

Appendix C

Survey (Questionnaire)

Risk Management in Construction Industry

Introduction

Risk management in construction is seen as deficient in the way it caters for mitigation times. This research is intended to investigate the nature of how people make time allowance for any identified risk event that has to be mitigated.

Your participation in this survey and the information you provide is essential for establishing a consensus on how professionals such as yourself account for time in their risk related decisions.

The survey will take about 20 minutes to complete. Your participation is voluntary and all responses will be treated with strict confidence.

Your contribution is highly appreciated and I wish to take this opportunity to thank you in advance for taking time to respond to the survey.

Should you require further information please do not hesitate to contact me

Yours sincerely,

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Risk Management in Construction Industry

Section 1:
Background and General Information

1. Which of the following organisation/company you are working with in the delivery of projects?

◯ Client ◯ Consultant ◯ Contractor

◯ Other (please specify)

[ ]

2. Which of the following sectors you are working with in the delivery of projects?

◯ Private ◯ Public

3. Which of the following best describes your position in your current organisation?

◯ Project manager ◯ Site manager ◯ Engineer ◯ Surveyor ◯ Consultant ◯ Architect ◯ Planner

◯ Other (please specify)

[ ]

4. How many years of experience do you have in the following

Construction industry [ ]

Current company/organisation [ ]

Your current position [ ]

5. How many construction projects has your organisation/company undertaken in the past 10 years?

◯ 1-10 ◯ 11-20 ◯ 21-30 ◯ 31-40 ◯ over 40

6. How often do you implement risk management in your projects?*(on a scale of 0 to10 please indicate)*

Never 1	2	3	4	5	6	7	8	9	Always 10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

2

7. Please indicate the necessity of implementing risk management in construction industry?*On a scale of 1 to 10)*

Not necessary at all 1	2	3	4	5	6	7	8	9	Extremely necessary 10
○	○	○	○	○	○	○	○	○	○

8. How has the management of risk contributed to the successful delivery of the projects on construction industry?*(on a scale of 1 to 10 please indicate)*

No contribution at all 1	2	3	4	5	6	7	8	9	Extreme contribution 10
○	○	○	○	○	○	○	○	○	○

Risk Management in Construction Industry

Section 2:
Risk Timeframe

Risk timeframe is:

- ***The time between a decision on a risk event and the last opportunity to mitigate it.***

.

9. How often do you estimate the required time for mitigating each identified risk event?

Never 0	1	2	3	4	5	6	7	8	9	Always 10
○	○	○	○	○	○	○	○	○	○	○

10. What information do you require in order to estimate the mitigation time of an identified risk event?

11. In order of priority provide four additional factors that should be considered for estimating the required time of mitigation for the identified risk events?

1-

2-

3-

4

12. How often do you prioritise your mitigation responses in projects for any identified risk event?*(on a scale of 0 to 10 please indicate)*

Never 0	1	2	3	4	5	6	7	8	9	Always 10
○	○	○	○	○	○	○	○	○	○	○

13. With reference to Q12, to what degree does the time allowance for mitigation influence your decision in prioritising your mitigation response? *(on a scale of 1 to 10 please indicate)*

Lowest influence 1	2	3	4	5	6	7	8	9	Highest influence 10
○	○	○	○	○	○	○	○	○	○

4

14. Based in your experience, in the process of estimating the required time for mitigating an identified risk event, What of the following were your estimations have been mostly relied on? (You can choose more than one answer)

- [ ] Personal experience
- [ ] The risk event's nature
- [ ] The risk event's level
- [ ] The available information about it
- [ ] Mathematical/Computerised model
- [ ] Risk data base
- [ ] Personal judgment
- [ ] Pulled experience of several risk managers or executives
- [ ] external advice or consultant
- [ ] Other (please specify)

15. With reference to Q14, how reliable were your estimations of the required time for mitigating the identified risk events?

Not reliable at all									extremely reliable
1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

16. Please rate the following from the most important to the least important resource that you consider in estimating the required time for mitigating risk events? *(from 1 to 9 where 1 is the most important and 9 is the least important)*

Personal experience	
The risk event's nature	
The risk level	
The available information about it	
Mathematical/Computerised model	
Risk database	
Personal judgement	
Pulled experience of several managers or executives	
External advice	

17. What risk category would you normally consider in your mitigation?
(You can choose more than one answer)

- [ ] Hight risk level
- [ ] Medium risk level
- [ ] Low risk level

5

18. Based on your experience, to what extent does the risk level affect your decision on the estimated time for mitigation? *(On a scales of 1 to10 please specify)*

Least affect 1	2	3	4	5	6	7	8	9	Most affect 10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

