THE DEVELOPMENT OF AN EMPIRICAL-BASED FRAMEWORK FOR PROJECT RISK MANAGEMENT

A thesis submitted to the University of Manchester for the degree of
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ABSTRACT

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The Development of an Empirical-Based Framework for Project Risk Management

This research is conducted to formulate a framework for project risk management by evaluating the current understanding and practices. It examines the risk management processes provided by the various standards, frameworks and guidelines available globally. The research argues that the existence of varying risk management standards, frameworks and guidelines is not an assurance that organisations will adopt their principles and processes. Furthermore, these documents do not provide sufficient information concerning the understanding of the concept of risk and uncertainty and their management. To accomplish this goal, it became necessary for the research to reach an understanding about the concepts and fundamental issues of risk and uncertainty management. This research also sought to know how organisations in different industries manage risks and uncertainties for their projects. This research was confined to the study of the understanding and practices of PRM by established or influential organisations in aerospace and aviation, oil, gas and petrochemical, power, telecommunication as well as construction industries with matching criteria. Semi-structured interviews were conducted using an '*aide-memoire'* with managers involved in the management of project risks to document the current practices of risk management. Thematic analyses were used to compress and summarise the large amount of data into internally consistent understandings of risk and uncertainty. Based on the results, the research proposes a structure that explains the current understanding of the concepts of risk and uncertainty as well as an outline process framework for conducting risk management for industry use. Practically, risk and uncertainty are found to be interrelated whereby and they happen as an outcome of each other's occurrence. The proposed framework consists of six major steps which incorporated the purposes and activities within, providing a better understanding of how risk can be managed. This research contributes theoretically, methodologically and practically to project risk management body of knowledge.

DECLARATION

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning

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LIST OF CONTENTS

Contents **Page No.**

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LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Abbreviation	Description
AIPM	Australian Institute of Project Management
APM	Association for Project Management, UK
APMBOK	APM Body of Knowledge, UK
ARM	Active Risk Management
AS/NZS	Australia Standards/New Zealand Standards
BOK	Body of Knowledge
BS	British Standards
CAN/ CSA	Canadian Standards Association
CAQDAS	Computer Aided Qualitative Data Analysis Software
CEPA	Schwartz Center for Economic Policy Analysis
COBIT	Control Objectives for Information and related Technology
COSO	Committee of Sponsoring Organizations or the Treadway Commissions
CPMC	Corporate Project Management Council
CRM	Continuous Risk Management
CMU-SEI	Carnegie-Mellon University-Software Engineering Institute
DAG/ DAU	Defence Acquisition Guidebook/ Defence Acquisition University, US
DRDC	Defence Research and Development of Canada
DoD	Department of Defense, US
DRMF	Defence Risk Management Framework, Australia
ENAA	Engineering Advancement Association, Japan
EU	Expected Utility
EUT	Expected Utility Theory
FERMA	Federation of European Risk Management Association
GAPPS	Global Alliance for Project Performance Standards
GoC	Government of Canada
GFORM	Group Framework for Risk and Opportunity Management
GQP	General Quality Procedure
IAPPM	International Association for Project and Program Management
ICE	Institute of Civil Engineering, UK
IEEE	Institute of Electrical & Electronic Engineering
IEEE-SA	Institute of Electrical & Electronic Engineering-Standards Authority
IPMA	International Project Management Association
IRGC	International Risk Governing Council
IRM/ AIRMIC/ ALARM	Institute of Risk Management/Association of Insurance and Risk Managers/The National Forum for Risk Management in the Public Sector

IRMF	Integrated Risk Management Framework
ISACA	Information Systems Audit and Control Association
ISIC	International Standard Industrial Classification of All Economic Activities
ISO	International Standards Organisation
K-K	Knight and Keynes
MOD	Ministry of Defence
M_o_R	Management of Risks
MPM	Maturity in Project Management
MSP	Managing successful projects
NAO	National Audit Office, UK
NASA	National Aero Space Agency, US
NCSPM	National Competency Standards for Project Management, Australia
NPR	NASA Procedural Requirements
NUD*IST	Non-numerical Unstructured Data, Indexing, Searching, and Theorizing
OGC	Office of Government Commerce, UK
OPM-CIPFA	Office for Public Management – the Chartered Institute of Public Finance Accountancy, UK
P2M	Guide-book for Project & Program Management for Enterprise Innovation, Japan
PDF	Project Delivery Framework
PFI/PPP	Private Finance Initiatives/ Public-Private Partnership
PfMO	Portfolio Management Office
PgMO	Programme Management Office
PM	Project Management
PMAJ	Project Management Association of Japan
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMO	Project Management Office
PRAM	Project Risk Analysis and Management
PRINCE	Project in Controlled Environment
PRM	Project Risk Management
RACI	Responsibility, Accountability, Consultant, Informed
RAMP	Risk Analysis and Management for Projects
RIDM	Risk-Informed Decision Making
RM	Risk Management
SEI	Software Engineering Institute, Carnegie-Mellon University, US

SEU	Subjective Expected Utility
SEUT	Subjective Expected Utility Theory
SQEP	Suitably qualified and experienced personnel
TOC	Theory of constraints
TRM	Team Risk Management
UNECE	United Nations Economic Commissions for Europe

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Overview

The concept of risk and uncertainty management has been discussed and researched for many years and due to research that is being undertaken currently, is still being debated today. Risk and uncertainty are closely related to economics, management and decision-making, therefore the debate can be tracked through the history of economic thought. Risk management has its foundation from the expected utility theory (EUT) [see (Kutsch and Hall, 2010, Pender, 2001)], whereby the EUT was adopted as a model of rational choice for taking risky decisions (Tversky and Kahneman, 1992). According to Pender (2001), the EUT was the foundation for the laws of probability; the dominant paradigm of risk analysis. The history of economic thought indicates that whilst Frank Knight and John Maynard Keynes distinguished between risk and uncertainty, Leonard Savage, Jacob Marschak, John von Neumann and Oskar Morgenstern argued that risk and uncertainty were not dissimilar.

This research will discuss the issues relating to the practices and processes of managing risk and uncertainty in project management. Unlike risk, uncertainty is an immeasurable probability, making it difficult for even experienced project managers to manage, as projects differ from one to another. Project managers usually use management tools, such as risk management, to manage risk and uncertainty.

1.2 Background

The application and practice of risk management for projects (or project risk management) started in the 1950s upon the development of scheduling and risk management tools for project management (Morris, 1997). The risk management principles, apart from being a popular research and development topic (Kähkönen, 2006), have since been adopted for practice in the area of project management. Research conducted recently by Raz and Hillson (2005) indicates that modern risk management has evolved substantially due to an improved ability to deal with uncertainty.

This chapter addresses the theoretical underpinning this research, which are the fundamental issues pertaining to the concept of project risk and uncertainty involving the history and evolution of the EUT and the current application. The investigation will be conducted with a view to outline a theoretical framework that can be used by any organisation in any industry to develop their risk management framework for projects. Although an abundance of literature concerning the management of risk and uncertainty can be found, literature relating to distinguishing methods to manage them appears to be absent. Literally, it is prevalent that risk and uncertainty are understood to be of the same kind; disagreeing with Frank Knight's (1921) classic distinction between risk and uncertainty. Knight's approach suggests situations of risk being measurable deductive or inductive probabilities, estimates as uncertain, thus requiring different methods to measure and manage.

Project risk management (PRM) is an area that has seen a growing concern in project management and its need has been widely recognized (Williams, 2005, Metcalfe and Lynch, N.D.). PRM literature is vast, incorporating the best practice standards, and tools and techniques that aid its study and implementation (Koskela and Howell, 2002, Williams, 2005). There are an abundance of varying approaches to undertaking PRM such as Project Risk Analysis and Management or PRAM (Chapman, 1997, Chapman, 2006, Gray, 1998), Project Uncertainty Management or PUMA (Jugdev and Müller, 2001), Project Risk and Opportunity Management Process (ROMP) and Project Risk and Opportunity Management (PROM) (Cicmil and Hodgson, 2006), Multi-party Risk and Uncertainty Management Process (MRMP) (Engwall, 2003), Shape, Harness, And Manage Project Uncertainty (SHAMPU) (Chapman and Ward, 2003), and also Active Threat and Opportunity Management (ATOM) (Cleland and Ireland, 2002a). According to Seyedhoseini and Hatefi (2009:138), a large number of processes have been generated since 1990 to address the need for more effective risk management [see (Seyedhoseini and Hatefi, 2009)]. The existence of such processes make the risk management exercise more objective (Williams, 2005). Due to the abundance of approaches to PRM, issues regarding the suitability and the usage of PRM approaches have been highlighted in previous research as follows:-

(i) Olsson (2007:746) has pointed out that the existing risk management processes differ to some extent. Therefore, there is a need to improve risk management processes due to several shortcomings, including the ineffectiveness of the tools and being deemed inappropriate for the industry (Olsson, 2007).

(ii) The challenges towards the existing risk management processes, such as the suitability within an organization, tools and techniques for enhancing uncertainty management, and the acceptance and enhancement of opportunity management had not been raised until very recently (Metcalfe et al., 2001).

(iii) Chapman and Ward (2003:97) have argued that the existing PRM processes have limited focus which in turn restricts the contribution to improving project performance. Chapman and Ward have moved beyond the conventional risk management approach by proposing the uncertainty management concept, which takes into account the positive and negative consequences of uncertainty [see (Chapman and Ward, 2003, Ward and Chapman, 2003)].

(iv) Sanchez et al. (2009) have highlighted that project risk management must also consider positive consequences and not only negative because projects are becoming more dynamic (Sanchez et al., 2009).

This research is influenced by three main researchers or scholars in the area of PRM namely Chapman and Ward (Chapman, 1997, Chapman, 2006, Chapman and Ward, 2003, Ward and Chapman, 1991, Ward and Chapman, 2003), David Hillson (Hillson, 2002, Hillson, 2011, Hillson et al., 2006, Hillson and Murray-Webster, 2011, Cleland and Ireland, 2002a, Raz and Hillson, 2005), and also the INSEAD[1] team (De Meyer et al., 2001, De Meyer et al., 2002, Loch, 2004, Loch et al., 2006, Loch et al., 2000, Loch et al., 2008, Pich et al., 2002, Sommer and Loch, 2004).

[1] INSEAD; formerly known as "***INS**titute **E**uropéen d'**AD**ministration des Affaires*", or European Institute of Business Administration. The name INSEAD team in this research means its related research team.

In their work, Chapman and Ward (2003) identify tools and techniques related to PRM. Additionally, Ward and Chapman (2003) propose the concept of project uncertainty management, arguing that a broader perspective is needed to manage uncertainty. They outline five types of uncertainty; namely, variability associated with estimates, uncertainty about the basis of estimates, the design and logistics, the objectives and priorities, and the fundamental relationships between project parties. However, the concept of project uncertainty management was merely the substitution of the word related to uncertainty for risk in all terminologies as well as modifying the existing wordings in the PRM guidelines associated with risk to threat. For example, a downside risk is termed as a threat; an upside risk is termed as an opportunity; a risk is a source of uncertainty; a major risk is a significant uncertainty; and mitigate is modify (Ward and Chapman, 2003:102). Meanwhile, Hillson (2002) has proposed the extension to the risk processes to manage opportunities. According to Hillson, risk has been commonly associated with the downside and therefore to argue that risk management practitioners are recognizing risk as uncertainty can affect the project's objective which incorporates threats and opportunities (Hillson. 2002:239). The four strategies which were proposed in responding to opportunities: to exploit, share, enhance and ignore; replaced the common strategies of avoid, transfer, mitigate and accept (Hillson, 2002). Therefore, Hillson concluded that what was needed was an extension of risk management processes to include opportunity management as an integral part. Recently, Hillson and Simon (2012) suggested a variance to the concept of opportunity management known as Active Threat and Opportunity Management (ATOM). They claimed ATOM as a simple process and one of the critical success factors for effective risk management. Meanwhile, the INSEAD's approach provides a distinct view in managing risk and uncertainty. The first approach is to classify uncertainty into four types: variation, foreseen uncertainty, unforeseen uncertainty, and chaos. Further, they proposed four strategies to cope with uncertainty: learning, selectionism strategy, instructionism, and learning and selectionism strategy.

The global availability of various risk management standards, frameworks and guidelines of processes has enabled organizations and industry to adopt and implement risk management principles. Factors that have led to the development and application of risk management methodology include the expanded view of the organization, the growing importance of projects as a framework for planning and executing work in organizations, and the rapid increase of project complexity (Raz and Hillson, 2005). However, this research found that there is a need to acquire the existing knowledge and practices in managing project risks identified by other scholars. This need was highlighted by Kululanga and Kuotcha, in which they indicated there being a low implementation of formal PRM methods in practice which in turn led to poor project performance (Kululanga and Kuotcha, 2010). They have conducted studies within the construction industry to ascertain the extent to which current PRM practices are adopted. They also argue that the existence of various risk management standards, frameworks and guidelines is not an assurance that organizations will adopt their principles and processes. This argument is supported by Seyedhoseini et al. (2008) and Kutsch (2008). Seyedhoseini et al. (2008) have identified several factors for future risk management process studies such as adaptability, agility, goals and outputs, perspective, structure, and tools and techniques [see (Seyedhoseini et al., 2008)]. For example, they highlighted that as most risk processes have a rigid framework, there was a possibility that they not adapt well to project conditions, perceive them as complex or too costly, as having a weak structure thus requiring new tools and techniques to increase the depth of analysis. Kutsch's (2008) studies are related to the information technology industry. The study investigated the discrepancy between the adequacy of project risks which should be managed and are actually managed (Kutsch, 2008).

Additionally, the standards, frameworks, and guidelines do not seem to provide clear differentiation on the particular issues being debated in the history of economic thought by Knight (1921) and Keynes (1921). Therefore, it is hoped that the theoretical framework developed from this research will take into account and consolidate the aforementioned documentation and provide a generic process rather than being an industry or project specific. It does not attempt to replace any existing documents such as PRAM, PUMA, ATOM, MRPM, PROM and the likes, nor guarantee that there will be tools and techniques provided within. It is an amalgamation of the available documents, the current knowledge and practices from the industries; thus contributing to the body of knowledge in risk management.

1.3 Aim of the research

The aim of this research is to formulate a framework for project risk management process by evaluating the current understandings and practices.

1.4 Research objectives

The following objectives are set to support the above aim.

1. To evaluate existing risk management processes from standards, frameworks, and guidelines;
2. To investigate the current practices of managing risk for projects by different organisations in different industries;
3. To develop a structure that explains the current understanding of risk, uncertainty and opportunity concepts.
4. To formulate a generic framework for conducting risk management process for industry use.

1.5 Research questions and research problems

The two types of research questions developed for this research and are identified as primary and secondary questions. The research has developed one primary question and three secondary questions to support the research problems.

<u>Primary research question</u>

"How do organisations manage risks and uncertainty for their projects?"

The proposed research is based on the theoretical background of Knight (1921) and Keynes (1921), which distinguishes between risk and uncertainty; risks are quantifiable probabilities, while uncertainties are not. A very recent study by Lechler et al., (2012:66) has highlighted that the lack of a clear distinction between risk and uncertainty allows for misperceptions and consequently leads to forgone value opportunity at project and enterprise levels (Lechler et al., 2012). Additionally, existing standards in project management do not explicitly address the identification of uncertainties [see (Allen, 1995)]. In practice, risks are measured and quantified using the tools and techniques available in the market, such as the Delphi technique, assumption analysis, constraint analysis, decision tree, and Monte Carlo analysis. There are also attempts to link risk with uncertainty. For example, Hillson [see (Smyth and Morris, 2007)] has used the theories of aleatory and epistemic uncertainty to discuss risk and uncertainty; therein risk is stated as a measurable uncertainty, uncertainty as an immeasurable risk. Ward and Chapman (2011) provide a differing view as to how uncertainty can be managed; which goes beyond the scope of common risk management practice. They focus on generic 'performance uncertainty management processes' or PUMPs, designed to clarify uncertainty, opportunity and risk in any projects (Whitty and Maylor, 2009). Sandøy et al., (2005:8) argue that risk and uncertainty are addressed in different analyses, carried out throughout the phases of a project. Additionally, Sandøy et al. indicate that uncertainty management constitute events with both negative and positive consequences, i.e. events that can increase or decrease the value of a project. Based on the varying information related to the practice of risk and uncertainty management processes, the research found that there is a need to capture the current practice of PRM.

<u>Secondary research questions</u>

The following are identified problems that require investigation in this research:

1. *"How does a project organisation conduct its project risk management process*?"

   Literature reviews on risk management indicate that risk management generally entails the processes of identifying, analysing, responding and monitoring risk. However, due to the availability of varying approaches to undertake the PRM, organisations may adopt a distinct approach to risk management for projects; the difference being in terms of scope as well as the way the process is structured (Packendorff, 1995). Prior research conducted [see (McHugh and Hogan, 2011, Kutsch and Hall, 2010, Söderlund, 2004, Goodman, 1967)] indicate that there are issues in implementing formal PRM methods.

2. *“What are the techniques adopted by organisations to manage project uncertainty*?” “*How can these techniques be included and harmonised in existing risk management methods for projects?”*

   The aforementioned techniques (PRM, PRAM, PUMA, PROM, ROMP, MRMP, SHAMPU and ATOM) to manage uncertainty were used throughout all phases of projects to minimise delays and other issues relating to project performance (Whitty, 2005). However, findings by the INSEAD team showed that managers still failed to recognise uncertainties that existed within the project due to the lack of awareness of the uncertainty issues and common understanding of project definition (De Meyer et al., 2002).

3. *“What are the tools adopted by organisations to manage project risk and uncertainty? What is the significance to the PRM processes?”*

   There are existing problems on dependency of risk management systems, guidelines, tools and techniques available on the market, which can be used and can provide practical results. This problem has been criticised by Hogarth (1980) who argues that as tools lack the flexibility to capture the essence of many important problems (Hogarth, 1980). Researchers [see (Packendorff, 1995, Metcalfe and Lynch, N.D.)] have propounded that it is not about the use of particular tools or methods, but to always perform suitable and sound risk management to suit the need for the project. The research indicates that the use the available tools and techniques only may not contribute to the overall PRM processes.

1.6 Research strategy, design and methods

The research strategy seeks to examine current practices relating to the concept of risk and uncertainty, this pertaining to projects conducted by organizations in varying industries in the UK. This strategy is underpinned by methods drawn from the interpretive and positivist paradigms which have been discussed and adopted by those researching project management [see (Shenhar and Dvir, 1996, White and Fortune, 2002, Duncan, 1995, Wirth and Tryloff, 1995, Ahlemann et al., 2009a, Abran and Moore, 2004)]. A previous study in software risk management by Padayachee

(2002:120) indicates that in order to obtain clarification, interpretive research seeks to understand all nuances of the phenomena. Interpretive research does not predefine dependent and independent variables nor seek for a particular explanation based on the complexity of human sense (Everett, 2011). Whereas, positivist, as based on Humean law of causality i.e. linear thinking, is said to seek for general explanations and solutions for practice (White and Fortune, 2002). Therefore, the research utilises the positivist and interpretivist paradigms. The research conducted will identify the current practice of the processes of PRM from individual experiences in order to recognise themes (interpretive). This will subsequently lead to the development of a structure that explains the understanding based on the study (positivism; defined phenomenon). Meanwhile, research design provides a structure or framework for the collection and analysis of data (Bryman, 2001) whereas research method is a technique for collecting data (Vaus, 2001).

Research on risk management for projects has been conducted in various industries including automotive manufacturing (Patterson et al., 1999, Patterson, 2002), construction (Greene, 2002, Mak, 1992, Mootanah, 1999, Li, 2003), and information technology (Kutsch and Hall, 2010, Baccarini et al., 2004, Kutsch and Hall, 2005). The empirical knowledge of the management approach to risk management is still subjective and mainly based on how risk management is assumed to work rather than how it is practiced (de Bakker et al., 2010, Goodman, 1967). Although Raz and Hillson (2005) provided theoretical comparisons of risk management standards based on six different documents, it can be argued that information regarding whether the practices being outlined in the documents are being implemented is lacking.

To this regard, the research suggests that there is a need to explore the current understanding and practice of risk management for projects; this should consider the implementation by project organisations in different industries. In order to explore current understanding and practices, the research intends to adopt interview methodology, which will be discussed below.

1.6.1 Interviews – semi-structured

Semi-structured interviews will be conducted with managers involved in the management of project risks in various organizations. This choice of interview has been influenced by the large number of participants from different organisations and industries. Moreover, the information to be collected is anticipated to be diverse; as interview methodology depends very much on the type of information to be collected (Hague, 1993), the semi-structured interview structure seems ideal for the information to be collected. Also, previous studies have adopted structured and semi-structured interviews, which are discussed in Chapter 4. Semi-structured interviews will not impinge on the reliability and validity of the data as an '*aide-memoire*' or a list of specific topics will be specified to address the range of topics relating to the research, and the interviewee will be allowed to respond freely. This method tends to be very similar to a conversation (Bryman, 2001).

1.6.2 Data collection and analysis

Data collection helps illustrate the research process as well as assessing research design. To further understand how the data collection process works the diagram provided by Cresswell (1998) has been utilised, as seen below:

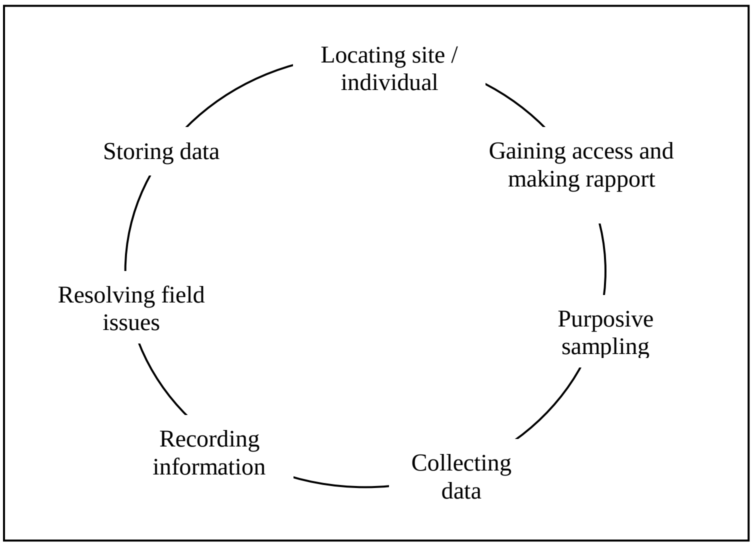


Figure 1.1: Data collection activities *(Source: (Cresswell, 1998))*

Using the multiple method data collection suggested by Cresswell (1998), individuals involved with the particular project will be identified and approached to gain access to the data. This is where the purposive sampling steps come into the picture. Snowball sampling will be added to the method via interviewee recommendations. The next step will be deciding upon the most appropriate and feasible methods to collecting data. For this research, data collection will be done through the triangulation method. Interviews are to be recorded using a digital voice recorder, then transcribed into text format, stored and managed using qualitative software before being analysed.

1.6.3 Issues with data collection methods: reliability and validity

The primary source of data for the study is the interviews; the reliability depends very much on the consistency of the interviews conducted. The validity issue that may arise is the biasness or response bias (C.F. Cannel in (Beed and Stimsom, 1985)). This thesis will explore the implementation of risk and uncertainty management in projects, whereby participants are those involved in the projects, without having to consider external stakeholders. To overcome this issue, the scope shall be bounded to study on the project organisations and their risk management process for projects.

1.7 Definitions and scope of study

1.7.1 Definitions

In principle, the research adopts the definition of risk by Knight (1921) and Keynes (1921), which corresponds to the concepts of risk and uncertainty chosen as the background of this research.

a) Risk

Risk is defined as "*insurable hazards; events subject to known or knowable probability distribution* (Knight, 1921) whereby *probability is considered to have less subjectivity and is measurable"* (Keynes, 1921b). The UK's Office of Government Commerce (OGC) and the British Standards Institutions define risk related to project and project management as:

“…exposure to the possibility of economic and financial loss or gain, physical damage or injury, or delay as a consequence of the uncertainty associated with pursuing a particular course of action”

(OGC, 2010d)

“…an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of project objectives."

(BS-EN-9200, 2004)

“…an uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives."

(OGC, 2010b)

b) Uncertainty

Knight (1921) defines uncertainty as “*uninsurable hazards”* by which he denotes the impossibility in specifying its probability. Meanwhile, Keynes (1921) indicates that uncertainty arises when one cannot calculate the probability of the event, and hence, there is no basis to do so. Other definitions are given by Galbraith (1977), and Runde (1998), who clarified Knight’s concept of risk and uncertainty, and also by the UK’s OGC. The definitions are as follows:

“…difference between the information that the organisation has and the information it needs."

(Galbraith, 1977)

“…a situation where the decision maker is unable to assign probabilities to events because it is not possible to calculate chances."

(Runde, 1998)

“…a state of incomplete knowledge about proposition; usually associated with risks, both threats and opportunities."

(OGC, 2010a)

1.7.2 Scope of study

Due to the broad scope of the topic and the time constraint, the research is limited to project risk management practices within project organisations. Established or influential project organisations in their related industries, such as aerospace and aviation, oil, gas and petrochemical, power, telecommunication and construction will be selected to match the common criteria, as follows:

a) Organisations that produce clear engineered products.

b) Organisations that have design, engineering and construction processes.

c) Organisations that have project management/risk management practices in place.

Interviews will be conducted with project managers, risk managers, project directors or other managers responsible for the processes in the organisation. The interviews will be guided by a series of questions derived from this research.

1.8 Contributions

This research attempts to produce theoretical and practical contributions in project risk management. Theoretically, the research commits to improve the body of knowledge through the understanding of the concept of risk and uncertainty. The theoretical contributions are reflected according to the findings, and methodologies adopted, which underpinned the interrelationships of the concept of risk and uncertainty. Additionally, the research will yield a practical contribution by providing insights to how industries currently understand and implement PRM. In doing so, the research will develop a structure that explains the current understanding, identifying their consistency or lack thereof with those of Knight (1921) and Keynes (1921). Based on the findings relating to current practice, a hypothetical framework for PRM process will be developed. This does not imply changes in existing approaches to project risk and uncertainty management be definitely advocated. It will, however, provide a generic framework and be developed as an amalgamation of various processes available to suit varying industries.

1.9 Organisation of the thesis

This thesis is divided into nine chapters. Chapter 1 introduces the subject and the issues concerning the research topic, by clarifying the aim and objectives of the study with the means for achieving them. It also defines key terminology of the subject.

Chapter 2 provides the theoretical background to the concept of risk and uncertainty and their recent development. It describes the evolution of the history of economic thought related to risk and uncertainty. Additionally explained is the theoretical framework upon which this research is based, which is the understanding of risk and uncertainty concepts.

Chapter 3 provides a systematic review and synthesis of the theoretical and literature in the management of risk relating to projects. It describes the importance of managing risks for projects, and the various standards, frameworks, and guidelines available and the existing methods, tools and techniques utilised to conduct the process.

Chapter 4 gives details of research design and methodology employed in the study. This includes selective organizations and their methods of collecting and analysing data.

Chapter 5 presents the first part of data analysis. It describes detailed analysis of the interviews conducted using qualitative software, NVivo. It covers the definitions and relationships of the concept of risk, uncertainty and opportunity.

Chapter 6 marks the second part of data analysis, explaining how managing project risks are implemented in practice. This includes current knowledge and understanding project risks, adopted practices and processes of managing risk, as well as the use of risk management standards, frameworks, and guidelines relating to projects.

Chapter 7 presents the third part of data analysis for the research. This chapter discusses gathered project management and governance, describing the information about the project management office or PMO, project management processes, project procurement and contracts. This is all discussed with regards to the views and information ascertained by the interviewees.

Chapter 8 discusses the research findings. It summarises the research, discusses the principal findings concerning the theoretical and practical implications of risk and uncertainty concepts.

Chapter 9 concludes the research. It recommends the proposed framework developed as an outcome of the research. This chapter also provides suggestions for further research within this very field.

A diagram of the structure of the thesis is shown in Figure 1.2.

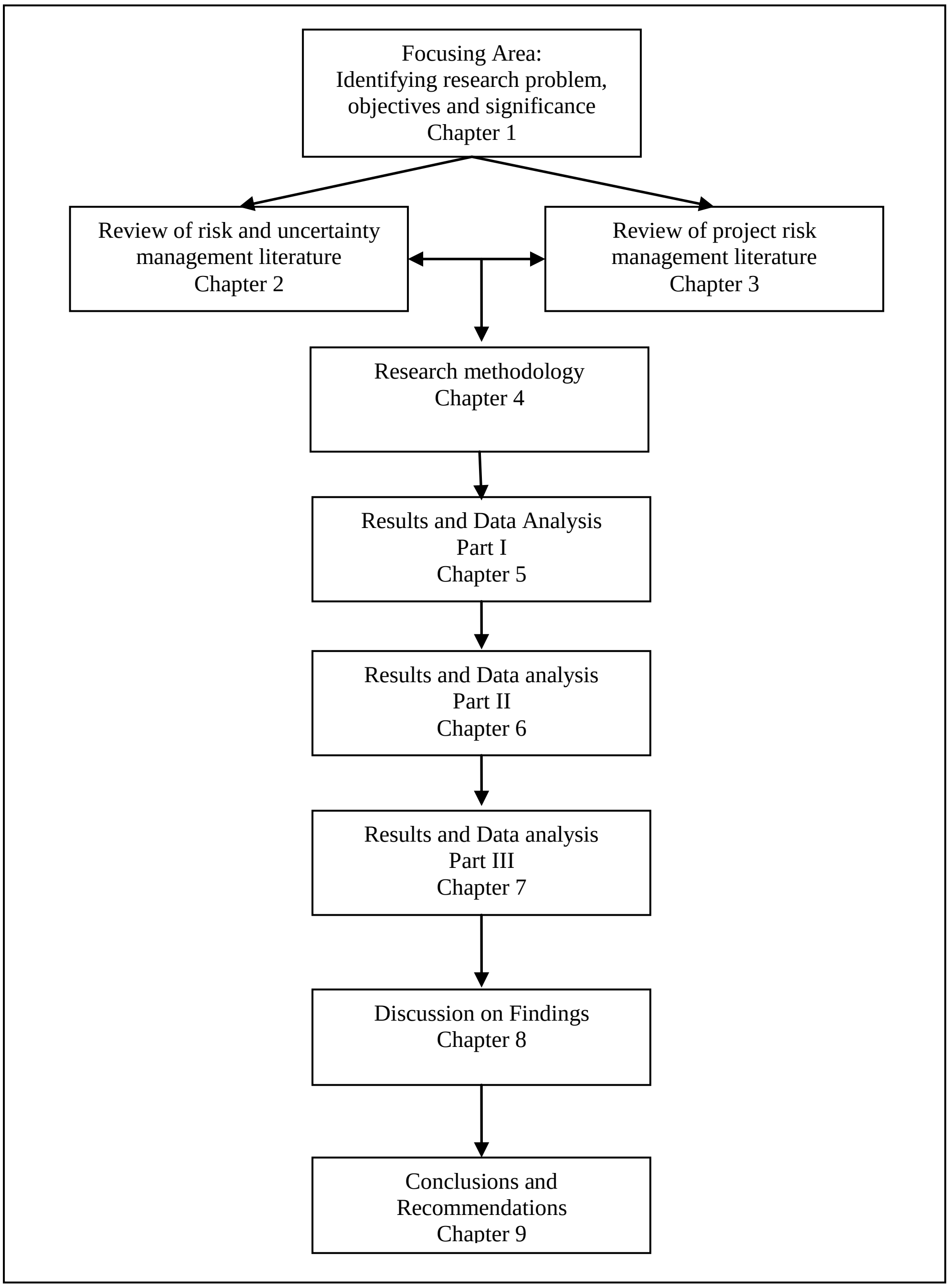


Figure 1.2: Outline of thesis

1.10 Summary

This chapter has introduced the research by providing an insight into the research domain, aim, objectives as well as methodology. Additionally, the structure of the thesis is included to ascertain the logic and flow of the approach in undertaking this research. The next chapter will discuss the concept of risk and uncertainty relating to the research.

CHAPTER 2

THE CONCEPTS OF RISK AND UNCERTAINTY

2.1 Introduction

This chapter introduces the background and history of the concepts of risk and uncertainty. It will explain in brief the history of economic thought relating to risk and uncertainty. As discussed in Chapter 1, risk and uncertainty have their foundation from the EUT. The theory of Knight (1921) and Keynes (1921) which differentiates risk and uncertainty, upon which this research is based, will also be discussed. Additionally, the chapter will provide an overview of the three approaches to project risk management that are available today.

2.2 History of Economic Thought Related to Risk and Uncertainty

This section will explain the history of economic thought by examining differing schools of thought. The research background is based on the method by the Schwartz Center for Economic Policy Analysis (CEPA[2]), which divides the schools into four; namely, the schools of political economy, the neo-classical schools, the thematic schools, and the alternative schools. The CEPA method highlighted major tensions and differing patterns of thought in economics and identified the issues relating to the history of economics by positioning the key authors and contributors into different schools of thought. To understand the concept of uncertainty and its fundamental principles, it is first necessary to analyse the history and the evolution of economic thought. The concept of uncertainty has evolved from statistical and mathematical subjects, later been adopted into the theory of economics as a result of studies in utility theory (CEPA, 2007). Figure 2.1 illustrates the general schools within the history of economic thought.

[2] CEPA is one of the units at the New School for Social Research, New York, which currently gathers information relating to the history of economic thought.

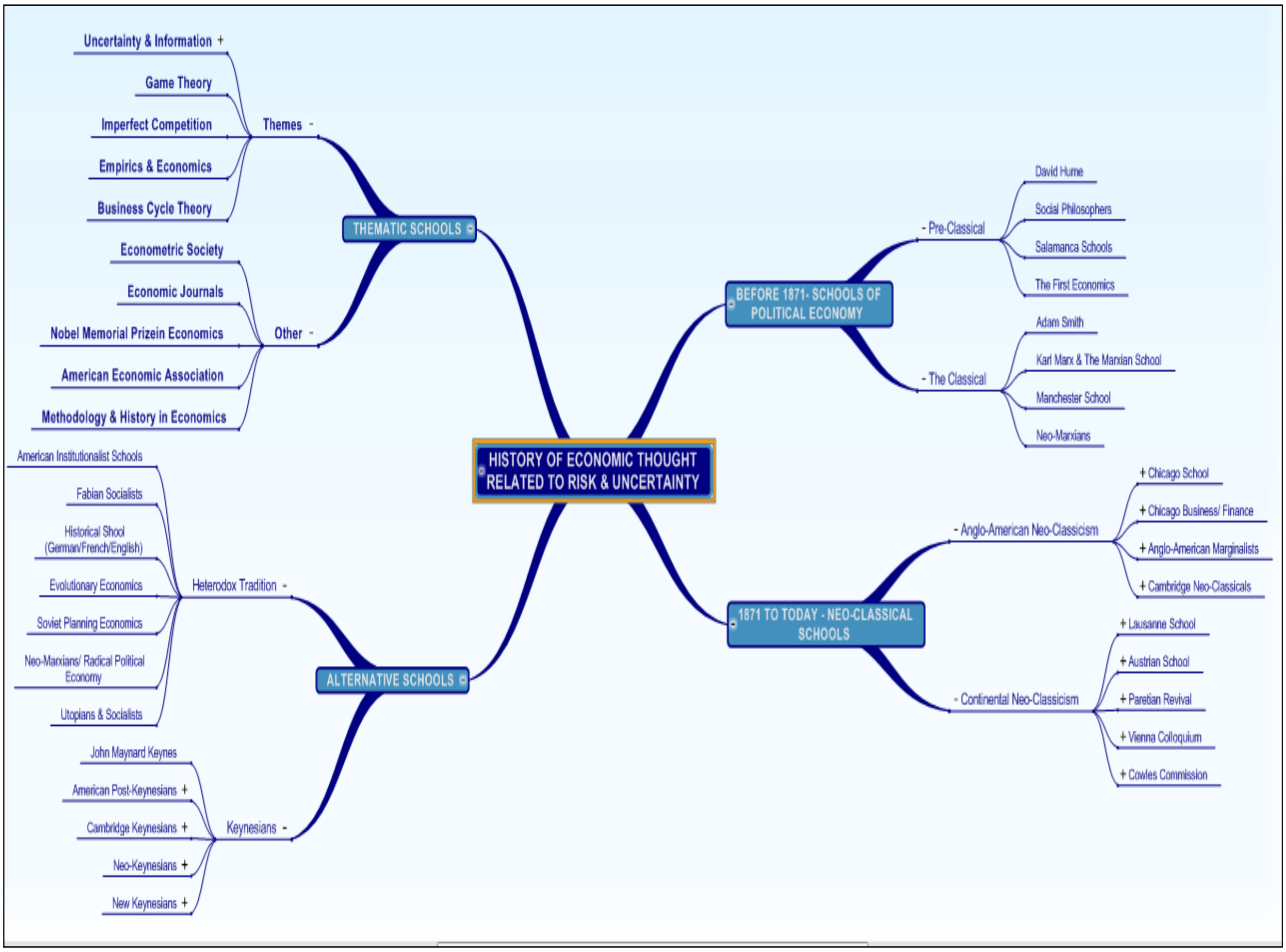


Figure 2.1: Different Schools of Thought within the History of Economic Thought

a) *The Schools of Political Economy – The Classical School*

The schools of political economy were classified into two: pre-classical, of which David Hume and the social philosophers were integral. Adam Smith, Karl Marx and the Manchester School are affiliated with the classical school.

b) *The Neo-Classical Schools– Anglo-American and Continental Schools*

The second school of thought, the Neo-Classical school, started in 1871. This school is divided into two main groups of thinking: Anglo-American Neo-Classicism, and Continental Neo-Classicism. Notable scholars relating to Anglo-American Neo-Classicism are the Chicago Schools, such as Frank Knight, Milton Friedman, George Stigler and Harry Markowitz. W. Stanley Jevons, a marginalist, and Alfred Marshall of Cambridge, who introduced "The

Principles of Economics", also belongs to this school of thought. Figure 2.2 highlights the Anglo-American schools.

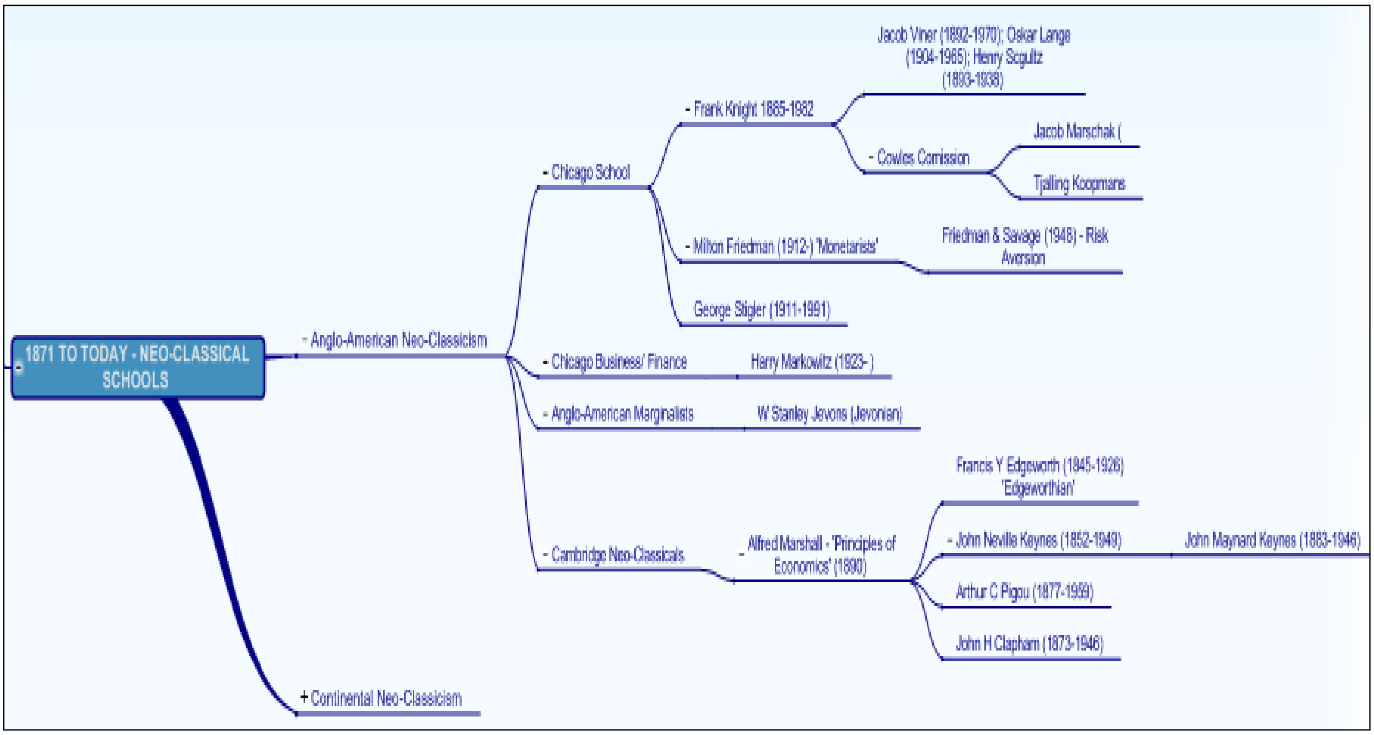


Figure 2.2: Anglo-American Neo-Classical schools within the History of Economic Thought

Meanwhile, Continental Neo-Classicism consists of five different schools: the Lausanne school (Leon Walras and Vilferado Pareto), the Austrian school (Carl Menger and Eugan von Bohm-Bawerk), the Paretian revival (the London School of Economics, Oskar Lange, Maurice Allais and Henry Schultz), the Vienna colloquium (Karl Menger, Abraham Wald, John von Neumann, Oskar Morgenstern and Gerard Tintner), and the Cowles commission (Harry Markowitz, Gerard Debreu, Donald Hester, Thomas Tobin, Jacob Marschak, and Roy Radner). The Continental schools introduced uncertainty into the theory of choice. Figure 2.3 illustrates the Continental schools.