19. What of the following approaches would you consider in setting-up your mitigation plan?

◯ What comes first ◯ Risk event's nature ◯ No particular order ◯ The nature of mitigation requirements

◯ Laissez faire

◯ Other (please specify)

20. How do you establish the order of priority for any identified risk event that have to be mitigated?*(Please explain)*

21. Overall, how sufficient do you think the estimation of the required time for mitigating any identified risk event is ?*(on a scale of 1 to 10 please indicate)*

Not sufficient at all 1	2	3	4	5	6	7	8	9	Extremely sufficient 10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

22. How do you think the estimation of the required time for mitigating any identified risk event could be improved?

23. Please provide any further comments on risk timeframe in construction projects that could contribute to the research in order to improve the management of risk ?

6

Appendix D

D.1 Implementations of the proposed Risk prioritisations' equation

As proposed in chapter Four, the implementations of the proposed risk prioritisations' equation are presented as follow;

$$\mathbf{R}_{Prioritisation} = \frac{P \; x \; I}{R_T}$$

Table D1 Prioritisation degree

Probability	Priority	**Impact**	Priority	**Time Dimension**	Priority
0.1	Very Low	0.1	Very Low	0.1	Very High
0.2	Low	0.2	Low	0.2	High
0.3	Higher Low	0.3	Higher Low	0.3	Lower High
0.4	Lower Medium	0.4	Lower Medium	0.4	Higher Medium
0.5	Medium	0.5	Medium	0.5	Medium
0.6	Higher Medium	0.6	Higher Medium	0.6	Lower Medium
0.7	Lower High	0.7	Lower High	0.7	Higher Low
0.8	High	0.8	High	0.8	High
0.9	Very High	0.9	Very High	0.9	Very Low

Table D2.1 Implications of risk prioritisations

Probability	Impact	Time Dimension	Priority	Probability	Impact	Time Dimension	Priority
0.1	0.1	0.1	0.1	0.6	0.1	0.1	0.6
0.1	0.1	0.2	0.05	0.6	0.1	0.2	0.3
0.1	0.1	0.3	0.033333333	0.6	0.1	0.3	0.2
0.1	0.1	0.4	0.025	0.6	0.1	0.4	0.15
0.1	0.1	0.5	0.02	0.6	0.1	0.5	0.12
0.1	0.1	0.6	0.016666667	0.6	0.1	0.6	0.1
0.1	0.1	0.7	0.014285714	0.6	0.1	0.7	0.0857143
0.1	0.1	0.8	0.0125	0.6	0.1	0.8	0.075
0.1	0.1	0.9	0.011111111	0.6	0.1	0.9	0.0666667
0.2	0.1	0.1	0.2	0.7	0.1	0.1	0.7
0.2	0.1	0.2	0.1	0.7	0.1	0.2	0.35
0.2	0.1	0.3	0.066666667	0.7	0.1	0.3	0.2333333
0.2	0.1	0.4	0.05	0.7	0.1	0.4	0.175
0.2	0.1	0.5	0.04	0.7	0.1	0.5	0.14
0.2	0.1	0.6	0.033333333	0.7	0.1	0.6	0.1166667
0.2	0.1	0.7	0.028571429	0.7	0.1	0.7	0.1
0.2	0.1	0.8	0.025	0.7	0.1	0.8	0.0875
0.2	0.1	0.9	0.022222222	0.7	0.1	0.9	0.0777778
0.3	0.1	0.1	0.3	0.8	0.1	0.1	0.8
0.3	0.1	0.2	0.15	0.8	0.1	0.2	0.4
0.3	0.1	0.3	0.1	0.8	0.1	0.3	0.2666667
0.3	0.1	0.4	0.075	0.8	0.1	0.4	0.2
0.3	0.1	0.5	0.06	0.8	0.1	0.5	0.16
0.3	0.1	0.6	0.05	0.8	0.1	0.6	0.1333333
0.3	0.1	0.7	0.042857143	0.8	0.1	0.7	0.1142857
0.3	0.1	0.8	0.0375	0.8	0.1	0.8	0.1
0.3	0.1	0.9	0.033333333	0.8	0.1	0.9	0.0888889
0.4	0.1	0.1	0.4	0.9	0.1	0.1	0.9
0.4	0.1	0.2	0.2	0.9	0.1	0.2	0.45
0.4	0.1	0.3	0.133333333	0.9	0.1	0.3	0.3
0.4	0.1	0.4	0.1	0.9	0.1	0.4	0.225
0.4	0.1	0.5	0.08	0.9	0.1	0.5	0.18
0.4	0.1	0.6	0.066666667	0.9	0.1	0.6	0.15
0.4	0.1	0.7	0.057142857	0.9	0.1	0.7	0.1285714
0.4	0.1	0.8	0.05	0.9	0.1	0.8	0.1125
0.4	0.1	0.9	0.044444444	0.9	0.1	0.9	0.1
0.5	0.1	0.1	0.5				
0.5	0.1	0.2	0.25				
0.5	0.1	0.3	0.166666667				
0.5	0.1	0.4	0.125				
0.5	0.1	0.5	0.1				
0.5	0.1	0.6	0.083333333				
0.5	0.1	0.7	0.071428571				
0.5	0.1	0.8	0.0625				
0.5	0.1	0.9	0.055555556				