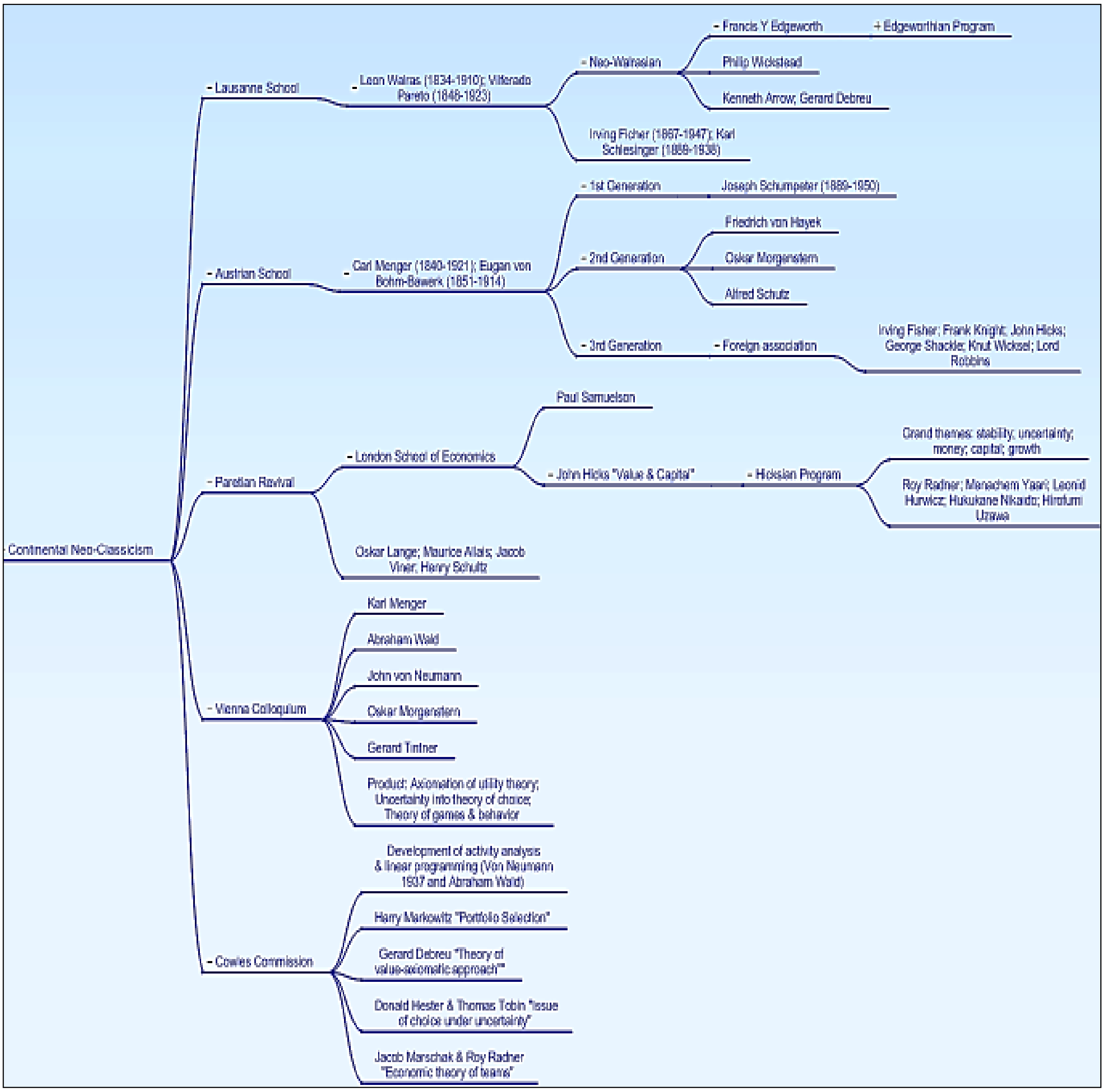


Figure 2.3: The history of economic thought – continental neo-classical schools

c) *The Thematic Schools*

The third category is the thematic schools, which utilise various theories and ideas to create specific themes. There are five main themes; uncertainty and information, game theory, imperfect competition, empirics and economics, and business cycle theory. Each theory is represented by clear concepts generated by different authors, as illustrated in Figure 2.4.

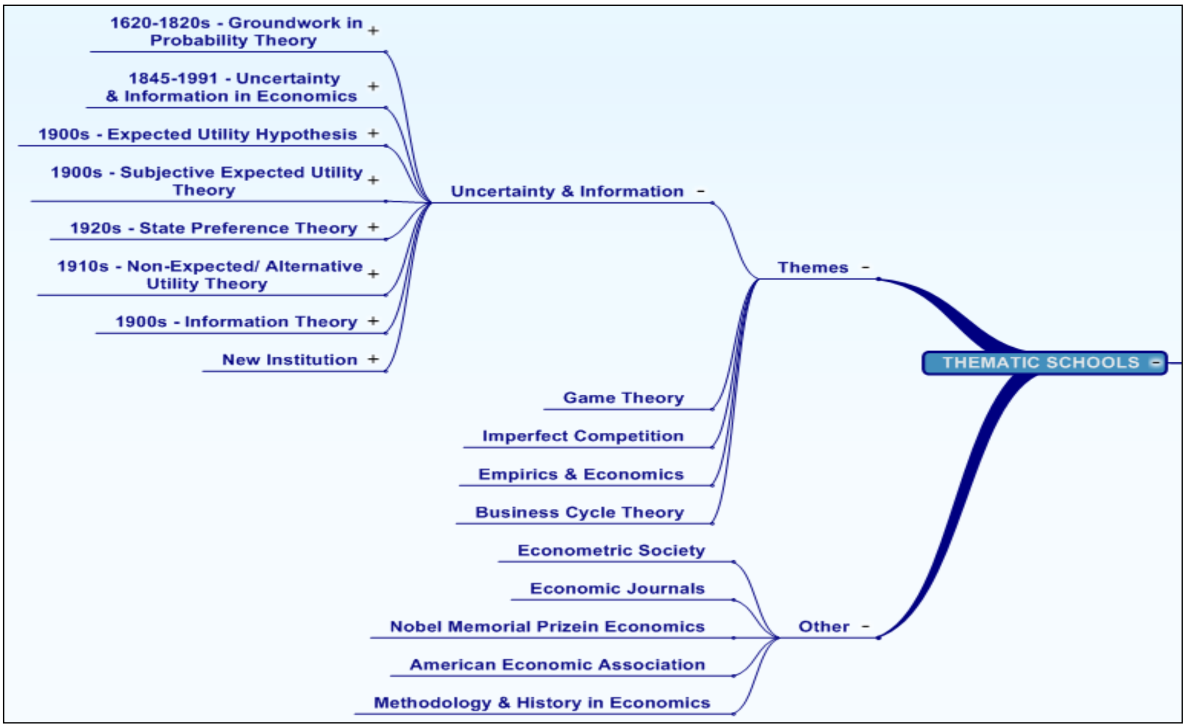


Figure 2.4: The history of economic thought – Thematic Schools

However, in relation to the scope of this study, only uncertainty and information are to be considered. The theme consists of the following sub-themes mentioned below.

i) Ground Work in Probability Theory

Daniel Bernoulli was famous for his St. Petersburg Paradox while the Bayesian technique was named after Thomas Bayes. CEPA indicated that the groundwork of the problem in probability theory (the St. Petersburg Paradox) was developed in the early 1700s by mathematician and scientist Daniel Bernoulli. Bernoulli defined probability theory as a systematic process by which people make their decision on choices and arrive at a decision by applying measurement to something that cannot be counted (Bernstein, 1998). According to the St. Petersburg Paradox, as the willingness to take risk and to maximize EU are irrational (Bernoulli, 1954), the choice under risk and uncertainty is considered to be outside the realm of economic theory. Bernoulli's concept of EU became the foundation of choice under risk.

Excepting Bernoulli and Bayes, Blaise Pascal, Jacob Bernoulli and Pierre Laplace are other notable contributors to the probability theory.

ii) Uncertainty and Information in Economics

Contributions from Frank Knight, Irving Fisher, George Stigler, Gerard Tintner, Freidrich Hayek, John Hicks, and John Kenneth Galbraith have been included into this sub-theme. Carl Menger, a logical positivist, shared common ideas with Francis Edgeworth in that there was a potential modification of risk and uncertainty within economic theory. John Maynard Keynes, a logical rationalist, argued probability as being subjective, and risk and uncertainty as different.

iii) EU Hypothesis

This idea of choices among alternatives involving risk is conceptualized by the maximization of EU (Friedman and Savage, 1948). The utility theory was placed in economic theory during the 1870s, based on the accepted work of W. Stanley Jevons, Karl Menger, Léon Walras, Irving Fisher and Francis Edgeworth (Stigler, 1950). Risk and EU are both important ideas which were developed during this period. Risk relates to the valuation of risky venture as the sum of utilities from outcomes weighted by the probabilities of outcomes; the measurement of value of risk is not valid without considering its utility (Bernoulli, 1954). In the early 1800s, economists tried to modify and situate the concept of risk and uncertainty in the modern theory of economics, criticizing the Ricardian (of David Ricardo) theory of value, which had impacted on the price and income uncertainty.

Jacob Marschak's proposition of utility as the quantity of whole mathematical expectations to be maximized by the rational man has been accepted in the EU hypothesis. Additionally, the risk aversion and portfolio selection theories by Harry Markowitz are part of this theme. Other scholars affiliated with this theme include John von Neumann, Oskar Morgenstern, Joseph Stigliz and Menachem Yaari.

iv) Subjective Expected Utility Theory (SEUT).

The SEUT theory emphasized probability as subjective and not disembodied knowledge. This view has been propagated by Frank Ramsey and Bruno de Finetti. Milton Friedman and Leonard Savage developed the theory of risk aversion using the concepts of EU and subjective probability. Friedman and Savage (1948) were labelled as subjectivists as they introduced the EU hypothesis without imposing objective probabilities and allowed for subjective probabilities to be determined jointly. Their idea of SEU has been used as the basis for insurance and gambling; insurance as being about choosing certainty in preference of uncertainty, and gambling as choosing uncertainty in preference of certainty.

v) Non- Expected Utility/ Alternative Utility Theory.

Other than the EU and SEUT theory, the non-EU or alternative utility theory has been included as part of this theme. This theory disputes the EU and SEU, arguing that risk is independent of EU. The disputants include Maurice Allais, George Shackle, Paul Davidson, Daniel Kahneman, Amos Tversky, Peter Fishburn, Mark Machina, Menahem Yaari, and Edi Karni. Kahneman and Tversky (1979) emphasised the need to rethink the EUT. They disagreed with Ramsey (1926) and Von Neumann and Savage (1953) regarding the normative theory of decision making. Kahneman and Tversky thought that decision making under risk was tougher than under certainty or uncertainty for which the probabilities are ill-defined. The certainty effect also contributed to risk aversion.

vi) State Preference Theory

The state preference theory was proposed by Kenneth Arrow and Gerard Debreu. State preference relates to the low state of information to the economic decision making and assume the odds using inductive reasoning (Shubik, 1954, Shubik, 1961), as it is not fully understood as to what is being dealt. Such an approach to uncertainty does not involve mathematics and probabilities, the payoffs are not money but bundles of goods, and therefore, uncertainty is not considered as being similar to risk as there is no assignment of probability (Arrow, 1951, Debreu, 1971).

vii) New Institution

The new institution consists of alternative theories and ideas that do not fall within the other themes. Bernard Chester, Herbert Simon, Ronald Coase, Oliver Williamson, and Howard Raiffa are amongst the scholars considered as the new institution. They share common ideas and theories relating to decision-making and problem solving.

d) The Alternative Schools

Keynesian's theory or Keynesian economics, named after the notable British economist John Maynard Keynes, has been categorized as an alternative school. The American Post-Keynesian, the Cambridge-Keynesian, Neo-Keynesian, and New-Keynesian are but a few examples of the expanded Keynesian economic theory. John Hicks and Paul Samuelson have interpreted Keynes's writings, their work now regarded as Neo-Keynesian economics.

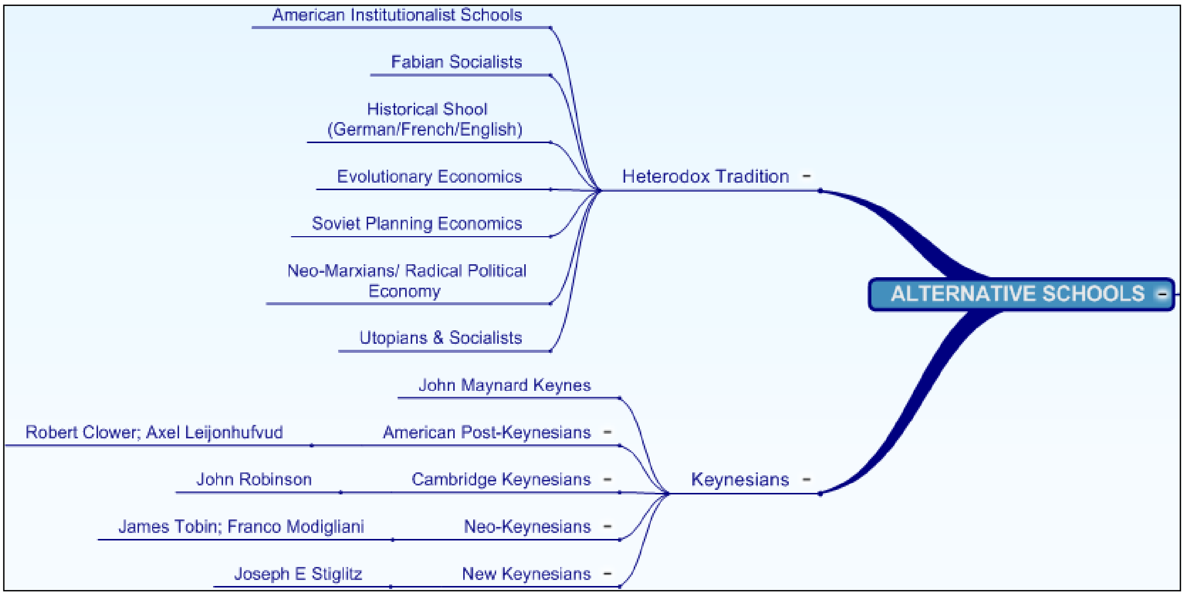


Figure 2.5: The history of economic thought – Alternative Schools

2.2.1 The Formal Incorporation of Risk and Uncertainty into Economic Theory

Based on the above discussion, the theory of economic thought has been extended further to understand its relationship with the concept of risk and uncertainty. The formal incorporation of risk and uncertainty into economic theory was introduced by von Neumann and Morgenstern (1944), who invented the game theory. They also propagated the process of decision making under risk due to the lack of information of which the decision maker chooses as though his goal is maximizing the EU, as utilities are substitutable and are restrictively transferable between the players (von Neumann and Morgenstern, 1953). In this situation, they assumed that behaviourally, the decision makers or the players are risk neutral or risk takers. However, Markowitz (1952) has argued that this ignores the idea of risk aversion, as insurance companies eliminate almost all risks (Markowitz, 1952b, Markowitz, 1952a). The use of inductive reasoning in making decisions with limited information has been influenced by the game theory (Simon, 1955, Simon, 1959, Marschak, 1946, Marschak, 1950). Von Neumann and Morgenstern (1944) suggested that there were three types of uncertainty: ignorance (due to the lack of information or knowledge), risk or probability considerations and economic indeterminacy. Although different ideas and thoughts have long been known, authors are still debating the problem in probability theory and economic theory. Detailed explanation regarding the theories and methods of risk and uncertainty management shall be discussed in the next section.

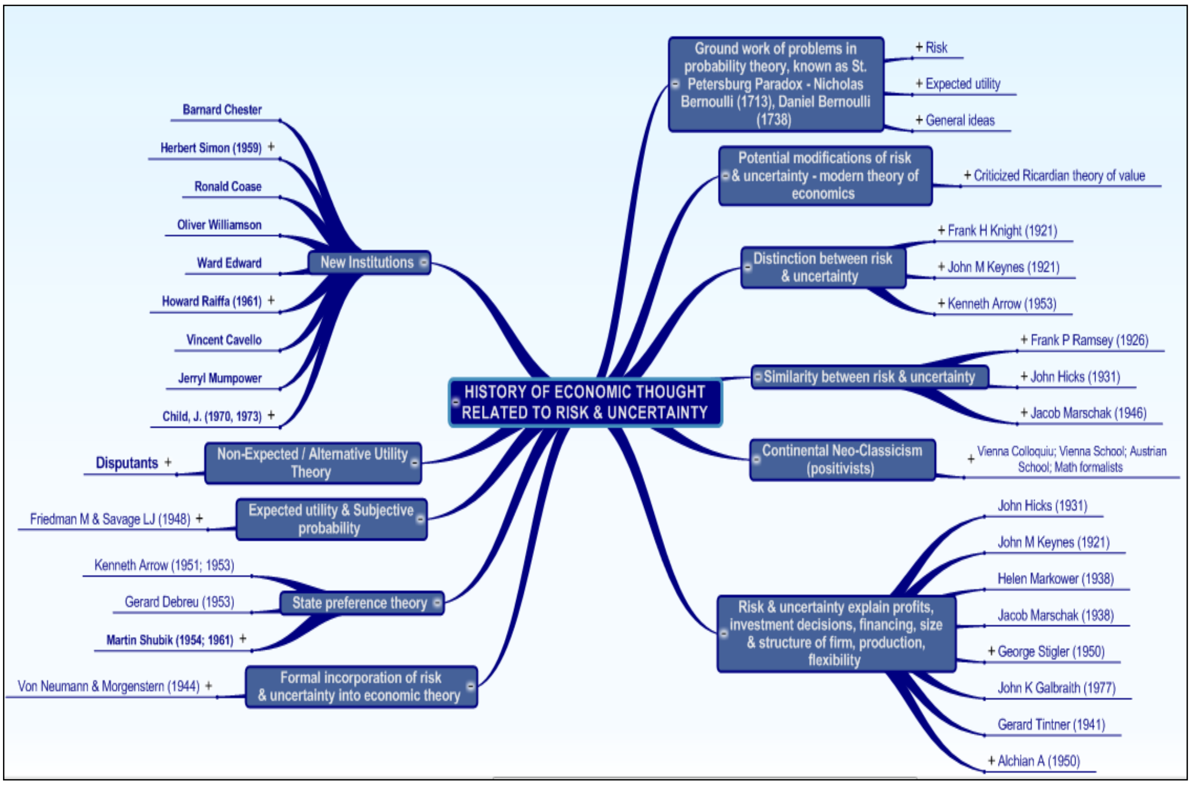


Figure 2.6: The history of economic thought relating to risk and uncertainty

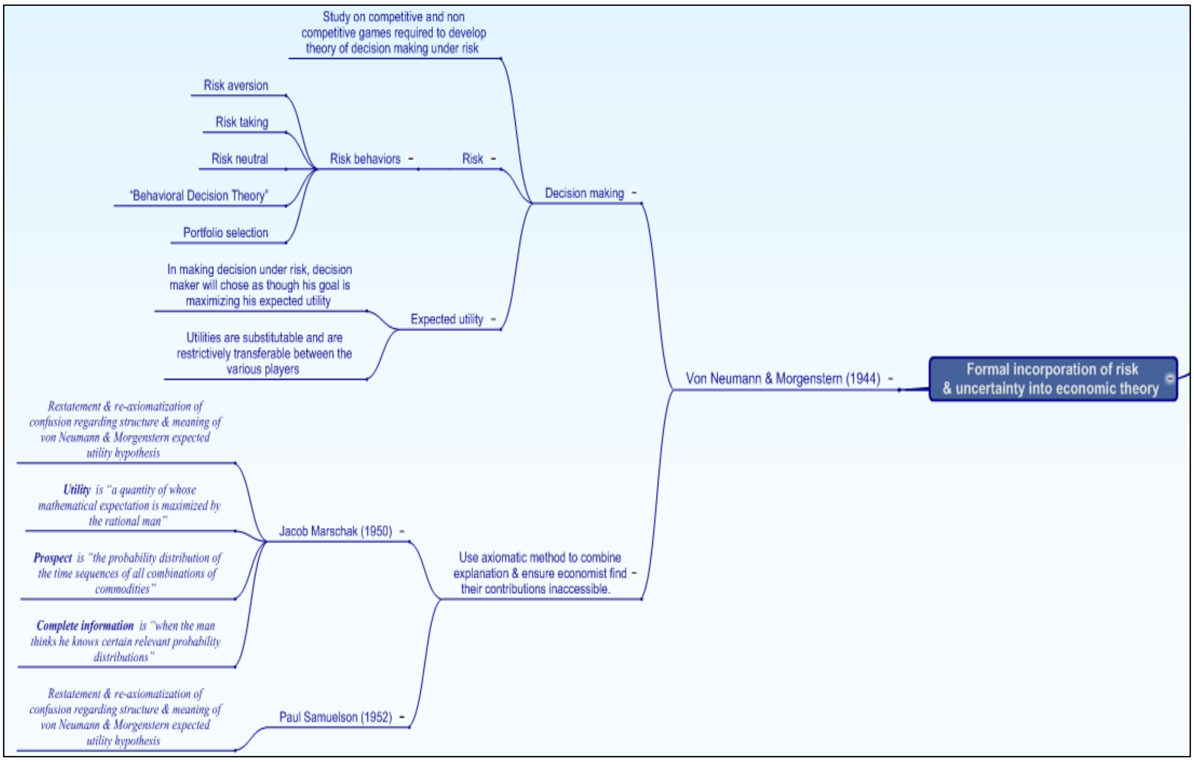


Figure 2.7: The formal incorporation of risk and uncertainty in the economic theory.

2.2.2 Probability Theory and EUT

Using the concept of probability, Bernoulli provided the hypothesis of marginal utility through repeatedly tossing a coin in the air (CEPA, 2007). Thus, the principle of utility was developed as a result of the problem of probability theory. Bernoulli introduced his famous principle relating to the utility of wealth, which is the satisfaction from the increase in wealth as essentially proportionate to the quantity of goods previously possessed (Bernstein, 1998). This principle has been expanded by other theorists [see (Morgenstern, 1976, Markowitz, 1952b, Markowitz, 1952a, von Neumann and Morgenstern, 1953, Kahneman and Tversky, 1979, Savage, 1954a, Friedman and Savage, 1948)] and become fundamental in risk-aversion. John von Neumann, who invented the game theory (Bernstein, 1998), was of the view that more than mathematics was involved in the theory, while the economist, Oskar Morgenstern, did not believe that people in business take precautions into consideration nor alter their decisions and actions accordingly.

Decision-making and its relationship with human behaviour has been debated throughout the history of economic thought. For example, Markowitz (1952a, 1952b) used diversification as a method to reduce investors' risk; whereby reasonable investors who expected returns would select the portfolio that best suits them for aggressive objectives or defensive objectives to maximize the expectation of utility function. The propositions of von Neumann and Morgenstern (1953), Savage (1954), and Markowitz (1952a, 1952b) were in line with Bernoulli's principle, implying that people are rational; understand their choices and preferences, and apply them consistently (Bernstein, 1998) with subjective probability that is exactly as described.

2.3 Risk vs. Uncertainty – the Contentious Issue

This section discusses the highly debated issue concerning the concepts of risk and uncertainty. Based on the history of economic thought, there are two distinct groups that argue the relationship between risk and uncertainty. The views of Knight (1921) and Keynes (1921) are discussed in detail as they are used as the basis for this research; all the theorists researched have alluded to their views of uncertainty and risk. This section also discusses the current approach on risk and uncertainty, which is not drawn from the EU paradigm.

The formal incorporation of risk and uncertainty into economic theory and behaviour was pioneered by von Neumann and Morgenstern in 1944 and later complemented by Savage in 1954 (Winch, 2007), this has been mentioned above. Their work showed that, in making decisions under risk, the decision maker makes his choice by maximizing EU; this became the basic theory of behavioural decision. Prior to any decision, one has to consider the risks associated with future events and their behaviour. This method is defined as risk aversion, risk taking, risk neutrality and portfolio selection (Friedman and Savage, 1948, Savage, 1954a).

The concept of risk and uncertainty has been discussed widely by many scholars, including Knight (1921), Keynes (1921), Arrow (1951), Ramsey (1926), as well as Friedman and Savage (1948); they have presented and defended their argument regarding the relationship between risk and uncertainty. Aven [see (Aven, 2004, Aven and Renn, 2009, Aven et al., 2011, Aven, 2012)] argues that the concept of risk is understood in different ways, to the extent that certain definitions of risk can be disputed. For example, the general definition of risk as expected values or loss was criticized and rejected (Aven, 2012:43). Additionally, Aven suggested that the definition of risk that relates to probability to be removed and replaced with uncertainty for a broader perspective. Renn [see (Aven and Renn, 2009, Renn, 2004, Renn, 2008)] indicates that the concept of risk may be interpreted from various perspectives: risk as a fatal threat, a fate, test of strength, a game of chance or an early warning. These perceptions rely partly on erroneous judgements and simple lack of knowledge (Renn, 2004:412).

Through the history of economic thought, two distinct views emerge regarding the concept of risk and uncertainty. The first group claim distinction exists between risk and uncertainty, while another group argue risk and uncertainty as similar. The former emphasize that risk involves probabilities that can be numerically assigned (Knight, 1921) and is not subjective (Keynes, 1921b). Knight (1921) and Keynes

(1921) further claim that risk involves a classification of unknown outcomes, divided into *a priori probabilities* and statistical probabilities. Meanwhile, uncertainty occurs when the probability of an event cannot be calculated (Keynes, 1921b) due to a lack of knowledge (Knight, 1921) - which is an epistemological issue. Additionally, uncertainty does not involve mathematical probabilities (Arrow, 1951, Debreu, 1971) and cannot be analysed (Knight, 1921). Whilst in decision-making, people can overestimate the amount of information available to them; Arrow (Arrow, 1951) became convinced of this when economists failed to comprehend the causes of the Great Depression, thus demonstrating (to Arrow) that their knowledge of the economy was very limited (Bernstein, 1998).

The second group disagreed with Knight, Keynes and Arrow, arguing risk was a subjective probability, not disembodied knowledge (Ramsey, 1926). Ramsey's idea became the basis of further work for others, such as John Hicks and Jacob Marschak. Risk and uncertainty explain profits and investment decisions; risk cannot be separated from pure preference over outcome, and people should form preferences over distributions (Tintner, 1941a, Marschak, 1950, Tintner, 1941b). Marschak (1946) argued with Knight's understanding of risk and uncertainty, claiming that men do not act upon probabilities as cardinal numbers, but as mere probable events, while utility is the quantity of whole numerical explanations. According to Bernstein (1998), K-K distrusted classical theories based on laws of mathematical probability or assumptions of certainty as guides to decision making; they defined risk as it is understood today.

2.3.1 *Knightian* and *Keynesian* approaches to risk and uncertainty

Frank Knight's book, "Uncertainty, Risk & Profit" provides a clear distinction between risk and uncertainty, in which risk refers to events subject to known or knowable probability distribution, uncertainty referring to events for which it is impossible to specify its probability (LeRoy and Singell, 1987, Runde, 1998). According to Knight, "*uncertainty must be taken in a sense radically distinct from the familiar notion of risk, from which it has never been properly separated", "it will appear that a measurable uncertainty or risk proper…is so far different from an immeasurable one that is not in* *effect an uncertainty at all" (Knight, 1921:205)*. His emphasis upon uncertainty made him independent of other predominant economists. Furthermore, Knight (1921) distinguishes between objective and subjective probability, treating subjective probability as true probability. According to Runde (1998), Knight's distinction of risk and uncertainty focuses on a trichotomy of probability situations as *a priori* probability; statistical probability and estimates. An *A priori* probability is related to mathematical and logical instances or deductive probability. Such instances are homogeneous and the chances of an event occurring can be calculated through general principles. Statistical probability relates to empirical instances, evaluating the frequency of occurrences. The difference between these two instances is that the frequency evaluation for statistical probability cannot be analysed equally to the same degree of homogeneity. Therefore, Knight proposed a form of statistical grouping to produce more meaningful probabilities and the frequency of occurrence.

When the basis of classifying instances is uncertain, decision makers use intuition, classified as estimates (Knight, 1921), to judge probability.. The first two situations are radically different from the latter; Knight insisted that the former was not uncertainty but best grouped as situations of risk whilst the latter was known as situations of uncertainty (Runde, 1998, Atkins and Anderson, 1999, Lawson, 1988). Knight argued that in classical economics, decisions usually depend on forecasts of the future where information is readily available, and, when the future is unknown, the laws of probability determine the outcome. He reiterated the difficulty in forecasting the future, and he found it impossible to apply mathematical propositions to it. He also cast doubt upon whether much could be learnt from an empirical evaluation of the frequency of past occurrences (Bernstein, 1998). *A priori* reasoning cannot eliminate indeterminateness from the future because an extrapolation of past frequencies is the favoured method of arriving at judgments about what lies ahead (Bernstein, 1998). For example, decision makers regularly make generalizations upon the future from the past, but fail to recognise when conditions begin to change from poor to better or vice versa as the environment changes.

John Maynard Keynes is a well-known and influential theorist. In his writings relating to economic decisions, he does not distinguish between risk and uncertainty as

Knight does. Keynes provides detailed presumption and builds his argument relating to risk and uncertainty based on the problem of probability. According to Keynes, the probability theory has little relevance to real-life situations (Keynes, 1921:51). He argued that an objective probability of a future event does not exist, and when our ignorance denies us the certainty of knowing what that probability is, we then fall back on estimates. Although the theory of probability is subjective, the degree of belief that is rational to entertain in given conditions is logical (Keynes, 1921b). Nonetheless, probability is considered to have less subjectivity. Keynes developed the perspective of probability being measurable, and uncertainty arising when there is no basis to calculate the probability of the prospect of uncertain events. Thus Lawson (1988) asserts that economists should follow Keynes's concept of uncertainty, of which there is no knowledge available regarding the numerical probability.

Keynes added that when there is an unknown probability, it does not mean that the probability can only be known when more evidence is available, but it is due to the lack of skill in arguing using the given evidence (Keynes, 1921b). Furthermore, Keynes acknowledged the weakness of peoples' reasoning power prevented them from knowing the degree of knowledge. Therefore, Keynes account of uncertainty arises in the absence of knowledge, in which there is no basis to determine or to compare the probability that is known to only a select few. Keynes also highlighted the importance of judgement and relative perceptions in determining risk probabilities. Bernstein (1998) cited Keynes (as well as Knight) as disagreeing with decisions based on the frequency of past occurrences, which many insurance companies use in calculating their premiums; doubting that two equally intelligent brokers would consistently arrive at the same result if given the identical situation. He too rejected analysis based on events but welcomed predictions based on propositions.

The writings of K-K predate Arrow's proposition (Bernstein, 1998), that the mathematicians and philosophers of the past were concerned only with establishing laws of probability to tackle issues of uncertainty. When similar experiences have occurred enough to resemble the patterns of games of chance, probabilities can be calculated. Bernstein criticised the view of prominent theorists who argued that the laws of probability are successful when we have no control over the next throw of the dice, and when our subsequent error in measurement occurs. This critique of the laws of probability demonstrate that we sometimes have insufficient information to arrive at a judgement, which makes it difficult to act as we tend to fall back on inductive reasoning, try to guess the odds, then cope with the uncertainties and the risk we take (Bernstein, 1998). Therefore, we are gamblers with no recourse and we cannot influence the result. These situations considered, it can be argued that in economic decision making, numerical or an *a priori probability* is inapplicable as decision making involves judgement of future outcomes, which are subjective and not objective. Keynes added that humans are forced to act with knowledge to provide a sufficient basis for calculating mathematical expectation (Keynes, 1936). Business decisions deal with uncertain situations, which are unique for statistical tabulations to have value for guidance (Knight, 1921); and uncertainty is only relevant to the randomness of economics, especially when associated with time and information issues (Davidson, 1991, Shackle, 1949).

2.3.2 Other risk and uncertainty approaches

The relationship between EUT and risk management has been discussed and debated for decades, increasing the understanding of the concept of risk. Such a proposition was raised by Schoemaker (1982) in that the EUT was the major paradigm in decision making. According to Peterson & Sandin (2010), those with technical backgrounds more readily accept the proposition, to the extent that moving away from it is considered to them as unreasonable. Although the concept of risk management has its roots in the maximization of the EUT, there is criticism that the EU approach is inadequate (Peterson and Sandin, 2010).

The research found that there are different approaches to risk in the area of project management. The usual approach being known as the project risk management (PRM), in which the methodology is drawn from the EU. Besides PRM, there is an emergent idea from the INSEAD[3] team; Winch (2007) arguing that the team had introduced its own method, which was different from the EU paradigm.

The INSEAD team, led by Christoph Loch, Michael Pitch and Arnoud DeMeyer, developed an alternative approach, slightly different from the EU paradigm. They argued that uncertainty was not a set of neat categories but continuously varying, any categorisation therefore being subjective; the categorisation is changeable depending on what one is trying to highlight. Their categorisations of uncertainty are identified as *variation, foreseen uncertainty, unforeseen uncertainty* and *chaos* (De Meyer et al., 2002, Pich et al., 2002, Loch et al., 2006).

Variation involves many small risks, and as the risks have only a minuscule influence, there is no worth managing individually. Instead, variation can be managed using an accumulated buffer. *Foreseen uncertainty is* identifiable and has recognisable influences which can require risk management. As risk is an individual stochastic factor which has a large impact in some possible outcomes it can be managed with "risk management". The significant difference between these two categories is a decision. In risk management, risks are identified then it is decided as to which risks are worth attention, and which are manageable with a buffer. This categorisation of uncertainty is in contrast to Markowitz's profound proposition of 'Portfolio Selection' (Markowitz, 1952b, Markowitz, 1952a). Markowitz's objective in Portfolio Selection was to use the notion of risk to construct portfolios for investors who diversify their investment into different portfolios, because diversification is the best weapon against variance. The INSEAD team argue that rather than being broken up into sub-sections, variance should be managed as a whole. *Unforeseen uncertainty* may arise out of an unanticipated interaction of events, which in principle, are foreseeable, although existing decision tools do not address them (De Meyer et al., 2002). *Chaos* (or unforeseeable uncertainty) is the fourth categorisation of uncertainty developed by the INSEAD team. This occurs when the return is completely different to what was expected due to unawareness, known as 'unknown unknowns' or 'unk unks'.

[3] INSEAD, formerly known as *"**INS**titut **E**uropéen d'**AD**ministration des Affaires"*, or *European Institute of Business Administration.* The name INSEAD team in this research means its related research team.

Although the team does not differentiate nor saying that risk and uncertainty are similar, their work demonstrated an inclination to argue with K-K's philosophical statement of EU regarding risk and uncertainty, in that risk and uncertainty are relatively synonymous. To deal with different categorisations of uncertainties, the team introduced distinct strategies or management approaches, namely the *learning strategy, instructionist strategy, and selectionist strategy* relating to project management and its associated techniques, such as project planning. More often than not, managers introduce slack or a buffer in their planning; thus having the knowledge to anticipate what will happen. For each type of uncertainty, managers need sufficient knowledge and skills prior to making decisions for future events (Pich et al., 2002, Sommer and Loch, 2004, Loch et al., 2006, Loch et al., 2008).

Additionally, the INSEAD team mentioned that learning from experience, be it via one's own or others, is crucial. In light of the EUT, this proposition is open to criticism. The laws of probability acknowledge the inability to calculate probabilities using similar experiences that have occurred in the past- to give us the ability to decide for the future. However, it must not be forgotten that business decisions involve not only nature, but humans, thus each experience is unique. Although managers acquire sufficient knowledge and information from experience, they have no control of future subjective outcomes, the tendency being to revert to inductive reasoning to cope with risk and uncertainty (Bernstein, 1998).

2.4 Risk and its management for projects – different ideas and approaches

In this section, the research compares three different approaches to risk management practice that are currently available, predominantly within the area of project management. The three different approaches: - Chapman and Ward, the INSEAD team, and David Hillson have been selected due to their valued contribution to the theory and practices of risk and uncertainty management, particularly relating to projects. The idea is to understand the basis, concept and linkages to the history of economic thought relating to risk and uncertainty.

2.4.1 PRM: Chris Chapman and Stephen Ward

Both notable authors on risk management, specifically for projects, Chris Chapman and Stephen Ward's book entitled *'Project Risk Management: Processes, Techniques and Insights',* entails comprehensive processes of PRM, focusing on the process and illustrating the techniques in a detailed cycle rather than a basic risk management cycle [refer to (Chapman and Ward, 2003)]. In this book, risk management is integrated with project management using the project life cycle to illustrate the techniques. Besides this book, they have conducted and published their research, relating to risk management, individually and also in joint research ventures with other counterparts [refer to (Chapman, 1991, Chapman, 1997, Chapman, 2006, Chapman and Ward, 1994, Chapman and Ward, 2000, Chapman and Ward, 2003, Chapman and Ward, 2004, Chapman et al., 2000, Cooper and Chapman, 1987, Ward and Chapman, 1991, Ward and Chapman, 1999, Ward and Chapman, 2003, Ward and Chapman, 2008, Ward et al., 1991)]. Their concept of PRM was founded upon four areas; namely, economics, management science, decision science, and portfolio management.

a) Economics

In the area of economic theory, Chapman and Ward's concept of PRM was found to be in relation to utility theory, especially regarding the concept of utility and behavioural decisions. Chapman and Ward also researched the area of probability and prediction, considering Stan Kaplan on probability [refer to (Kaplan, 1997, Kaplan and Garrick, 1991)]; Howard Raiffa, Daniel Kahneman, Amos Tversky and Paul Slovic on uncertainty and reliability [refer to (Kahneman et al., 1982, Alpert and Raiffa, 1982)] and Daniel Kahneman and Amos Tversky on the psychology of prediction [refer to (Kahneman and Tversky, 1973)].