Table D2.2 Implications of risk prioritisations

0.1	0.2	0.1	0.2	0.6	0.2	0.1	1.2
0.1	0.2	0.2	0.1	0.6	0.2	0.2	0.6
0.1	0.2	0.3	0.066666667	0.6	0.2	0.3	0.4
0.1	0.2	0.4	0.05	0.6	0.2	0.4	0.3
0.1	0.2	0.5	0.04	0.6	0.2	0.5	0.24
0.1	0.2	0.6	0.033333333	0.6	0.2	0.6	0.2
0.1	0.2	0.7	0.028571429	0.6	0.2	0.7	0.1714286
0.1	0.2	0.8	0.025	0.6	0.2	0.8	0.15
0.1	0.2	0.9	0.022222222	0.6	0.2	0.9	0.1333333
0.2	0.2	0.1	0.4	0.7	0.2	0.1	1.4
0.2	0.2	0.2	0.2	0.7	0.2	0.2	0.7
0.2	0.2	0.3	0.133333333	0.7	0.2	0.3	0.4666667
0.2	0.2	0.4	0.1	0.7	0.2	0.4	0.35
0.2	0.2	0.5	0.08	0.7	0.2	0.5	0.28
0.2	0.2	0.6	0.066666667	0.7	0.2	0.6	0.2333333
0.2	0.2	0.7	0.057142857	0.7	0.2	0.7	0.2
0.2	0.2	0.8	0.05	0.7	0.2	0.8	0.175
0.2	0.2	0.9	0.044444444	0.7	0.2	0.9	0.1555556
0.3	0.2	0.1	0.6	0.8	0.2	0.1	1.6
0.3	0.2	0.2	0.3	0.8	0.2	0.2	0.8
0.3	0.2	0.3	0.2	0.8	0.2	0.3	0.5333333
0.3	0.2	0.4	0.15	0.8	0.2	0.4	0.4
0.3	0.2	0.5	0.12	0.8	0.2	0.5	0.32
0.3	0.2	0.6	0.1	0.8	0.2	0.6	0.2666667
0.3	0.2	0.7	0.085714286	0.8	0.2	0.7	0.2285714
0.3	0.2	0.8	0.075	0.8	0.2	0.8	0.2
0.3	0.2	0.9	0.066666667	0.8	0.2	0.9	0.1777778
0.4	0.2	0.1	0.8	0.9	0.2	0.1	1.8
0.4	0.2	0.2	0.4	0.9	0.2	0.2	0.9
0.4	0.2	0.3	0.266666667	0.9	0.2	0.3	0.6
0.4	0.2	0.4	0.2	0.9	0.2	0.4	0.45
0.4	0.2	0.5	0.16	0.9	0.2	0.5	0.36
0.4	0.2	0.6	0.133333333	0.9	0.2	0.6	0.3
0.4	0.2	0.7	0.114285714	0.9	0.2	0.7	0.2571429
0.4	0.2	0.8	0.1	0.9	0.2	0.8	0.225
0.4	0.2	0.9	0.088888889	0.9	0.2	0.9	0.2
0.5	0.2	0.1	1				
0.5	0.2	0.2	0.5				
0.5	0.2	0.3	0.333333333				
0.5	0.2	0.4	0.25				
0.5	0.2	0.5	0.2				
0.5	0.2	0.6	0.166666667				
0.5	0.2	0.7	0.142857143				
0.5	0.2	0.8	0.125				
0.5	0.2	0.9	0.111111111				