Additionally, Chapman and Ward referred to other renowned authors when considering risk and uncertainty. For example, they utilised Frank Knight's concept of risk and uncertainty [see (Knight, 1921)] as well as the concept of uncertainty by Daniel Kahneman, Paul Slovic and Amos Tversky [see (Kahneman et al., 1982)]. They also referred to Kaplan's views of risk and reliability [see (Kaplan, 1991)]; and David Hillson's understanding of project and business risk [see (Hillson, 2002, Hillson, 1997)].

b) Management Science

Chapman and Ward's concept of PRM has its roots in strategic management, specifically made evident by Goldratt's book on *'Critical Chain'* [see (Goldratt, 1997)], Mintzberg's strategy formation [see (Mintzberg, 1978, Mintzberg and Waters, 1985)], and Ansoff's strategic management [see (Ansoff, 1984, Ansoff, 1991)].

c) Decision Science

Decision Science is another area covered by Chapman and Ward. The root of their PRM concept was generally lifted from Howard Raiffa's theory of decision under uncertainty [see (Raiffa, 1968)]. Their research has also closely linked to the theory of decision-making by Herbert Simon [see (Simon, 1959)], and the theory of the anatomy of decisions [see (Moore and Thomas, 1976)], as well as Chapman's book on decision analysis [see (Chapman, 1975)

d) Portfolio Management

Chapman and Ward included portfolio management as a part of their PRM concept; this is traced to the theory of portfolio selection and investment by Markowitz [see (Markowitz, 1952a)]. Chapman also developed a portfolio selection module theory, *'Portfolio Analysis',* which has been used as their basis for PRM [see (Chapman, 1974)].

2.4.2 Uncertainty and Project Management: The INSEAD Team

The INSEAD team of researchers conducted their own research relating to risk, uncertainty and project management. This research found that the background of their work was based on four fundamental principles, namely economics, management science, decision science, and project management.

a) Economics

The INSEAD team's work originates from the history of economic thought, in which three main headings are reiterated. The first heading being the theory of games and behaviour by von Neumann and Morgenstern (1948), the second is from Savage (1954) on statistics. The third relates to the concept of risk and uncertainty in the history of economic thought concerning the work of Schoemaker (2002) and Fishburn (1988) on the concept of uncertainty, ambiguity and EU. The fourth heading is the risk aversion by Pratt (1964).

b) Management Science

Alongside economics, the approach of the INSEAD team relate to management science. For example, they explore the area of strategic management relating to engineering projects, [see "*Strategic management of large engineering projects"* by Miller and Lessard (2000); *'Imitation of complex strategies'* (Rivkin, 2000); *'Critical chain'* (Goldratt, 1997)]. The concept of 'learning and adaptation' and its mechanism are adopted from Herbert Simon. The team researched the area of behaviour, referring to the work of von Neumann and Morgenstern (1944) *('Theory of games and economic behaviour')*, Herbert Simon on '*A Behavioural Model of Rational Choice'* (Simon, 1955) and *'A Formal Theory of the Employment Relationship'* (Simon, 1951). Additionally, the team's approaches were based on Karl Weick's 'organizational sensemaking' concept (Weick, 1993, Weick, 1995).

c) Decision Science

In the area of decision science, the team's approach is divided into two; decision analysis and problem solving. Alongside the research by Herbert Simon, studies on decision analysis by Howard Raiffa [see (Raiffa, 1968)] were used as one of many a base of their research. Simon's theory of games and choice and his theory of rationality and subjective expected utility (SEU), whereby according to Simon's theory of rationality, people are said to be inconsistent in making choices between the present and the future, were especially considered. Furthermore, Simon (1986) argued that the decision maker possessed utility function as human tastes and priorities changed over time; the utility function being assumed as fixed in the SEU.

d) Project Management

Project management is part of the primary research theme by the INSEAD team. Four project management research areas were identified and adopted by the group. Research by Chris Chapman and Steve Ward and their counterparts have been used as the basis of their research on PRM, risk engineering and risk analysis for projects [see (Ward and Chapman, 1991, Ward and Chapman, 1999, Ward et al., 1991, Cooper and Chapman, 1987, Chapman, 1991, Chapman, 1997, Chapman and Ward, 1994)]. Other than PRM, the group also referred to the work of Peter Morris and George Hough in 1987 *('The Anatomy of Major Projects: A Study of the Reality of Project Management'*) as the basis for their research on mega and complex projects.

The INSEAD team draw the distinction between conventional projects and novel projects using the fundamental logic of PRM; that there is a real project plan. For novel projects, the plan is an illusion and simple sketch, and the actual project plan does not really exist. Focusing on the 'unk unks', the INSEAD team provide ideas as to how to manage them effectively. They discuss the different types of uncertainty and methods to deal with them, including the need for a new approach rather than the conventional PRM approach.

2.4.3 The Risk Doctor: David Hillson

David Hillson, currently a risk management consultant, has been promoting the proactive use of risk and opportunity management in the risk process, including updating the RM chapter of the PMI's PMBOK. Hillson has been researching the risk management maturity model [see (Hillson, 1997)], risk breakdown matrix [see (Hillson et al., 2006)], as well as the usage risk management process to manage opportunity [see (Hillson, 2002)]. Hillson has also participated in the debate to define risk and uncertainty; an issue raised by the publication of the ISO 31000:2009 [see (Hillson, 2011, Leitch, 2010, Purdy, 2010)].

Additionally, Hillson and his counterparts [see (Hillson and Murray-Webster, 2011)] have conducted research relating to risk appetite, risk attitude, and risk behaviour. This research has found that Hillson conducted his studies using experiences gained from projects, including the use of current available standards, guidelines and frameworks relating to risk management. Little reference has been made to existing literature and theories published by renowned authors in the area of risk and uncertainty. The studies were mainly based on research conducted earlier; hence the sources of information were from third parties rather than sourcing the 'rich vein of research' from well-known authors. For example in the area of psychology and behavioural economics, other publications concerning risk perception and market risks have been considered [see (Kumar and Persaud, 2002)]. This can be tracked via the theory of decision under risk and uncertainty by Kahneman and Tversky [see (Kahneman et al., 1982, Kahneman and Tversky, 1979, Tversky and Kahneman, 1974)]; and from Neumann-Morgenstern's utility function theory (von Neumann and Morgenstern, 1953, Morgenstern, 1976), as well as Pratt-Arrow's relative risk aversion [see (Arrow, 1971, Pratt, 1964, Arrow, 1951)]. The second example of third party information relates to risk behaviour and risk perceptions; research by Sim Sitkin on the effect of risk on decision-making behaviour in organizations was studied [see (Sitkin and Pablo, 1992, Sitkin and Weingart, 1995, Hogarth, 1987)]. Sitkin studied various areas and issues relating to risk behaviour, such as the prospect theory (Kahneman and Tversky, 1979); behaviour (Hogarth, 1987); behavioural models of risk-taking in business decisions (Libby and Fishburn, 1977); bounded rationality and the way preferences are processed in behavioural studies (March, 1978); as well as organizations, organisational learning and organisational decision-making (Levitt and March, 1988, March and Shapira, 1987, March and Simon, 1958).

2.4.4 General Summary of Approaches

The above reviews are summarized in Table 2.1. The table illustrates the similarities of sources to which the three approaches discussed above adapt into their work, and are explained below.

a) Daniel Kahneman and Amos Tversky – *psychology, behaviour and judgement under uncertainty*

Chapman and Ward, and David Hillson adopted Kahneman and Tversky's theories and ideas, especially the economic theory, as a basis to relate to risk, uncertainty and decision making.

b) John von Neumann and Oskar Morgenstern – *theory of games and behaviour*

It was found that the INSEAD team and David Hillson referred to the theories of von Neumann and Morgenstern (1953) which related to utility function, risk attitude and game theory and behaviour.

c) Herbert Simon – *learning, rationality, behaviour and decision making.*

Two types of similarities were found from reviewing these three groups. First, the INSEAD team and David Hillson were found to look into Simon's theory on rationality in psychology and economics, particularly relating to organizational learning and its mechanism. The second type is linked to Simon's theory of rationality, decision-making and problem solving. These theories have been referred to and adopted by Chapman and Ward, and the INSEAD team.

d) Peter Fishburn – *decision making*

Both the INSEAD team and David Hillson's root of research can be traced back to the EUT, particularly on decision-making under risk and uncertainty.

e) Eli M. Goldratt – *critical chain and strategic management*

Goldratt's publication on the critical chain demonstrates the application of his theory of constraints (TOC) to project management. This was adopted by Chapman and Ward, and the INSEAD team. The theory concerns the behaviour and rationality of people in making decisions.

To summarize, it is found that all three groups have a similar approaches to how uncertainty and risk for projects is considered. They have referred to and adopted the theories of related authors, particularly in relation to the peoples' behaviour in making decisions.

	Chapman & Ward Project Risk Management (PRM)	**The INSEAD team Uncertainty & Project Management**	**David Hillson The Risk Doctor**
ECONOMICS			
Utility Theory	Utility & behavioural decision (Slovic et al., 1977)	Economic theory of teams (Marschak and Radner, 1972)	Utility function, risk attitude (von Neumann and Morgenstern, 1953)
Risk & Uncertainty	Risk & uncertainty (Knight, 1921);	Strategies to make profit during uncertainty (Schoemaker, 2002)	Risk appetite, risk perception (Kahneman and Tversky, 1979, Tversky and Kahneman, 1974, Dyer and Sarin, 1982)
	Uncertainty, reliability & heuristic (Kahneman et al., 1982)	Ambiguity and algebra (Fishburn, 1993)	Outcome uncertainty (Libby and Fishburn, 1977)
	Probability & reliability (Kaplan and Garrick, 1991, Kaplan, 1991)	Risk aversion (Pratt, 1964)	Risk attitude, risk seeking, risk averse (Kahneman and Tversky, 1979, Arrow, 1971, Pratt, 1964)
		Behaviour towards risk (Tobin, 1958)	Risk behaviour (Kahneman and Tversky, 1979, Sitkin and Pablo, 1992, Sitkin and Weingart, 1995, Hogarth, 1980, Libby and Fishburn, 1977)

Probability & Prediction	Probability & reliability (Kaplan and Garrick, 1991, Kaplan, 1991)	-	-
	Psychology of prediction (Kahneman and Tversky, 1973)	-	-
Games Theory	-	Theory of games and behaviour (von Neumann and Morgenstern, 1953)	-
Statistics	-	Statistics (Savage, 1954b)	-
MANAGEMENT SCIENCE			
Strategic Management	Critical chain (Goldratt, 1997)	Critical chain (Goldratt, 1997)	-
	Strategy formation (Mintzberg, 1978, Mintzberg and Waters, 1985)	Strategic management for engineering projects (Miller and Lessard, 2000)	-
	Strategic management (Ansoff, 1984, Ansoff, 1991)	Complex strategies (Rivkin, 2000)	-
	-	Strategies to make profit during uncertainty (Schoemaker, 2002)	-
Learning	-	Learning and adaptation, learning mechanism (Simon, 1986)	Organizational learning (Levitt and March, 1988)
Behavioural	-	Theory of games and behaviour (von Neumann and Morgenstern, 1953)	-
	-	Behavioural, rational choice, and theory of employment (Simon, 1951, Simon, 1955)	Bounded rationality (March, 1978)
	-	Behaviour towards risk (Tobin, 1958)	Risk decision making behaviour (Sitkin and Pablo, 1992, Sitkin and Weingart, 1995)
Organizational	-	Sensemaking (Weick, 1995)	Organization (March and Simon, 1958)

Performance	-	Performance and uncertainty (Weick and Sutcliffe, 2001)	-
DECISION SCIENCE			
Decision Science, Decision Making & Problem Solving	Decision under uncertainty (Raiffa, 1968)	Decision making, theory of rationality & SEU (Simon, 1986)	Organizational learning (Levitt and March, 1988)
	Decision making (Simon, 1959)	Learning and adaptation (Simon, 1986)	Decision making under risk (Kahneman and Tversky, 1979, Tversky and Kahneman, 1974)
	Anatomy of decisions (Moore and Thomas, 1976)	Problem solving and decision making (Simon, 1986)	-
	Decision analysis (Chapman, 1975)	-	-
PORTFOLIO MANAGEMENT			
Portfolio Management	Portfolio selection & investment (Markowitz, 1952a, Chapman, 1974)	-	-
PROJECT MANAGEMENT			
Project Management	Risk analysis for projects (Cooper and Chapman, 1987)	Mega and complex project (Morris and Hough, 1987)	-
Project Risk Management	-	PRM (Ward and Chapman, 1991, Ward et al., 1991, Chapman, 1997)	-
	-	Risk management & risk engineering (Chapman and Ward, 1994, Cooper and Chapman, 1987)	-

Table 2.1: Summary of the three different ideas and approaches to PRM

2.5 Summary

This chapter explains the background of the research, which is based on the history of economic thought relating to risk and uncertainty. The history of economic thought has provided an understanding of the concept of risk and uncertainty, which have undergone major tensions and have been debated for years. CEPA has established a structure to distinguish theories according to various schools of thought, namely:

the Schools of Political Economy, the Neo-Classical Schools, the Thematic Schools, and the Alternative Schools. Although risk and uncertainty have been discussed and debated at length before 1871, the concepts only received recognition and formally integrated into the economic theory in 1944 due to von Neumann and Morgenstern's theory of games and behaviour. This does not mean however, that other theorists' views were invalid; thus they are used to support the arguments in relation to risk and uncertainty. The decision-making processes have been influenced by the integration of risk and uncertainty concepts.

2.5.1 The Development of Probability Theory

Pre 1871

Bernoulli developed the probability theory, known as the St. Petersburg Paradox, which was a process of making decisions through measurement. The choice under risk and uncertainty was considered outside of the economic theory as the willingness to take risk and maximize utility was found to be irrational. In the early 1800s, economists tried to modify and position the concept of risk and uncertainty into modern economic theory.

Post 1871

The post 1871 era shows further development of the probability theory, the utility theory becomes positioned in economic theory. For example, Jacob Marschak's proposition of utility as the quality of whole mathematical expectations, maximized by rational man, is included in the EU hypothesis.

Extension of the Principle of Utility and EUT

The problem of probability theory led to the development of the principle of utility; this being extended further by scholars such as von Neumann and Morgenstern (1953), Markowitz (1952a, 1952b), and Kahneman and Tversky (1979). SEU is an extension of the principle of utility, which emphasizes probability as subjective. Meanwhile, the introduction of the EU hypothesis by Friedman and Savage has been adopted for insurance and gambling. The theory of decision making was also developed from the principle of utility, and it became the fundamental of risk aversion; people being considered as rational in making decisions thus selecting the best option to maximize utility. Being rational means able to distinguish between alternatives and understand their preferences by applying the probability-impact technique.

2.5.2 The concept of risk and uncertainty

The concept of risk and uncertainty was formally included in economic theory after the introduction of the game theory (which involved the theory of decision making) by von Neumann and Morgenstern in 1944. Making a decision is an inductive process; influenced by the lack of information alongside the assumption that people are risk neutral or risk takers in order to maximize utility. Von Neumann and Morgenstern classified such a process as that of ignorance; one of the three types of uncertainty, others being risk or probability considerations, and economic indeterminacy. Additionally, uncertainty is linked to the problems of forecasting or controlling future events in relation to economics, thus showing that if making decisions under uncertainty, the decision maker need consider the risks associated with future events whilst maximizing the EU.

Based on the above, this research found that von Neumann and Morgenstern classified risk as a factor that contributes to decision making under uncertainty. This led to the thesis argument: that risk and uncertainty are different. The concepts of risk and uncertainty have been debated at length, particularly in relation to the relationship between them. Various theorists who have outlined their arguments and criticisms can be divided into two main streams. The first who argue that risk and uncertainty differ; the second stress both as alike. Their propositions are summarised as follows:

a) Distinction between risk and uncertainty

Risk	**Uncertainty**
• Subjective, derived either deductively or inductively.	• Subjective, happens due to lack of knowledge.
• Involves numerical probabilities	• Probabilities cannot be calculated.

and can be calculated.	
• Involves classification of unknown outcome; a priori probabilities and statistical probabilities.	• Does not involve mathematical probabilities and cannot be analysed.
• Outcome is known through general principles or empirical and recurrent observation.	• Outcome is uncertain, can only be anticipated based on instinct or other subjective forms.

Table 2.2: Distinctions between risk and uncertainty

b) Risk and uncertainty are alike

- Risk is subjective probability
- Risk and uncertainty explain profits
- People will not act on numbers but on probable events
- Risk cannot be separated from pure preference over outcome

The difference in ideas has contributed to the current understanding of risk and uncertainty.

2.5.3 Knight and Keynes (K-K) concept of risk and uncertainty

This research involved reviewing the K-K argument which differentiated between risk and uncertainty. Knight focuses his argument on three probability situations: a priori probability, statistical probability, and estimates. A priori probability relates to mathematics, statistical probability relates to empirical instances by evaluating the frequency of occurrences. Estimates are in the form of a judgement.

Knight criticized the fallibility of humans, acting with limited knowledge in relation to the event. Furthermore, he criticized the rational man who decides upon unknown facts or events, which do not currently exist. In an uncertain situation, the decision maker uses intuition and judgement to decide, this being known as the uncertainty situation. Typically, the decision is made by forecasting the future events using the information provided. However, when the future is unknown, the laws of probability are used to ascertain the outcome. The decision maker generalizes empirical instances without considering conditions due to changes in the environment. Knight argued the impossibility in applying mathematical propositions or empirical evaluation to such situations. He differentiated between risk and uncertainty, arguing that risk was subject to known probabilities while uncertainty was an event for which it was difficult to specify its probability.

Knight’s principal contribution revolves around the concept of risk and uncertainty. For Knight, risk is a tangible or measurable entity which can be quantified through the frequency, severity, and magnitude of its impact. As a rationalist, he contributed to the demarcation of risk and uncertainty and vigorously advocated that the limitation of knowledge in decision making is uncontrollable.

On the other hand, Keynes stated emphatically that probability is unknown, only to be known from the existence of evidence. He agreed Knight’s opposition to the statistical measurement of uncertainty, pointing out that there is no objective probability for future events. He argued that the theory of probability is subjective but logical because probability is measurable, but uncertainty does not have a basis to calculate its probability. Keynes argued that in some cases, it is impossible to calculate probability, due to there being no probability whatsoever or the existence of no common unit of the set of probabilities that can be measured.

Although Keynes's account of uncertainty seemed different to what Knight proposed, he highlighted that the situation of uncertainty occurred in the absence of knowledge and there was no basis to measure or compare the probability. He added that an unknown situation occurred when there is a lack of skill in arguing the given evidence to justify the knowledge. Keynes concluded that, in general, it is impossible to measure the future outcome based on the present situation despite being knowledgeable about certain existing facts. What is being practiced is that people will use current situations to project or to forecast the future. Such false rationalisation has been contended by Keynes because it neglects the degree of knowledge, probability of the future, and the rational behaviour of the decision maker.

Based on these arguments, the research found that in uncertain situations people have insufficient information to make a decision and arrive at judgements, thus they tend to revert to inductive reasoning and guessing to cope with uncertainties.

2.5.4 Approaches to Risk, Uncertainty and their Management

Although the concept of risk and uncertainty management has been comprehensively discussed and researched for many years, the research stresses the importance of discussing the varied approaches and modes of thinking relating to risk and uncertainty. Differing ideas and approaches in relation to the concept of risk and uncertainty are available. A review of current approaches to risk and uncertainty, focussing on three different groups, was conducted; the groups being chosen due to their contribution to the theory and practices of risk and uncertainty management, predominantly in the area of project management. In this chapter, the research compares their ideas to comprehend the basis, concept and linkages to the history of economic thought relating to risk and uncertainty. They are Project Risk Management (PRM) team (Chapman and Ward), the INSEAD team, and the Risk Doctor (David Hillson). From the comparisons, the researcher summarizes the similarities in terms of their approach. Earlier, in section 2.3.2, the research indicated that the PRM approach was based on the EU paradigm whilst the INSEAD team used an alternative approach, drawn from empirical research. Despite being contended by EU theorists, the INSEAD team proposed an emergent method in relation to the concept of risk and uncertainty that did not seem to be drawn from EU. The INSEAD team categorised uncertainty as *variation, foreseen uncertainty, unforeseen uncertainty* and *chaos.* These categories were derived from their distinct strategies, namely, *learning strategy, instructionist strategy, and selectionist strategy*. Despite the different approaches, the research found that all three groups have a similar understanding to how they consider risk and uncertainty for projects. They have referred to, and adopted, theories by authors such as Kahneman and Tversky (1979), von Neumann and Morgenstern (1953), Simon (1951, 1955, 1959, 1986), and Goldratt (1997), as they in particular, consider the area relating to peoples' behaviour in making decisions. The next chapter will further discuss the practice of risk and uncertainty related to the management projects.

CHAPTER 3

THE MANAGEMENT OF PROJECT RISKS

3.1 Introduction

This chapter critically appraises the applications of the concept of risk and uncertainty in the management of projects. It allows one to understand projects and project management through reviewing the definitions, this followed by the debate on the standards, guidelines and bodies of knowledge. It also explicates the fundamental understanding of risk, uncertainty, and opportunity, by examining the standards, statutes or governmental documents and the views of professional bodies. The research highlights the comprehensive definitions substantiated from these documents. Next, the research attempts to evaluate the different approaches to the project risk management processes using existing standards, frameworks, and guidelines. Based on these evaluations, the research illustrates the details of the processes in a typical diagram, later developing a hypothetical process for managing project risk.

3.2 Project and Project Management

In this section, the research attempts to evaluate the currently available concepts of project and project management. It assesses various definitions of project management which are extracted from the literatures, including standards, guidelines, and bodies of knowledge. Additionally, it delves into the debate on the use of project management standards, guidelines, and bodies of knowledge.

3.2.1 What is a Project?

The definitions of a project have been instituted in many ways by various authors [see (PMI, 2004, AIPM, 2008a)], however these definitions contain the same key elements. First, unlike business operations, the nature of a project is temporary, with predetermined or defined start and end points. A project is not an on-going business process; it has distinctive attributes which are dedicated to ensure that it is completed at a specified point. - This distinguishes between project and non-project or task. Secondly, a project creates deliverables that have not existed or never previously been done; a project is therefore said to be unique. However, the use of the word "*unique*" in defining a project was criticised earlier by Raftery (1996), who advocated that projects have similarities: many operations, components and materials, similar management styles and structures and physical elements that form an equivalent function.

In responding to Raftery's criticism, the research found that there is no project that was executed utterly in the same environment and context [see (Ohara, 2005)] In fact, it was actually managed in a different way, using tasks that had not been performed before and resources which were assembled at separate places, thus making the project unique (Loch et al., 2006) Meanwhile, Packendorff (1995) provided an example as to military operations being treated as repetitive projects although they were legitimately unique; he argued the product as unique but the process as standardized. A project is also about creating value (Winch, 2002, Ohara, 2002), which involves the interpretation of ideas and missions into physical activities and end products. These arguments are central as they correlate to the appreciation and better understanding of the importance of project management.

3.2.2 Definitions of Project Management

The concept of project management started way back in the 1900s and 1950s and was applied long before the existence of its profession [see (Kwak, 2005, BS6079-1, 2010). There are no documents which exist to support any claim that project management was invented by anyone specific,(Cleland and Ireland, 2002b) but the construction of pyramids was found to be the first project to embrace project management, it was further integrated into the modern world, especially during the World War II (Kerzner, 2005). The methodologies have been applied in the US Navy since the 1950s [see (Smyth and Morris, 2007), to NASA and other large engineering and construction companies in the 1960s and 1970s, to the manufacturing and software development sectors in the 1980s, and, later came to be widely accepted by different industries in the 1990s (Kwak, 2005). As a project is unique, the ultimate objective of project management is therefore to make sure that the project is delivered towards achieving its definitive context and goals, within the thresholds of time, cost and quality [see (Maytorena, 2013, Everett, 2011)]. Defining project management is a very demanding and effortless task. (Morris et al., 2011, Kerzner, 2003). Scholars have struggled to provide an acceptable definition; its definition continuously being developed by interested parties to enhance the project management profession. Although a good definition of project management is hard to find (Carmichael, 2006), a multitude of definitions can be found in various books, standards and guidelines which are globally available. These definitions can be categorised as practitioners and professional bodies' definitions, theoretical definitions and organisational and governmental definitions.

a) Practitioners and Professional Bodies' Definitions

The practice of project management has seen a quick growth in its professional certification since the 1990s (Söderlund, 2004). Consequently, practitioners and professional bodies began documenting its bodies of knowledge (BoKs). These BoKs are used as best practices, guidelines, and to certain extent standards, therefore justifying the differing terminologies which are found. There are six documents or BoKs published by the respective bodies examined, representing the practitioners and professional bodies in project management. Their definitions of project management are provided in Table 3.1 below.

Institution	Definition of Project Management	Identified Keywords
APM	"…*the process by which projects are defined, planned, monitored, controlled and delivered such that the agreed benefits are realised"* (APM, 2006b)	Defined; planned; monitored; controlled; delivered; benefits realised
PMI	*"…the application of knowledge, skills, tools, and techniques to project activities to meet project requirements"* (PMI, 2004)	Knowledge; skills; tools; techniques; meet requirements
IPMA	*"…the planning, organising, monitoring and controlling of all aspects of a project and the management and leadership of all involved to achieve the project objectives safely and within agreed criteria for time, cost, scope and performance/ quality"* (IPMA, 2006)	Planning; organising; monitoring; controlling; management; leadership; achieve objectives; agreed criteria
PMAJ	*"…the professional capability to deliver, with due diligence, a project product that fulfils a given mission by organising a dedicated project team,*	Capability to deliver; fulfils mission; organising; technical and managerial; methods;

	effectively combining the most appropriate technical and managerial methods and techniques and devising the most efficient and effective work breakdown and implementation routes" (Ohara, 2002)	techniques; work breakdown
AIPM	*"…formalised and structured methods of managing change in a rigorous manner. It requires the application of knowledge, skills, tools and techniques to project activities to achieve the required project outcome"* (AIPM, 2008a)	Structured methods; managing change; knowledge; skills; tools; techniques; achieve outcome
IAPPM	*"…the centralized management by an individual to plan, organize, control and deploy key milestones, deliverables and resources from conception through retirement, according to customer goals. Often project managers are skilled to use specific templates and techniques to manage through the preferred project life-cycle" (http://www.iappm.org/concepts.htm accessed on 26/9/2011)*	Plan; organise; control; deploy; deliverables; customer goals; skill; technique

Table 3.1: Professional bodies' definitions' of project management

The above definitions reflect the common interest of the professional bodies: promoting the standardization (Wirth and Tryloff, 1995) and project management profession. Although project management has been defined differently, the universal understanding is relatively similar through identified keywords: planning, organising, monitoring, controlling, deliver, knowledge, skills, manage, and achieving objectives. Therefore, from the points of view of the practitioners and professionals, project management has been defined as a management process which includes planning, organising, controlling, and monitoring, through the application of appropriate knowledge (technical and managerial), to deliver intended products. This indicates that although the BoKs provide various definitions of project management, there are similarities in terms of keywords reflected in the similar understandings; Ahleman et al. (2009a) pointing out that these similarities will help to harmonize the divergent terminology.

b) Theoretical Definitions

By and large, the theoretical definitions of project management are extracted from project management literature. The research found two leading sources of literature, which defined project management in their own way. Harold Kerzner defined project management in two ways; the first stressed it as an art or an ability to convince others that the results achieved were based on planned actions; whereas the second definition appeared similar to that of Cleland and Ireland (2002), the main concern being able to achieve project objectives. Kerzner's first definition emphasized that project management was more behavioural than quantitative; involved people, and was not only about planning mechanisms [see (Ahlemann et al., 2009a)]. In contrast, the other set of definitions was found to be similar to the professional bodies, focusing on the project activities involving organizing, planning, controlling and monitoring. For example, Peter Morris (Morris et al., 2011, Morris et al., 2006a, Morris et al., 2006b) adopted the definitions by professional bodies like the PMI, APM and IPMA, whereas Janice Thomas (Thomas, 2006) took on board Harold Kerzner's definition of project management and Graham Winch (Winch, 2002) embraced the concept of project management by Peter Morris.

Author	Definition of Project Management	Identified Keywords
Kerzner, H (p.4)	*"…the art of creating the illusion that any outcome is the result of a series of predetermined, deliberate acts when, in fact, it was dumb luck"* (Kerzner, 2003)	Art of creating; illusion; outcome; predetermined
Kerzner, H (p.57)	*"…the process of achieving project objectives through the traditional organisational structure and over the specialties of the individuals concerned"* (Kerzner, 2003)	Achieving project objectives; organisational structure; specialties
Cleland and Ireland (p.39)	*"…a series of activities embodied in a process of getting things done on a project by working with members of the project team and with other people in order to reach the project schedule, cost, and technical performance objectives"* (Cleland and Ireland, 2002b)	Activities; process; project team; reach project objectives

Table 3.2: Theoretical definitions of project management

c) Organisational and Government Definitions

Organisation/ Document	Definition of Project Management	Identified Keywords
BSI: BS 6079-2	*"…planning, monitoring and control of all aspects of a project and the motivation of all those involved in it to achieve the project objectives on time and to the specified cost, quality and performance" (BS6079-2, 2000)*	Planning; monitoring; controlling; motivation; achieve project objectives
ISO:	*"…planning, organizing, monitoring, controlling and*	Planning; organizing;

ISO 10006	*reporting of all aspects of a project and the motivation of all those involved in it to achieve project objectives" (ISO-10006, 2003)*	monitoring; controlling; reporting; motivation; achieve project objectives
OGC PRINCE2	*"…planning, delegating, monitoring and control of all aspects of the project, and the motivation of those involved, to achieve the project objectives within the expected performance targets for time, cost, quality, scope, benefits and risks" (Williams, 2010)*	Planning; delegating; monitoring; control; motivation; achieve project objectives
OGC P3M3 Project Model	*"…guides a project through a visible set of activities, from controlled start-up, through delivery, to controlled closure, and review. There will be visible milestones and well-managed resources, stakeholders and interdependencies, with all parties involved being clear about their goals and individual responsibilities" (OGC, 2010c)*	Activities; controlled; delivery; review; milestones; well-managed; goals

Table 3.3: Organisational and government definitions of project management

Table 3.3 provides four divergent definitions of project management from different organisations. Two of them are taken from well-known standards organisations, the BSI and the ISO, whereas the other two are from the former UK's Office of Government Commerce (OGC). Indeed, these organisations shared common keywords – planning, monitoring, controlling, motivation, and achieve project objectives. The organisational definitions are undeniably related to the objective of the professional bodies and thus these standards were issued to organisations to promote industry-specific standards (Gray, 1998). Meanwhile, Cicmil and Hodgson (2006:115) highlighted that the involvement of government in developing and promoting project management models signified the determination in implementing it in the public sector.

3.2.3 The Summary of Project Management Definitions

The research acknowledges various keywords which define project management; these are tabulated in Table 3.4. Using these keywords, project management can be defined as follows:

"A defined or structured process that organises, manages or delegates the required activities of planning, monitoring, controlling, delivering, motivating, reporting, and

reviewing to achieve the project objectives, mission and goals. It involves the application of relevant knowledge, skills, tools and techniques by the project team."

Keyword From the Definitions of Project Management	**Name of Standard/ Document**	**Name of Government Unit/ Department**	**Name of Author**	**Name of Institution/ Society**
Define/ Structure/ Activities/ Process		OGC P3M3 2010	Cleland & Ireland (2002)	APM 2006 AIPM 2008a
Plan	BS6079-2:2000 ISO10006:2003	OGC PRINCE2 2010		APM 2006 IPMA 2006 IAPPM 2007
Monitor	BS6079-2:2000 ISO10006:2003	OGC PRINCE2 2010		APM 2006 IPMA 2006
Organize/ Manage/ Delegate	ISO10006:2003	OGC PRINCE2 2010 OGC P3M3 2010		IPMA 2006 PMAJ (Ohara 2002)
Control	BS6079-2:2000 ISO10006:2003	OGC PRINCE2 2010 OGC P3M3 2010		APM 2006 IPMA 2006
Deliver		OGC P3M3 2010		APM 2006 PMAJ (Ohara 2002)
Motivate	BS6079-2:2000 ISO10006:2003	OGC PRINCE2 2010		
Report	ISO10006:2003			
Review		OGC P3M3 2010		
Benefits/ Outcome/ Requirement/ Objectives/ Mission/ Goal	BS6079-2:2000 ISO10006:2003	OGC PRINCE2 2010 OGC P3M3 2010	Cleland & Ireland (2002) Kerzner (2003)	APM 2006 AIPM 2008a PMI 2004 IPMA 2006 PMAJ (Ohara 2002)
Knowledge				PMI 2004 AIPM 2008a
Skills/ Technical/ Managerial				PMI 2004 PMAJ (Ohara 2002) AIPM 2008a
Tools				PMI 2004 AIPM 2008a
Techniques				PMI 2004 PMAJ (Ohara 2002) AIPM 2008a
Leadership				IPMA 2006
Team			Cleland & Ireland (2002)	
Organisational			Kerzner (2003)	

Table 3.4: Summary of keywords – Definitions of project management by authors

Project management has been conceptualized as a universal phenomenon, concerning multidimensional and differing projects. Projects are people-centred with need and demand [see (Ahlemann et al., 2009a)], thus project management involves solving practical problems by practitioners. According to Morris et al. (2011), the growth of project management has been greatly led by practitioners and covers a wide-ranging perspective within the modern economy.

To summarize, project management has been defined differently by practitioners, professional bodies, academics, organisations due to the complexity of the projects [see (Atkinson, 1999, Wirth and Tryloff, 1995)]. However, they share a collective understanding about project management: managing the activities systematically throughout the project to deliver the intended and tangible goal. As discussed above, project management approaches involve the concept of planning. The plans are encumbered with unknowns, ambiguities, estimates and assumptions, and therefore, projects tend to take in risk and uncertainty. The concepts of risk and uncertainty in a project will be further discussed later in this chapter.

3.2.4 Project Management Standards, Guidelines and Bodies of Knowledge (BoKs)

Due to the multidimensional nature of project management, the project management community had to seek reference from various points for terminology and processes. The theory and practices have been developed since the 1950s, with the publication of international and national standards as well as the establishment of professional bodies and their BoKs; this has helped stimulate the knowledge and skills in project management (Cleland and Ireland, 2002b). Meanwhile, Ahleman et al. (2009b) and Bredillet (2003) acknowledge the importance of standards as a socio-economic construct, which demonstrates that standards have influenced economic and capability improvement. This has motivated the production and evolution of standards, which avoids confusions. Crawford (2007) claimed that an official endorsement is not a necessity in developing the standards. The rationale is that these standards, guidelines and BoKs are formulated through consensus; decisions of the scholars and professionals and are perceived as essential in acknowledging the profession. Although these standards, guidelines and BoKs differ in terms of their approach, Ahleman et al. (2009a:293) argued that guidelines can be converted into standards as well, for example, the PMBOK, which befitted the ANSI norm in 2004. At present, there are more than one thousand established standards which exist, excluding those in-house guidelines that are developed for internal or local use only [see (Bredillet, 2003)]. As a result, this has complicated the process of selecting the best practices in project management. The research therefore suggests that these documents be categorized into two; general standards and guidelines and; BoKs and competency standards.

a) Project Management Standards and Guidelines

Two distinguished standards concerning project management were reviewed; namely, ISO 10006 (Guidelines to Quality in Project Management) and BS 6079 (Project Management). Additionally, there are other national-level standards, such as Germany's DIN 69900 (network analysis) and DIN 69901 (project management systems) published by the German Institute for Standardisation. Both documents serve as national standards and are meant to be a source of reference and guidance in Germany. BS 6079 aimed to draw attention to the management challenges in different environments and to present potential approaches (BS6079-1, 2010). In April 2011, ISO published the ISO 21500: Guidance on Project Management, which offered a universal point of reference in project management.

b) Project Management BoKs and Competency Standards

Bodies of knowledge or BoKs and competency standards are formulated in response to the demand for common terminology and practices, and its development is driven by the recognition of a distinct profession. Issues relating to the project management BoKs and competency standards have been discussed at length since 1995 [see (Stretton, 1995, Willis, 1995, Wideman, 1995)] and since then, it has been deliberately contested amongst authors and researchers [see (Ahlemann et al., 2009b, Bredillet, 2003, Crawford, 2007, Morris et al., 2006a, Morris et al., 2006b, Cleland and Ireland, 2002b, Jugdev and Müller, 2001, Engwall, 2003, Söderlund, 2004, Smyth and Morris, 2007, Whitty and Maylor, 2009, Shenhar and Dvir, 1996, White and Fortune, 2002, Duncan, 1995, Wirth and Tryloff, 1995, Atkinson, 1999, Ahlemann et al., 2009a, Everett, 2011, Aven, 2011, Pennock and Haimes, 2002, Maytorena, 2013)].

Leading BoKs and competency standards, such as the PMBOK, APM BOK, ENAA's P2M and IPMA's ICB, are developed by the professional bodies in project management. Besides that, the IAPPM has also published its competency standards called 'A Guide to Project and Program Management Standard'. Table 3.4 lists the professional bodies and their publications.

Guide Name	Name of Professional Body or Organisation	Country of Origin / Coverage	Published Since
PMBOK® (PMI Body of Knowledge)	Project Management Institute (PMI)	US / International	1987
APM BOK (APM Body of Knowledge)	Association for Project Management (APM)	UK / Europe	1992
NCSPM (Australian National Competency Standards for Project Management)	Australian Institute of Project Management (AIPM)	Australia / National	1996
ICB (IPMA Competence Baseline)	International Project Management Association (IPMA)	European Countries / Europe & a few other countries	1998
P2M (A Guidebook for Project & Program Management for Enterprise Innovation)	Engineering Advancement Association (ENAA)	Japan / National	2001
A Guide to Project and Program Management Standard	International Association of Project and Program Management (IAPPM)	US / International	2007

Table 3.5: Various bodies of knowledge and competency standards for project management

The primary function of the professional bodies is to facilitate the exchange of information and promote the project management profession. Certification programmes are introduced by the professional bodies to provide recognition to those who has gone through the BoKs and understand the discipline. The following are examples of BoKs or competency standards which have been published by various organisations.

i) PMBOK®

PMBOK® is a registered trademark of the Project Management Institute (PMI); their main aim is to provide a consistent knowledge structure for its certification programme. It defines a project management framework which consists of ten knowledge areas. The purpose of PMBOK is to promote project management practices through a foundational reference to those interested in the profession (PMI, 2004). It is a set of project management standards, suggestions and best practices based upon substantial experiences of many professionals.

ii) APM BOK

APM is the UK based project management's association, which publishes, promotes and updates its body of knowledge known as APM BOK. It comprises of 46 techniques, categorized into six main areas identified as: planning the strategy, executing the strategy, techniques, business, and commercial, organisation and governance, and people and the profession (Newton, 2009).

iii) NCSPM

The Australian Institute of Project Management (AIPM) was formed to develop and implement the project management BoK, certification, as well as accreditation of programmes. Its competency standard is modelled upon the PMBOK and the APM BOK. In fact, the development of the NCSPM was in co-operation with the UK's INTERNET Association [see (Stretton, 1995)].

iv) ICB

IPMA started to have its own certification programme in 1998, which was an amalgamation of APM BOK (Morris et al., 2006b), called the IPMA Competency Baseline or ICB. Besides the UK, the ICB developed in harmonisation with France and Germany's project management's qualifications and competency programmes. Similarly to PMBOK, the ICB's main purpose is to assist its certification programmes. It has 28 core elements and 14 additional elements of project management knowledge and experience, which is presented in the form of a "Sunflower" (Crawford, 2007).

v) PRINCE 2

The UK's former Office of Government Commerce (OGC) has developed a guide called "*PRoject IN Controlled Environment*" or PRINCE, and this was part of the Best Management Practice portfolio. In July 2013, the Cabinet Office announced AXELOS as the new joint venture company to own the intellectual property of this portfolio. PRINCE 2, which is developed from PRINCE, aims to be a generic, tailored approach, as well as a working tool, for managing projects [see (Newton, 2009)]. In contrast with the BoKs, which serve as a source of reference, PRINCE 2 is compulsory for most government projects. It also certifies project management professionals through its various levels of competency, thus competing with other project management certification programmes.

vi) P2M

P2M is the Japanese based BoK called "A Guide-book for Project and Program Management for Enterprise Innovation". Morris, et al. (2006, p.462) argued that P2M provided a wider-ranging view of project management than PMBOK because it was developed after a comprehensive review was conducted on existing BoKs and guidelines. It also developed its own competency standard called Capability Building Baseline (CBB);Crawford (2007) claimed that this had made P2M better than other BoKs Additionally, it has 11 segments of knowledge areas, represented by the 'Project

Management Tower' and emphasised upon successful stakeholder management, effective project delivery, as well as enterprise value creation.