Table D2.3 Implications of risk prioritisations

0.1	0.3	0.1	0.3	0.6	0.3	0.1	1.8
0.1	0.3	0.2	0.15	0.6	0.3	0.2	0.9
0.1	0.3	0.3	0.1	0.6	0.3	0.3	0.6
0.1	0.3	0.4	0.075	0.6	0.3	0.4	0.45
0.1	0.3	0.5	0.06	0.6	0.3	0.5	0.36
0.1	0.3	0.6	0.05	0.6	0.3	0.6	0.3
0.1	0.3	0.7	0.042857143	0.6	0.3	0.7	0.2571429
0.1	0.3	0.8	0.0375	0.6	0.3	0.8	0.225
0.1	0.3	0.9	0.033333333	0.6	0.3	0.9	0.2
0.2	0.3	0.1	0.6	0.7	0.3	0.1	2.1
0.2	0.3	0.2	0.3	0.7	0.3	0.2	1.05
0.2	0.3	0.3	0.2	0.7	0.3	0.3	0.7
0.2	0.3	0.4	0.15	0.7	0.3	0.4	0.525
0.2	0.3	0.5	0.12	0.7	0.3	0.5	0.42
0.2	0.3	0.6	0.1	0.7	0.3	0.6	0.35
0.2	0.3	0.7	0.085714286	0.7	0.3	0.7	0.3
0.2	0.3	0.8	0.075	0.7	0.3	0.8	0.2625
0.2	0.3	0.9	0.066666667	0.7	0.3	0.9	0.2333333
0.3	0.3	0.1	0.9	0.8	0.3	0.1	2.4
0.3	0.3	0.2	0.45	0.8	0.3	0.2	1.2
0.3	0.3	0.3	0.3	0.8	0.3	0.3	0.8
0.3	0.3	0.4	0.225	0.8	0.3	0.4	0.6
0.3	0.3	0.5	0.18	0.8	0.3	0.5	0.48
0.3	0.3	0.6	0.15	0.8	0.3	0.6	0.4
0.3	0.3	0.7	0.128571429	0.8	0.3	0.7	0.3428571
0.3	0.3	0.8	0.1125	0.8	0.3	0.8	0.3
0.3	0.3	0.9	0.1	0.8	0.3	0.9	0.2666667
0.4	0.3	0.1	1.2	0.9	0.3	0.1	2.7
0.4	0.3	0.2	0.6	0.9	0.3	0.2	1.35
0.4	0.3	0.3	0.4	0.9	0.3	0.3	0.9
0.4	0.3	0.4	0.3	0.9	0.3	0.4	0.675
0.4	0.3	0.5	0.24	0.9	0.3	0.5	0.54
0.4	0.3	0.6	0.2	0.9	0.3	0.6	0.45
0.4	0.3	0.7	0.171428571	0.9	0.3	0.7	0.3857143
0.4	0.3	0.8	0.15	0.9	0.3	0.8	0.3375
0.4	0.3	0.9	0.133333333	0.9	0.3	0.9	0.3
0.5	0.3	0.1	1.5				
0.5	0.3	0.2	0.75				
0.5	0.3	0.3	0.5				
0.5	0.3	0.4	0.375				
0.5	0.3	0.5	0.3				
0.5	0.3	0.6	0.25				
0.5	0.3	0.7	0.214285714				
0.5	0.3	0.8	0.1875				
0.5	0.3	0.9	0.166666667				

Table D2.4 Implications of risk prioritisations

0.1	0.4	0.1	0.4	0.6	0.4	0.1	2.4
0.1	0.4	0.2	0.2	0.6	0.4	0.2	1.2
0.1	0.4	0.3	0.133333333	0.6	0.4	0.3	0.8
0.1	0.4	0.4	0.1	0.6	0.4	0.4	0.6
0.1	0.4	0.5	0.08	0.6	0.4	0.5	0.48
0.1	0.4	0.6	0.066666667	0.6	0.4	0.6	0.4
0.1	0.4	0.7	0.057142857	0.6	0.4	0.7	0.3428571
0.1	0.4	0.8	0.05	0.6	0.4	0.8	0.3
0.1	0.4	0.9	0.044444444	0.6	0.4	0.9	0.2666667
0.2	0.4	0.1	0.8	0.7	0.4	0.1	2.8
0.2	0.4	0.2	0.4	0.7	0.4	0.2	1.4
0.2	0.4	0.3	0.266666667	0.7	0.4	0.3	0.9333333
0.2	0.4	0.4	0.2	0.7	0.4	0.4	0.7
0.2	0.4	0.5	0.16	0.7	0.4	0.5	0.56
0.2	0.4	0.6	0.133333333	0.7	0.4	0.6	0.4666667
0.2	0.4	0.7	0.114285714	0.7	0.4	0.7	0.4
0.2	0.4	0.8	0.1	0.7	0.4	0.8	0.35
0.2	0.4	0.9	0.088888889	0.7	0.4	0.9	0.3111111
0.3	0.4	0.1	1.2	0.8	0.4	0.1	3.2
0.3	0.4	0.2	0.6	0.8	0.4	0.2	1.6
0.3	0.4	0.3	0.4	0.8	0.4	0.3	1.0666667
0.3	0.4	0.4	0.3	0.8	0.4	0.4	0.8
0.3	0.4	0.5	0.24	0.8	0.4	0.5	0.64
0.3	0.4	0.6	0.2	0.8	0.4	0.6	0.5333333
0.3	0.4	0.7	0.171428571	0.8	0.4	0.7	0.4571429
0.3	0.4	0.8	0.15	0.8	0.4	0.8	0.4
0.3	0.4	0.9	0.133333333	0.8	0.4	0.9	0.3555556
0.4	0.4	0.1	1.6	0.9	0.4	0.1	3.6
0.4	0.4	0.2	0.8	0.9	0.4	0.2	1.8
0.4	0.4	0.3	0.533333333	0.9	0.4	0.3	1.2
0.4	0.4	0.4	0.4	0.9	0.4	0.4	0.9
0.4	0.4	0.5	0.32	0.9	0.4	0.5	0.72
0.4	0.4	0.6	0.266666667	0.9	0.4	0.6	0.6
0.4	0.4	0.7	0.228571429	0.9	0.4	0.7	0.5142857
0.4	0.4	0.8	0.2	0.9	0.4	0.8	0.45
0.4	0.4	0.9	0.177777778	0.9	0.4	0.9	0.4
0.5	0.4	0.1	2				
0.5	0.4	0.2	1				
0.5	0.4	0.3	0.666666667				
0.5	0.4	0.4	0.5				
0.5	0.4	0.5	0.4				
0.5	0.4	0.6	0.333333333				
0.5	0.4	0.7	0.285714286				
0.5	0.4	0.8	0.25				
0.5	0.4	0.9	0.222222222				

Table D2.5 Implications of risk prioritisations

0.1	0.5	0.1	0.5	0.6	0.5	0.1	3
0.1	0.5	0.2	0.25	0.6	0.5	0.2	1.5
0.1	0.5	0.3	0.166666667	0.6	0.5	0.3	1
0.1	0.5	0.4	0.125	0.6	0.5	0.4	0.75
0.1	0.5	0.5	0.1	0.6	0.5	0.5	0.6
0.1	0.5	0.6	0.083333333	0.6	0.5	0.6	0.5
0.1	0.5	0.7	0.071428571	0.6	0.5	0.7	0.4285714
0.1	0.5	0.8	0.0625	0.6	0.5	0.8	0.375
0.1	0.5	0.9	0.055555556	0.6	0.5	0.9	0.3333333
0.2	0.5	0.1	1	0.7	0.5	0.1	3.5
0.2	0.5	0.2	0.5	0.7	0.5	0.2	1.75
0.2	0.5	0.3	0.333333333	0.7	0.5	0.3	1.1666667
0.2	0.5	0.4	0.25	0.7	0.5	0.4	0.875
0.2	0.5	0.5	0.2	0.7	0.5	0.5	0.7
0.2	0.5	0.6	0.166666667	0.7	0.5	0.6	0.5833333
0.2	0.5	0.7	0.142857143	0.7	0.5	0.7	0.5
0.2	0.5	0.8	0.125	0.7	0.5	0.8	0.4375
0.2	0.5	0.9	0.111111111	0.7	0.5	0.9	0.3888889
0.3	0.5	0.1	1.5	0.8	0.5	0.1	4
0.3	0.5	0.2	0.75	0.8	0.5	0.2	2
0.3	0.5	0.3	0.5	0.8	0.5	0.3	1.3333333
0.3	0.5	0.4	0.375	0.8	0.5	0.4	1
0.3	0.5	0.5	0.3	0.8	0.5	0.5	0.8
0.3	0.5	0.6	0.25	0.8	0.5	0.6	0.6666667
0.3	0.5	0.7	0.214285714	0.8	0.5	0.7	0.5714286
0.3	0.5	0.8	0.1875	0.8	0.5	0.8	0.5
0.3	0.5	0.9	0.166666667	0.8	0.5	0.9	0.4444444
0.4	0.5	0.1	2	0.9	0.5	0.1	4.5
0.4	0.5	0.2	1	0.9	0.5	0.2	2.25
0.4	0.5	0.3	0.666666667	0.9	0.5	0.3	1.5
0.4	0.5	0.4	0.5	0.9	0.5	0.4	1.125
0.4	0.5	0.5	0.4	0.9	0.5	0.5	0.9
0.4	0.5	0.6	0.333333333	0.9	0.5	0.6	0.75
0.4	0.5	0.7	0.285714286	0.9	0.5	0.7	0.6428571
0.4	0.5	0.8	0.25	0.9	0.5	0.8	0.5625
0.4	0.5	0.9	0.222222222	0.9	0.5	0.9	0.5
0.5	0.5	0.1	2.5				
0.5	0.5	0.2	1.25				
0.5	0.5	0.3	0.833333333				
0.5	0.5	0.4	0.625				
0.5	0.5	0.5	0.5				
0.5	0.5	0.6	0.416666667				
0.5	0.5	0.7	0.357142857				
0.5	0.5	0.8	0.3125				
0.5	0.5	0.9	0.277777778				