By and large, the project management BoKs and competency standards are prepared for certification purposes. These documents are fundamental for the profession as they have influenced the industry views on competence. A BoK should identify, describe and incorporate knowledge and competencies that are required to support the project management profession. Nevertheless, Morris et al. (2006a) asserts that it is the academicians' role to investigate attempts to define the BoKs and to question the validity of the knowledge base.

Developing a BoK and its associated training and certification programmes requires extensive resources and time. Therefore, the availability of various BoKs and competency standards globally, demonstrates that significant effort has been spent to establish documents for the same purpose by different organisations. Morris et al. (2006a) have criticized that these BoKs do not represent the broad understanding of knowledge in project management. Additionally, they are indeed competing with other existing standards and qualifications. For example, the APM BOK is competing with other UK competency standards such as PRINCE 2 and MSP. Meanwhile, the certification programmes are only a mean for recognising a person that has met the requirements set by the relevant bodies and has become proficient in project management. PMIs move to incorporate its PMBOK into the ANSI standard was seen as inappropriate. Morris et al. (2006b) questioned the validity of the project management knowledge represented because it is situated in ANSI's text. Another criticism on PMBOK approach was made by Williams (2005:501), who pointed out that PMBOK put too much emphasis upon planning rather than controlling. This approach is known as 'management-as-planning' in the management theory. A lack of research and literature has reflected upon the weak foundation of the knowledge areas in PMBOK.

Nevertheless, the research found that the ultimate difference which divides the PMBOK and APM BOK is the scope attentiveness. PMBOK concentrated on phase execution, whilst APM BOK focussed more broadly upon the management of projects and implementation of decisions [see (Cleland and Ireland, 2002b, Newton, 2009)].

However, although the criticisms seem to be valid, there might be elements of biasness towards APM BOK, which Peter Morris and his team have been researching for quite some time. Willis (1995) raised his concerns regarding the APM's weak certification programmes, which adopts a fixed exam approach and the candidate being assessed on their experience, not on the literature. However, other BoKs focus on the project's life cycle as well as addressing the enterprise aspects in a broader and global context. Regardless, these professional bodies and their BoKs have a similar purpose: to provide knowledge to the members and to accredit and certify those who qualify and fulfil the requirements to be a professional project manager.

3.3 Risk, Uncertainty, and their Management

This section investigates the concepts of risk and uncertainty and their management. It analyses the definitions of risk, risk management, and uncertainty from different documents; namely, the international and national standards, national statute or governmental definitions, professional bodies and societies, as well as other organisations like the United Nations (UN) and the European Commission (EC). It also assesses the relationship between risk, risk management and uncertainty, using the documents reviewed. Given the prevalence and importance of the concepts of risk and uncertainty, particularly for projects, it is important to understand their definitions

3.3.1 Definitions of Risk

According to the Concise Oxford Dictionary, risk means "*hazard, chance of or of bad consequences, loss; exposure to mischance…"* (Sykes, 1977). However, over the years, the definition has evolved and been expanded by different parties based on their research and level of understanding of what is meant by "risk." In this sub-section, the research examines various definitions of risk, divided them into international or national standards, national statute or governmental, other organisations, and professional bodies or societies.

a) International and National Standards' Definitions of Risk

Primarily, the standards published by the ISO and the BSI are the main sources of information for international and national-level standards. Nine international and national standards were reviewed; the research found that risk has been defined using varying terminologies. Table 3.6 provides the different definitions of risk from these documents.

Organisation/ Document	Definition of Risk	Identified Keywords
PD ISO/IEC Guide73:2002 (Risk Management-Vocabulary); ISO/IEC 16085:2006(E) IEEE Std 16085-2006	*"...combination of the probability of an event and its consequence" (PD-ISO-IEC-73, 2002, ISO/IEC-16085, 2006)*	Probability; consequence
PAS 99:2006	*"…likelihood of an event occurring that will have an impact on objectives" (PAS99, 2006)*	Likelihood; impact; objective
PD 6668:2000 Managing risks for corporate governance	*"…chance of something happening that will have an impact upon objectives, measured in terms of likelihood and consequences" (Robbins and Smith, 2000)*	Chance; impact; objectives; likelihood; consequences
BS ISO 31000:2009; BS 31100:2008	*"…effect of uncertainty on objectives"(BS-ISO-31000, 2009, BS-31100, 2008b)*	Uncertainty; objective
BS 6079-2:2000	*"…combination of the probability or frequency of occurrence of a defined threat or opportunity and the magnitude of the consequences of the occurrence" (BS6079-2, 2000)*	Probability; threat; opportunity; consequences
BS 6079-3:2000	*"…uncertainty inherent in plans and the possibility of something happening (i.e. a contingency) that can affect the prospects of achieving business or project goals" (BS6079-3, 2000)*	Uncertainty; possibility; affect goals
AS/NZS 4360:1999, HB 436:2004, DoD Australia-Defence RM Framework	*"…the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood" (AS/NZS-4360, 1999, HB436, 2004, Gaidow and Boey, 2005)*	Chance; impact; objectives; likelihood; consequences
CAN/CSA-Q850-97	*"...the chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value" [(CAN/CSA-Q850, 1997), p.3]*	Injury; loss; probability; severity; adverse effect

Table 3.6: International and national standards definitions of risk

COSO (2004a) claimed that the Australian and New Zealand standard (AS/NZS) were the first national standards to be sanctioned by the ISO for its holistic approach. Thus, its fundamental concepts have been used as the main source of reference for other standards. As such, its definition was found to be adopted in the BSI's PD 6668:2000. Meanwhile, the BS ISO 31000:2009 definition of risk was found to be focussed upon uncertainty, which covered positive and negative continuum to the entire business setting. It was formulated in response to the objective of managing the uncertainties within single frameworks.

There are inconsistencies of risk definition provided by the ISO and the BSI, thus making their definitions open for argument and criticism. For example, BS 6079-2:2000 uses "*threat"* and *"opportunity"* as part of its definition, but these keywords do not appear in PD 6668:2000, BS 31100:2008, PAS 99:2006. The publication of the ISO Guide 73 in 2002 indicated that there was an initiative to streamline inconsistencies. It offered risk definition which can be adopted by various standards which discuss risk-related terminologies. The IEEE was found to correspond with this recommendation and adopted the definition in its IEEE 16085:2006 standard. Yet, it is evident that inconsistencies have existed over the years, perhaps due to the differences in culture and approach. Evidently , the research found that BS 31100:2008 and BS ISO 31000:2009 adopted the word *"uncertainty"* within the definition of risk, contradictory to the ISO Guide 73. Another comparison of the definitions from various organisations and professional bodies are discussed further.

b) National Statute or Governmental Definitions of Risk

Table 3.7 provides a comparison of the definitions of risk from three different countries: the United Kingdom (UK), the United States (US) and Canada. The research reviewed five (5) documents published by UK governmental departments or bodies, three (3) from the US and one (1) from Canada.

Government Unit/ Department	Definition of Risk	Identified Keywords
National Audit Office, UK	*"…something happening that may have an impact on the achievement of objectives as this is most likely to affect service delivery for citizens. It includes risk as an opportunity as well as a threat" (NAO, 2000)* *"A hazard, or factor likely to cause loss or danger (such as a chance of loss or injury; the degree of probability of loss) that may occur in the future" (NAO, 2008)*	Impact; objectives; opportunity; threat Hazard; loss; danger; chance; probability; future
The Orange Book, UK; Strategy Unit, Cabinet Office, UK	*"…uncertainty of outcome, whether positive opportunity or negative threat, of actions and events. It is the combination of likelihood and impact, including perceived importance" (HM-Treasury, 2004b, Strategy-Unit, 2002a)*	Uncertainty; opportunity; threat; likelihood; impact
HM Treasury, UK	*"The likelihood, measured by its probability, that a particular event will occur" (HM-Treasury, 2005)*	Likelihood; probability
NASA Procedural Requirements (2002)	*"The combination of 1) the probability (qualitative or quantitative) that a program or project will experience an undesired event such as cost overrun, schedule slippage, safety mishap, compromise of security, or failure to achieve a needed technological breakthrough; and 2) the consequences, impact, or severity of the undesired event were it to occur" (NASA, 2002)*	Probability; undesired event; consequence; impact
US Presidential/ Congressional Commission on RA & RM (White Book)	*"…the probability that a substance or situation will produce harm under specified conditions" (Presidential/Congressional-Commission, 1997)*	Probability; harm
DoD USA RM Guide	*"…a measure of future uncertainties in achieving program performance goals and objectives within defined cost, schedule and performance constraints" (DoD, 2006a)*	Uncertainties; objectives
IRMF Treasury Board of Canada Secretariat, (2001)	*"...the uncertainty that surrounds future events and outcomes. It is the expression of the likelihood and impact of an event with the potential to influence the achievement of an organisation's objectives" (Canada, 2001)*	Uncertainty; future events; outcomes; likelihood; impact; objectives

Table 3.7: National statute or governmental definitions of risk

From the above list, four (4) documents used "*probability"* in their definition of risk, four (4) used *"likelihood",* five (5) used "impact", and four (4) used *"uncertainty."* There are also four negative words adopted; namely, "*hazard*", *"harm", "loss"* or *"damage"* and *"undesired".* According to the Concise Oxford Dictionary (Sykes, 1977), *"undesired"* means *"…dissatisfaction from attaining or possessing something; not wanted earnestly or not asked for…"* whilst *"harm"* means *damage or hurt* and *"hazard"* means *"danger."* These adverse words are related to *"threat",* which means an "*indication of something undesirable coming"* (Sykes, 1977).

The governments' definitions of risk are also lacking in consistency. For example, the UK's National Audit Office (NAO) documents were found to have two conflicting definitions: one with a negative point of view which adopted negative words, such as hazard, loss and damage; the other saw risk as having threat and opportunity. Another comparison was made between the UK's HM Treasury documents; namely, the "Managing risk to the public: appraisal guidance" (HM-Treasury, 2005) and "The Orange Book: management of risk-principles and concepts" (HM-Treasury, 2004b). In 2004, the HM Treasury adopted the definition of risk, which was published in a report by the Strategy Unit of the UK Cabinet Office (see Strategy-Unit, 2002). In this report, the words "uncertainty", "opportunity", and "threat" were used to define risk, along with "likelihood" and "impact." However, in 2005, the HM Treasury's definition of risk became short and simple, with only "likelihood" and "probability" as the keywords, which both appear to have the same meaning. This sort of 'updated' definition seems ambiguous, neglecting the importance of having a deep understanding as to what risk really means. Dix (2013) argued that the lack of understanding is attributable to disagreement upon the fundamental terminologies [see (Dix, 2013)].

Similar to the UK, there were also inconsistencies found in three documents that were published in the US. In 1997, the Presidential/ Congressional Commission on Risk Assessment and Risk Management published a White Book as a national statute. Two keywords were found in the White Book: "probability" and "harm"; indicating that risk was defined from a negative perspective. NASA's Procedural Requirements in 2002 adopted an enhanced definition of risk, with more keywords; namely, "undesired", "consequences" and "impact", together with "probability". However, from its definition, NASA was also found to view risk negatively. Another document reviewed was the "Risk management guide", published by the US Department of Defense (DoD) in 2006. In this document, the definition of risk covered a broader scope to include programme performance. It had "uncertainty" and "objective" within the definition and did not mention as to whether risk had been looked at from a negative or positive point of view.

One national statute or governmental document from Canada was examined in this research; namely, the "Integrated Risk Management Framework", published by the

Treasury Board of Canada Secretariat. In this document, the Government of Canada adopted the word “uncertainty” in its definition of risk, together with “likelihood", “impact” and “objectives". Additionally, there was no indication as to whether risk was viewed negatively or positively.

c) Other Organisations’ Definitions of Risk

Table 3.8 provides definitions of risk from three (3) different organisations. namely, the International Risk Governance Council (IRGC), the United Nations Economic Commission for Europe (UNECE), and the European Commission’s (EC) Aid Delivery Methods.

Organisation/ Document	Definition of Risk	Identified Keywords
IRGC	*“…an uncertain consequence of an event or activity with respect to something that humans value (original definition by Kates et al. 1985)[4] (IRGC, 2005)* *“…a combination of two components: the likelihood or chance of potential consequences and the severity of consequences of human activities, natural events or a combination of both” (IRGC, 2005)* *“…an uncertain (generally adverse) consequence of an event or activity with respect to something that human’s value. Risks are often accompanied by opportunities” (IRGC, 2008b)*	Uncertain; consequence Likelihood; severity; consequences Uncertain; consequence; opportunities
UN Economic Commissions for Europe	*“An event which can change the expected cash flow forecast for a project” (UN-ECE, 2008)*	Change; expected cash flow; forecast
EC - European Commission Aid Delivery Methods	*“…the probability that an event or action may adversely affect the achievement of project objectives or activities” (European-Commission, 2004)*	Probability; adverse effect; objectives; activities

Table 3.8: Other organisations definitions of risk

From the above list, no similarities were found in the definition of risk provided by these organisations. However, the keywords are commonly used in other categories. Two documents published by the IRGC were reviewed; namely the “White paper on Risk Governance – towards an integrative approach”, which was published in 2005,

[4] Kates, R.W.; Hohenemser, C.; Kasperson, J.X. (1985). Perilous progress: Managing the hazards of technology. Boulder: Westview Press.

and “An introduction to the IRGC Risk Governance Framework", published in 2008. Within the same document published in 2005, the research found two different definitions of risk. The first saw IRGC as adopting the definition used by other authors that had “uncertain” and “consequence” as keywords, and the latter using the word “likelihood” instead of “uncertain". There was no further explanation found in this “White Paper” concerning the use of different definitions. However, within the same publication, the IRGC distinguished risks from hazards - (see IRGC, 2005; p.19) hazards being described as *“potential for harm".* In 2008, the IRGC introduced an improved definition of risk, including “opportunity” in its definition, alongside “uncertain” and “consequence."

The European Commission (EC) has its own definition of risk, as can be seen in the Aid Delivery Methods document, published in 2004. “Probability", “effect” and “objectives” are keywords used by the EC in defining risk. On the other hand, the United Nations Economic Commission for Europe (UN-ECE, 2008) defined risk differently; Its definition being viewed from the financial perspective, only in contrast to the IRGC and EC definitions.

d) Professional Bodies and Societies' Definitions of Risk

The professional bodies or societies' definitions of risk are provided in Table 3.9. These are well-known and established professional bodies or societies; they represent various disciplines relating to risk management and project and programme management.

Institution	Definition of Risk	Identified Keywords
APM (APM BOK 5th Ed, 2006); APM (PRAM, 2004)	*“…an uncertain event or set of circumstances that should it or they occur have an effect on the achievement of one or more of the project objectives” (APM, 2006b, APM, 2004)*	Uncertain; effect; objectives
OGC (PRINCE 2)	*“…an uncertain event or set of events that, should it occur, will have an effect on the achievement of objectives. A risk is measured by a combination of the probability of a perceived threat or opportunity occurring, and the magnitude of its impact on objectives”(OGC, 2009)*	Uncertain; effect; objectives; probability; threat; opportunity; impact
PMAJ	*“…an uncertain event that affects the objective*	Uncertain; effect;

	of a project that is about to start and includes results and extent of influence it may cause" (Ohara, 2005)	objective; influence
GAPPS- Global Alliance for Project Performance Standards	*"…an uncertain event or condition that if it occurs, has a positive or negative effect on the project" (GAPPS, 2007)*	Uncertain; positive; negative
PMI PMBOK®	*"An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives" (PMI, 2004)*	Uncertain; positive; negative; effect; objectives
IAPPM (IAPPM, 2007)	*Adopts Chapman and Ward (2003) definition: "the implications of uncertainty about the level of project performance achievable"*	Implication; uncertainty; performance
AIPM	*"…factors that might adversely affect project outcomes" (AIPM, 2008b)*	Factors; adverse effect; outcomes
IRM/AIRMIC/ALARM (2002); FERMA (2003)	*"…the combination of the probability of an event and its consequences" (adopting ISO/IEC Guide 73)*	Probability; consequences
IEEE Standard for Software Life Cycle Processes - Risk Management	*"The likelihood of an event, hazard, threat, or situation occurring and its undesirable consequences; a potential problem" (IEEE, 2001)*	Likelihood; hazard; threat; situation; undesirable; consequences; problems
Software Engineering Institute (SEI)	*"…is the possibility of suffering loss" (Higuera et al., 1994)*	Possibility; loss
IT Governance Institute – COBIT 4.1	*"…the potential that a given threat will exploit vulnerabilities of an asset or group of assets to cause loss and/or damage to the assets; usually measured by a combination of impact and probability of occurrence" (IT.Governance.Institute, 2007)*	Potential; threat; vulnerability; loss/damage; impact; probability

Table 3.9: Professional bodies definitions of risk

There were twelve (12) professional bodies or societies included in this review, six (6) of which were project management-related organisations; namely APM, PMAJ, PMI, GAPPS, IAPPM, and AIPM. Although the OGC is not a professional body, it produces specific guidelines within the area of project management, and therefore, should be examined. The others are IRM, FERMA IEEE, SEI, and IT Governance Institute (COBIT). The APM used the same definition of risk in both of its publications [see (APM, 2006b, APM, 2004)], adopting the term "an uncertain event". Similarly, the PMAJ (Ohara, 2005) and OGC's PRINCE 2 (OGC, 2009) were found to agree with the APM's definition of risk but with some addition. PRINCE 2 added more terminologies, such as "probability", "threat", "opportunity" and "impact" to the definition, whilst the PMAJ tailored the definition to suit the project environment.

GAPPS adopted the PMI's definition of risk and the IAPPM adopted the definition from Chapman and Ward (2003). Unlike the others, the AIPM was found to develop its own terminology rather than adopting from others. FERMA adopted the standard by the IRM/AIRMIC/ALARM called "Risk Management Standard", which was published in the UK in 2002. However, the definition of risk in the risk management standard was adapted from the ISO/IEC Guide 73, which used the terms "probability" and "its consequences". On the other hand, the IEEE, SEI and COBIT view risk negatively, referring to the words "hazard", "threat", "undesirable", "problems", "loss", "damage" and "vulnerability."

3.3.2 A Summary of the Definitions of Risk

From the reviews, "probability", *"consequences",* and "*objectives"* are three important words used to define risk. *"Probability"* has been defined by the Concise Oxford Dictionary (Sykes, 1977) as "likelihood; extent to which an event is likely to occur". Therefore, *"probability"* and "*likelihood"* are synonymous. The meanings of the remaining keywords mentioned above are defined by the Concise Oxford Dictionary as follows:

i) Chance ~ *risk*
ii) Likelihood ~ *very probably*
iii) Consequences ~ *results*
iv) Impact ~ *(strong) effect; influence*
v) Objectives ~ *dealing with outward things*
vi) Threat ~ *indication of something undesirable coming*
vii) Opportunity ~ *favourable situation; good chance*
viii) Uncertainty ~ *not certainly knowing or known; not to be depended on; changeable*
ix) Hazard ~ *(source of) danger*
x) Harm ~ *damage, hurt*

Besides the inconsistencies, there are commonalities concerning the usage of various terminologies in defining risk. Table 3.10 provides the summary of keywords used in several standards, frameworks and guidelines which have been reviewed.