Table D2.6 Implications of risk prioritisations

0.1	0.6	0.1	0.6	0.6	0.6	0.1	3.6
0.1	0.6	0.2	0.3	0.6	0.6	0.2	1.8
0.1	0.6	0.3	0.2	0.6	0.6	0.3	1.2
0.1	0.6	0.4	0.15	0.6	0.6	0.4	0.9
0.1	0.6	0.5	0.12	0.6	0.6	0.5	0.72
0.1	0.6	0.6	0.1	0.6	0.6	0.6	0.6
0.1	0.6	0.7	0.085714286	0.6	0.6	0.7	0.5142857
0.1	0.6	0.8	0.075	0.6	0.6	0.8	0.45
0.1	0.6	0.9	0.066666667	0.6	0.6	0.9	0.4
0.2	0.6	0.1	1.2	0.7	0.6	0.1	4.2
0.2	0.6	0.2	0.6	0.7	0.6	0.2	2.1
0.2	0.6	0.3	0.4	0.7	0.6	0.3	1.4
0.2	0.6	0.4	0.3	0.7	0.6	0.4	1.05
0.2	0.6	0.5	0.24	0.7	0.6	0.5	0.84
0.2	0.6	0.6	0.2	0.7	0.6	0.6	0.7
0.2	0.6	0.7	0.171428571	0.7	0.6	0.7	0.6
0.2	0.6	0.8	0.15	0.7	0.6	0.8	0.525
0.2	0.6	0.9	0.133333333	0.7	0.6	0.9	0.4666667
0.3	0.6	0.1	1.8	0.8	0.6	0.1	4.8
0.3	0.6	0.2	0.9	0.8	0.6	0.2	2.4
0.3	0.6	0.3	0.6	0.8	0.6	0.3	1.6
0.3	0.6	0.4	0.45	0.8	0.6	0.4	1.2
0.3	0.6	0.5	0.36	0.8	0.6	0.5	0.96
0.3	0.6	0.6	0.3	0.8	0.6	0.6	0.8
0.3	0.6	0.7	0.257142857	0.8	0.6	0.7	0.6857143
0.3	0.6	0.8	0.225	0.8	0.6	0.8	0.6
0.3	0.6	0.9	0.2	0.8	0.6	0.9	0.5333333
0.4	0.6	0.1	2.4	0.9	0.6	0.1	5.4
0.4	0.6	0.2	1.2	0.9	0.6	0.2	2.7
0.4	0.6	0.3	0.8	0.9	0.6	0.3	1.8
0.4	0.6	0.4	0.6	0.9	0.6	0.4	1.35
0.4	0.6	0.5	0.48	0.9	0.6	0.5	1.08
0.4	0.6	0.6	0.4	0.9	0.6	0.6	0.9
0.4	0.6	0.7	0.342857143	0.9	0.6	0.7	0.7714286
0.4	0.6	0.8	0.3	0.9	0.6	0.8	0.675
0.4	0.6	0.9	0.266666667	0.9	0.6	0.9	0.6
0.5	0.6	0.1	3				
0.5	0.6	0.2	1.5				
0.5	0.6	0.3	1				
0.5	0.6	0.4	0.75				
0.5	0.6	0.5	0.6				
0.5	0.6	0.6	0.5				
0.5	0.6	0.7	0.428571429				
0.5	0.6	0.8	0.375				
0.5	0.6	0.9	0.333333333				

Table D2.7 Implications of risk prioritisations

0.1	0.7	0.1	0.7	0.6	0.7	0.1	4.2
0.1	0.7	0.2	0.35	0.6	0.7	0.2	2.1
0.1	0.7	0.3	0.233333333	0.6	0.7	0.3	1.4
0.1	0.7	0.4	0.175	0.6	0.7	0.4	1.05
0.1	0.7	0.5	0.14	0.6	0.7	0.5	0.84
0.1	0.7	0.6	0.116666667	0.6	0.7	0.6	0.7
0.1	0.7	0.7	0.1	0.6	0.7	0.7	0.6
0.1	0.7	0.8	0.0875	0.6	0.7	0.8	0.525
0.1	0.7	0.9	0.077777778	0.6	0.7	0.9	0.4666667
0.2	0.7	0.1	1.4	0.7	0.7	0.1	4.9
0.2	0.7	0.2	0.7	0.7	0.7	0.2	2.45
0.2	0.7	0.3	0.466666667	0.7	0.7	0.3	1.6333333
0.2	0.7	0.4	0.35	0.7	0.7	0.4	1.225
0.2	0.7	0.5	0.28	0.7	0.7	0.5	0.98
0.2	0.7	0.6	0.233333333	0.7	0.7	0.6	0.8166667
0.2	0.7	0.7	0.2	0.7	0.7	0.7	0.7
0.2	0.7	0.8	0.175	0.7	0.7	0.8	0.6125
0.2	0.7	0.9	0.155555556	0.7	0.7	0.9	0.5444444
0.3	0.7	0.1	2.1	0.8	0.7	0.1	5.6
0.3	0.7	0.2	1.05	0.8	0.7	0.2	2.8
0.3	0.7	0.3	0.7	0.8	0.7	0.3	1.8666667
0.3	0.7	0.4	0.525	0.8	0.7	0.4	1.4
0.3	0.7	0.5	0.42	0.8	0.7	0.5	1.12
0.3	0.7	0.6	0.35	0.8	0.7	0.6	0.9333333
0.3	0.7	0.7	0.3	0.8	0.7	0.7	0.8
0.3	0.7	0.8	0.2625	0.8	0.7	0.8	0.7
0.3	0.7	0.9	0.233333333	0.8	0.7	0.9	0.6222222
0.4	0.7	0.1	2.8	0.9	0.7	0.1	6.3
0.4	0.7	0.2	1.4	0.9	0.7	0.2	3.15
0.4	0.7	0.3	0.933333333	0.9	0.7	0.3	2.1
0.4	0.7	0.4	0.7	0.9	0.7	0.4	1.575
0.4	0.7	0.5	0.56	0.9	0.7	0.5	1.26
0.4	0.7	0.6	0.466666667	0.9	0.7	0.6	1.05
0.4	0.7	0.7	0.4	0.9	0.7	0.7	0.9
0.4	0.7	0.8	0.35	0.9	0.7	0.8	0.7875
0.4	0.7	0.9	0.311111111	0.9	0.7	0.9	0.7
0.5	0.7	0.1	3.5				
0.5	0.7	0.2	1.75				
0.5	0.7	0.3	1.166666667				
0.5	0.7	0.4	0.875				
0.5	0.7	0.5	0.7				
0.5	0.7	0.6	0.583333333				
0.5	0.7	0.7	0.5				
0.5	0.7	0.8	0.4375				
0.5	0.7	0.9	0.388888889				

Table D2.8 Implications of risk prioritisations

0.1	0.8	0.1	0.8	0.6	0.8	0.1	4.8
0.1	0.8	0.2	0.4	0.6	0.8	0.2	2.4
0.1	0.8	0.3	0.266666667	0.6	0.8	0.3	1.6
0.1	0.8	0.4	0.2	0.6	0.8	0.4	1.2
0.1	0.8	0.5	0.16	0.6	0.8	0.5	0.96
0.1	0.8	0.6	0.133333333	0.6	0.8	0.6	0.8
0.1	0.8	0.7	0.114285714	0.6	0.8	0.7	0.6857143
0.1	0.8	0.8	0.1	0.6	0.8	0.8	0.6
0.1	0.8	0.9	0.088888889	0.6	0.8	0.9	0.5333333
0.2	0.8	0.1	1.6	0.7	0.8	0.1	5.6
0.2	0.8	0.2	0.8	0.7	0.8	0.2	2.8
0.2	0.8	0.3	0.533333333	0.7	0.8	0.3	1.8666667
0.2	0.8	0.4	0.4	0.7	0.8	0.4	1.4
0.2	0.8	0.5	0.32	0.7	0.8	0.5	1.12
0.2	0.8	0.6	0.266666667	0.7	0.8	0.6	0.9333333
0.2	0.8	0.7	0.228571429	0.7	0.8	0.7	0.8
0.2	0.8	0.8	0.2	0.7	0.8	0.8	0.7
0.2	0.8	0.9	0.177777778	0.7	0.8	0.9	0.6222222
0.3	0.8	0.1	2.4	0.8	0.8	0.1	6.4
0.3	0.8	0.2	1.2	0.8	0.8	0.2	3.2
0.3	0.8	0.3	0.8	0.8	0.8	0.3	2.1333333
0.3	0.8	0.4	0.6	0.8	0.8	0.4	1.6
0.3	0.8	0.5	0.48	0.8	0.8	0.5	1.28
0.3	0.8	0.6	0.4	0.8	0.8	0.6	1.0666667
0.3	0.8	0.7	0.342857143	0.8	0.8	0.7	0.9142857
0.3	0.8	0.8	0.3	0.8	0.8	0.8	0.8
0.3	0.8	0.9	0.266666667	0.8	0.8	0.9	0.7111111
0.4	0.8	0.1	3.2	0.9	0.8	0.1	7.2
0.4	0.8	0.2	1.6	0.9	0.8	0.2	3.6
0.4	0.8	0.3	1.066666667	0.9	0.8	0.3	2.4
0.4	0.8	0.4	0.8	0.9	0.8	0.4	1.8
0.4	0.8	0.5	0.64	0.9	0.8	0.5	1.44
0.4	0.8	0.6	0.533333333	0.9	0.8	0.6	1.2
0.4	0.8	0.7	0.457142857	0.9	0.8	0.7	1.0285714
0.4	0.8	0.8	0.4	0.9	0.8	0.8	0.9
0.4	0.8	0.9	0.355555556	0.9	0.8	0.9	0.8
0.5	0.8	0.1	4				
0.5	0.8	0.2	2				
0.5	0.8	0.3	1.333333333				
0.5	0.8	0.4	1				
0.5	0.8	0.5	0.8				
0.5	0.8	0.6	0.666666667				
0.5	0.8	0.7	0.571428571				
0.5	0.8	0.8	0.5				
0.5	0.8	0.9	0.444444444				

Table D2.9 Implications of risk prioritisations

0.1	0.9	0.1	0.9	0.6	0.9	0.1	5.4
0.1	0.9	0.2	0.45	0.6	0.9	0.2	2.7
0.1	0.9	0.3	0.3	0.6	0.9	0.3	1.8
0.1	0.9	0.4	0.225	0.6	0.9	0.4	1.35
0.1	0.9	0.5	0.18	0.6	0.9	0.5	1.08
0.1	0.9	0.6	0.15	0.6	0.9	0.6	0.9
0.1	0.9	0.7	0.128571429	0.6	0.9	0.7	0.7714286
0.1	0.9	0.8	0.1125	0.6	0.9	0.8	0.675
0.1	0.9	0.9	0.1	0.6	0.9	0.9	0.6
0.2	0.9	0.1	1.8	0.7	0.9	0.1	6.3
0.2	0.9	0.2	0.9	0.7	0.9	0.2	3.15
0.2	0.9	0.3	0.6	0.7	0.9	0.3	2.1
0.2	0.9	0.4	0.45	0.7	0.9	0.4	1.575
0.2	0.9	0.5	0.36	0.7	0.9	0.5	1.26
0.2	0.9	0.6	0.3	0.7	0.9	0.6	1.05
0.2	0.9	0.7	0.257142857	0.7	0.9	0.7	0.9
0.2	0.9	0.8	0.225	0.7	0.9	0.8	0.7875
0.2	0.9	0.9	0.2	0.7	0.9	0.9	0.7
0.3	0.9	0.1	2.7	0.8	0.9	0.1	7.2
0.3	0.9	0.2	1.35	0.8	0.9	0.2	3.6
0.3	0.9	0.3	0.9	0.8	0.9	0.3	2.4
0.3	0.9	0.4	0.675	0.8	0.9	0.4	1.8
0.3	0.9	0.5	0.54	0.8	0.9	0.5	1.44
0.3	0.9	0.6	0.45	0.8	0.9	0.6	1.2
0.3	0.9	0.7	0.385714286	0.8	0.9	0.7	1.0285714
0.3	0.9	0.8	0.3375	0.8	0.9	0.8	0.9
0.3	0.9	0.9	0.3	0.8	0.9	0.9	0.8
0.4	0.9	0.1	3.6	0.9	0.9	0.1	8.1
0.4	0.9	0.2	1.8	0.9	0.9	0.2	4.05
0.4	0.9	0.3	1.2	0.9	0.9	0.3	2.7
0.4	0.9	0.4	0.9	0.9	0.9	0.4	2.025
0.4	0.9	0.5	0.72	0.9	0.9	0.5	1.62
0.4	0.9	0.6	0.6	0.9	0.9	0.6	1.35
0.4	0.9	0.7	0.514285714	0.9	0.9	0.7	1.1571429
0.4	0.9	0.8	0.45	0.9	0.9	0.8	1.0125
0.4	0.9	0.9	0.4	0.9	0.9	0.9	0.9
0.5	0.9	0.1	4.5				
0.5	0.9	0.2	2.25				
0.5	0.9	0.3	1.5				
0.5	0.9	0.4	1.125				
0.5	0.9	0.5	0.9				
0.5	0.9	0.6	0.75				
0.5	0.9	0.7	0.642857143				
0.5	0.9	0.8	0.5625				
0.5	0.9	0.9	0.5				