Keyword from the Definitions of Risk	Name of Standard/ Document	Name of Government Unit/ Department	Name of Organisation	Name of Institution/ Society
Probability / Likelihood	PD ISO/IEC Guide 73:2002 ISO/IEC 16085:2006 BS 6079-2:2000 PAS 99:2006 PD 6668:2000 AS/NZS 4360:1999	HM Treasury (2004) HM Treasury (2005) NAO UK (2008) Cabinet Office (2002) NASA (2002) US White Book (1997) IRMF Canada (2001)	EC (2004) IRGC (2005)	OGC PRINCE 2 (2009) IRM (2002) FERMA (2003) SEI (1994) IEEE (2001) COBIT (2007)
Chance	PD 6668:2000 AS/NZS 4360:1999	NAO (2008)		
Consequences/ Implication	PD ISO/IEC Guide 73:2002 ISO/IEC 16085:2006 BS 6079-2:2000 PD 6668:2000 AS/NZS 4360:1999	NASA (2002)	IRGC (2005) IRGC (2008)	IAPPM (2007) IRM (2002) FERMA (2003) IEEE (2001)
Impact/ Effect/ Influence	PAS 99:2006 PD 6668:2000 AS/NZS 4360:1999	IRMF Canada (2001) HM Treasury (2004) NAO UK (2000) Cabinet Office (2002) NASA (2002)	EC (2004)	APM BOK (2006) APM PRAM (2004) AIPM (2008) OGC PRINCE 2 (2009) COBIT (2007) PMI (2004) PMAJ (2005)
Objectives	PAS 99:2006 AS/NZS 4360:1999 BS ISO 31000:2009 BS 31100:2008	NAO UK (2000) DoD US (2006) IRMF Canada (2001)	EC (2004)	APM BOK (2006) APM PRAM (2004) AIPM (2008) OGC PRINCE 2 (2009) PMAJ (2005) PMI (2004)
Uncertain/ Uncertainty	BS ISO 31000:2009 BS 31100:2008	HM Treasury (2004) Cabinet Office (2002) DoD US (2006) IRMF Canada (2001)	EC (2004)	APM BOK (2006) APM PRAM (2004) GAPPS (2007) IAPPM (2007) OGC PRINCE 2 (2009) PMI (2004) PMAJ (2005)
Opportunity (Positive)	BS 6079-2:2000	HM Treasury (2004) NAO (2000) Cabinet Office (2002)	EC (2004)	OGC PRINCE 2 (2009) GAPPS (2007) PMI (2004)
Threat (Negative)/ Undesirable	BS 6079-2:2000	HM Treasury (2004) NAO (2000)		OGC PRINCE 2 (2009) GAPPS (2007) IEEE (2001) PMI (2004) COBIT (2007)
Hazard/ Danger		NAO UK (2008)		IEEE (2001)
Harm/ Loss/ Damage		NAO UK (2008) US White Book (1997)		SEI (1994) COBIT (2007
Problem				IEEE (2001)

Table 3.10: Summary of the keywords for risk definitions

The most commonly used keywords are probability or likelihood; impact or effect; uncertain or uncertainty; threat or adverse words like harm and danger, and objectives. Whereas the words opportunity or positive were rarely used, risk had become broadly construed as having a negative side. This is also in accordance with Kähkönen (2006, p.212) who said that people generally associated risk with adverse outcomes or situations [see (Kähkönen, 2006)].

There is also a lack of consistency in defining risk by the standards and guidelines, which contribute to the confusions concerning the terminology. The majority of the documents reviewed defined risk as a probability or likelihood of an event to occur, the consequences affecting or impacting, either positively or negatively. Such a definition is in line with the K-K proposition that risk involves probability and, can be numerically calculated. However, fourteen documents also define risk in relation to uncertainty. Retrospectively, the use of such terminology to define risk is inappropriate in accordance to the K-K concept of risk and uncertainty. The K-K proposition specified that risk is tangible and subject to known probabilities, hence, it is impossible to calculate the probability for uncertainty simply because the probability does not exist. Additionally, uncertainty occurs because of a lack of knowledge and skill in arguing the evidence.

The standards and guidelines are largely based on the expected value, and do not distinguish between risk and uncertainty as K-K does. The terminologies used in these documents violated the economics theory, Aven (2004) terming it as not behaving rationally according to the EUT. The definitions have paved the way for decision makers to make a firm stand and to choose the best alternative to maximize the utilities. The apparent reasoning is that these documents are issued by different organisations, thus inappropriate choices of reference may lead to poor decision making. It is the myopic nature of the different organisations that further enriches the parochially towards their settings.

3.3.3 Definitions of Risk Management

Just as project management has been defined differently by different people, the same applies to risk management, which can be categorised into theoretical definitions, international and national standards definitions, national statute and governmental definitions, other organisational definitions and those of professional bodies and society.

a) Theoretical Definitions

Researchers and academics have defined risk management based on their studies. This research found two (2) theoretical definitions which are independent and do not rely on any other definitions provided by institutions or organisations, as shown in Table 3.11. The definition by Edwards & Bowen (1998) was found to concentrate on the approaches and processes of managing risk, whist Cooper et al. (2005) focused on the process as well as the culture of managing the risk effectively.

Author	Definition of Risk Management	Identified Keywords
Edwards & Bowen (1998)	*"…a systematic approach to dealing with risk"* *"A risk management system should: establish an appropriate context; set goals and objectives; identify and analyse risks; influence risk decision-making; and monitor and review risk responses" (Edwards and Bowen, 1998)*	Systematic approach; context; set goals and objectives; identify and analyse; influence decision-making; monitor and review.
Cooper et al. (2005)	*"…the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects" (Cooper et al., 2005a) p.3*	Culture; structure; direct; management; opportunities; adverse effects

Table 3.11: Theoretical definitions of risk management

b) International and National Standards' Definitions of Risk Management

From the organisational and governmental perspective, risk management has been defined as follows:

Organisation/ Document	Definition of Risk Management	Identified Keywords
PD ISO/IEC Guide 73:2002-RM Vocabulary;	*"...coordinated activities to direct and control an organisation with regard to risk" (PD-ISO-IEC-73, 2002, BS-ISO-31000, 2009, BS-31100, 2008b)*	Coordinated activities; direct; control

BS ISO 31000:2009; BS 31100:2008		
ISO/IEC 16085:2006 IEEE Std 16085:2006	*"A continuous process for systematically identifying, analysing, treating, and monitoring risk throughout the life cycle of a product or service" (ISO/IEC-16085, 2006)*	Continuous process; systematic; identify; analyse; treat; monitor; life cycle
BS ISO 31000:2009	*"…systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analysing, evaluating, treating, monitoring and reviewing risk" (BS-ISO-31000, 2009)*	Systematic; management; procedures; communicating; consulting; context; identify; analyse; evaluate; treat; monitor; review
BS 31100:2008	*"…systematic application of management policies, procedures and practices to the tasks of communicating, consulting, establishing the context, identifying, analysing, evaluating, treating, monitoring and reviewing risk" (BS-31100, 2008b)*	Systematic; management; procedures; communicating; consulting; context; identify; analyse; evaluate; treat; monitor; review
BS/IEC 62198:2001	*"…systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk"(BS/IEC-62198, 2001)*	Systematic; management; procedures; communicating; consulting; context; identify; analyse; evaluate; treat; monitor; review
BS 6079-2:2000	*"…systematic application of policies, procedures, methods and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk" (BS6079-2, 2000)*	Systematic; procedures; identify; analyse; evaluate; treat; monitor
AS/NZS 4360:1999, HB 436:2004, DoD Australia Defence RM Framework (DRMF) (Gaidow & Boey 2005)	*"…the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects"(AS/NZS-4360, 1999, HB436, 2004, Gaidow and Boey, 2005)* *"…the systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk" (AS/NZS-4360, 1999, Gaidow and Boey, 2005)* *"...the systematic application of management policies, procedures and practices to the tasks of communicating, establishing the context, identifying, analysing, evaluating, treating, monitoring and reviewing risk" (HB436, 2004)*	Culture; process; structure; direct; management; opportunities; adverse effects Systematic; management; procedures; communicating; consulting; context; identify; analyse; evaluate; treat; monitor; review
CAN/CSA-Q850-97 (Canadian Standards Association)	*"...the systematic application of management policies, procedures and practices to the tasks of analysing, evaluating, controlling, and communicating about risk issues" (CAN/CSA-Q850, 1997, COSO, 2004a)*	Systematic; procedures; analyse; evaluate; control; communicate

Table 3.12: International and national standards definitions of risk management

Similar to the definition of risk discussed earlier, the published definitions of risk management provided by both the ISO and the BSI are inconsistent and debatable. The lack of clarity on the meaning has been highlighted very recently [see (Koskela and Howell, 2002)]. The ISO Guide 73-2002 provided a standardised definition of risk management and subsequently was embraced in BS 31100:2008 (Risk management - code of practice) and BS/ISO 31000:2009 (Risk management: Principles and guidelines). However, this definition was not adopted by ISO/IEC 16085:2006 (Systems and software engineering: Life cycle processes-risk management). Instead, the standard adopted a different definition focusing on systematic steps and looking at it as a continuous process. Three (3) standards published by the BSI were found to utilise the same keywords in defining risk management, except in BS/IEC 62198:2001, where some keywords were not used. The use of the term “tasks” in BS 31100:2008 and BS/IEC 62198:2001 has been replaced by “activities” in BS ISO 31000:2009. Although similar keywords are used in general, some changes, albeit not significant, have been made to the arrangement of these words in the overall definitions. The earliest publication of a standard by the BSI that had a risk management definition was the BS 6079-2:2000 (Project Management- Part 2: Vocabulary). In this standard, the definition of risk management was very much simpler and no review stage was mentioned.

There are three (3) Australian-based standards which were reviewed alongside the ISO and the British Standards, namely, the AS/NZS 4360:1999 (Australian Standard-Risk management); HB 436:2004 (Risk Management Guidelines Companion to AS/NZS 4360:2004), and the Australian Defence Risk Management Framework (DRMF). The term “culture” was used, which indicated that it emphasized the implementation of risk management to be embedded into the organisation. However, there is another definition of risk management to complement the earlier one as it does not describe the mechanisms or the processes of conducting risk management. Therefore, the AS/NZS 4360 further defined it to include the processes and procedures of managing risks. Such a definition was again adopted in the DRMF and HB436 documents.

The Canadian standards (CSA) have a single definition for risk management, which describes its processes clearly. However, the CSA's definition in terms of the processes itself as it does not take into account the task of *"identifying" and "treating"* the risks. In this case, the CSA has ignored the importance of highlighting "treating", "monitoring" and "reviewing" the risks and instead uses the word "controlling" to represent the whole process. On the other hand, although Chapter 11 of PMBOK was specifically written for project risk management, no definition of risk management was found within the standard.

c) National Statute and Governmental Definitions of Risk Management

Ten (10) documents published by government units or departments from three (3) countries were examined, with the majority of them being from the UK. Table 3.13 below provides the different definitions of risk management.

Organisation/ Document	Definition of Risk Management	Identified Keywords
IRMF Treasury Board of Canada Secretariat, (2001)	*"...a systematic approach to setting the best course of action under uncertainty by identifying, assessing, understanding, acting on and communicating risk issues" (Canada, 2001)*	Systematic; action; uncertainty; identify; assess; understand; act; communicate
DoD USA RM Guide Defense Acquisition Guidebook (DAG) (DAU 2011)	*"…the overarching process that encompasses identification, analysis, mitigation planning, mitigation plan implementation, and tracking" [(DoD, 2006a) p.1] (DAU, 2011)* *"…a continuous process that is accomplished throughout the life cycle of a system. It is an organized methodology for continuously identifying and measuring the unknowns; developing mitigation options; selecting, planning, and implementing appropriate risk mitigations; and tracking the implementation to ensure successful risk reduction" [(DoD, 2006a) p.3] (DAU, 2011)*	Process; identify; analyse; mitigate; track. Continuous; organised; identify; measure; mitigate; track; reduce.
COSO- Enterprise Risk Management	*"(Enterprise) risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives" (COSO, 2004b, COSO, 2004a)*	Process; affected; board of directors; strategy; enterprise; identify; manage; assurance; objectives
NASA Procedural Requirements (2002)	*"An organized, systematic decision making process that efficiently identifies, analyses, plans, tracks, controls, communicates, and documents risk to increase the likelihood of achieving program/project goals" (NASA, 2002)*	Systematic; decision-making; identify; analyse; plan; track; control; communicate; document; likelihood; goals

US's Presidential/ Congressional Commission on RA & RM	*"…the process of identifying, evaluating, selecting, and implementing actions to reduce risk to human health and to ecosystems. The goal of risk management is scientifically sound, cost-effective, integrated actions that reduce or prevent risks while taking into account social, cultural, ethical, political, and legal considerations" (Presidential/Congressional-Commission, 1997)*	Process; identify; evaluate; select; implement; reduce
The Orange Book, HM Treasury UK	*"…all the processes involved in identifying, assessing and judging risks, assigning ownership, taking actions to mitigate or anticipate them, and monitoring and reviewing progress" (HM-Treasury, 2004b)*	Process; identify; assess; judge; ownership; mitigate; monitor; review
Strategy Unit, Cabinet Office, UK	*"…all the processes involved in identifying, assessing and judging risks, taking actions to mitigate or anticipate them, and monitoring and reviewing progress" (Strategy-Unit, 2002a)*	Process; identify; assess; judge; act; mitigate; monitor; review
National Audit Office, UK	*"…having in place a corporate and systematic process for evaluating and addressing the impact of risks in a cost effective way and having staff with the appropriate skills to identify and assess the potential for risks to arise" (NAO, 2000)*	Systematic; evaluate; address impact; cost effective; identify; assess.
National Audit Office, UK	*"The systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk. The culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects" (NAO, 2008)*	
OPM (Office for Public Management Ltd) & CIPFA (The Chartered Institute of Public Finance and Accountancy)	*"…a planned and systematic approach to identifying, evaluating and responding to risks and providing assurance that responses are effective" (OPM-CIPFA, 2004)*	Systematic; identify; evaluate; respond; assurance; effective

Table 3.13: Governmental definitions of risk management

The Integrated Risk Management Framework (IRMF) is a 2001 publication of the Treasury Board of Canada Secretariat (Government of Canada). It defines risk management slightly differently, emphasizing that it is an approach to set the best course of action under uncertainty. It looks at the processes as a means of reacting to an uncertain event. It uses the words *"risk issues"*, adopted by the Canadian standards, as discussed earlier.

One of the earliest documents related to risk management was the US White Book, published in 1997 (Presidential/Congressional-Commission, 1997). It included terminologies, such as *"selecting and implementing actions," "reduce risk",* and *"human health and ecosystem"* in its definition. Additionally, it further explained the goal of risk management as part of its definition. Meanwhile, NASA (2002) included risk management and its definition in the Procedural Requirements. Besides providing the steps for the risk management process, it emphasized the importance of increasing the likelihood of achieving the programme or project goals in its definition. On the other hand, in its integrated framework, the US Committee of Sponsoring Organisations of the Treadway Commissions, or COSO, (COSO, 2004b, COSO, 2004a) has looked at risk management from the enterprise point of view, and included business-related terminology in its definition, such as board of directors, management, and strategy. It also emphasized the importance of managing risk within the appetite as well as providing reasonable assurance that the objective was achieved. The US defence published two (2) documents relating to risk management; namely the Risk Management Guide (2006) and the Defence Acquisition Guidebook (2011). In both documents, there were two (2) sets of definitions for risk management. The first was found to be a short and straightforward definition, which described risk management as having the processes of identifying, analysing, mitigating and tracking. It uses the terms *"mitigation planning", "mitigation plan implementation",* and *"tracking",* which were not found in any other documents in this review. The second document defines risk management comprehensively using different terminology, such as *"life cycle of a system", measuring the unknowns",* and *"successful risk reduction".* Having two (2) sets of definitions in one document may indicate that the organisation is not convinced by a single definition of risk management, which in turn makes it difficult for other people using such a document for implementation purposes.

Five (5) documents from the UK were examined from four (4) governmental units or departments, namely, the HM Treasury (2004), the Strategy Unit, the Cabinet Office (2002), the NAO (2000 and 2008) and the Office for Public Management, OPM-CIPFA (2004). In 2002, the Strategy Unit provided its definition of risk management and included terminology, such as *"judging risks", "taking actions",* and *"mitigate or anticipate".* The HM Treasury adopted this definition in its Orange Book in 2004 minus the term *"taking actions"* but adding *"assigning ownership"* as a new term. The

NAO (2000), started by evaluating and addressing the impact of risk; the identifying and assessing of risk being described later, towards the end of the sentence. However, in a latter document (NAO, 2008), the definition of risk management was improved with the inclusion of the terms *“identifying", “analysing", “threat”* and *“monitor”* as well as the further inclusion of risk management as a culture for effective management. The last document reviewed for this category was jointly published by the OPM & CIPFA (2004). It consulted risk management from the public management and financial perspective, placing emphasis upon risk event.

d) Definitions of Risk Management Given by Other Organisations

Another two (2) documents reviewed were the team risk management model published by the Software Engineering Institute (SEI) in 1994 and the risk governance framework (2008), and its white paper (2005) published by the IRGC. The SEI’s definition of risk management differed, focusing on decisions and reaction to risk as a discipline within the environment, but neglecting other important terminology, such as identify and monitor. In its white paper (IRGC, 2005), the IRGC put up a wide-ranging definition of risk management, encompassing the usage of demanding and complicated terminology, especially for the practitioners and non-experts. In 2008, the final document was published, this time with a precise but easier to understand definition.

Organisation/ Document	Definition of Risk Management	Identified Keywords
Software Engineering Institute (SEI)	*“…sets forth a discipline and environment of proactive decisions and actions to assess continuously what can go wrong (risks), determine what risks are important to deal with implement strategies to deal with those risk” (Higuera et al., 1994)*	Discipline; environment; decision; action; assess; risk; strategy
IRGC	*“…involves the design and implementation of the actions and remedies required to avoid, reduce, transfer or retain the risks” (IRGC, 2008b)*	Design; implement; action; remedy; avoid; reduce; transfer; retain.
	“The creation and evaluation of options for initiating or changing human activities or (natural and artificial) structures with the objective of increasing the net benefit to human society and preventing harm to humans and what they value; and the implementation of chosen options and the monitoring of their effectiveness” (IRGC, 2005)	Create; evaluate option; benefit; value; implement option; monitor effectiveness

Table 3.14: Other organisations definitions of risk management

e) Definitions Given by Professional Bodies

Table 3.15 below provides ten (10) documents which are considered as a standard or guideline relating to risk management. Unlike the definition of risk discussed earlier, the APM BOK and its PRAM guideline defined risk management differently. The APM BOK is concerned with the optimization of project success through minimising threats and maximizing opportunities. Meanwhile, the PRAM guideline is more interested in detailing the risk management process itself. However, both documents share a similar point that risk must be understood and managed. PRINCE 2 is another UK-based project management related guideline; its definition of risk management although focusing on the process of managing risk, is not similar to the APMs. The tasks included for managing risks are identifying, assessing, and planning and implementing risk responses. It can be argued that the processes seem to end with risk response without any means to monitor and review the risks.

Achieving sustainable benefits across a portfolio of activities was the motivation to manage risk described by the IRM and FERMA in their standards. Their definitions lacked the mechanisms or the processes as to how risks are managed. On the other hand, the ICB is a competency baseline, which provides a very different definition of risk management. It describes risk management as a warning system, which is very different to any other definition. The PMBOK®, PMAJ or PMCC's P2M, AIPM's competency standard and IEEE's standard share a common understanding in defining risk management. Although not entirely similar, they defined risk management as having a structured process; the term "identify" is found in each definition. This shows that the process of identifying risk is crucial in managing risk. In spite of looking at risk management as a process of minimizing adverse events, the AIPM has gone beyond the norm by incorporating the lessons which have been learnt into the definition.

Institution	Definition of Risk Management	Identified Keywords
APM (APM BOK 5th Ed)	*"…a structured process that allows individual risk events and overall (project) risk to be understood and managed proactively, optimising project success by minimising threats and maximising opportunities" (APM, 2006b)*	Structured; understood; managed; optimise success; threat; opportunities
APM (PRAM)	*"The process whereby project risk is*	Process; understood;

	understood and responses to the risk events are formulated, justified, planned, initiated, progressed, monitored, measured for success, reviewed, adjusted and closed" (APM, 2004)	response; formulate; justify; plan; initiate; progress; monitor; measure; review; adjust; close
PRINCE 2	*"…the systematic application of principles, approaches and processes to the tasks of identifying and assessing risks, and then planning and implementing risk responses" (OGC, 2009)*	Systematic; principles; identify; assess; plan; implement; responses
AIRMIC/ALARM/IRM, FERMA	*"…the process whereby organisations methodically address the risks attaching to their activities with the goal of achieving sustained benefit within each activity and across the portfolio of all activities" (FERMA, 2003, IRM/AIRMIC/ALARM, 2002)*	Process; sustain benefit; activity; portfolio
IPMA (ICB)	*"…an early warning system for the organisation to give it timely and accurate information to prepare management interventions when needed" (IPMA, 2006)*	Warning; timely; accurate information; intervention
PMI (PMBOK®)	*"…the process concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project…" (PMI, 2004)*	Process; plan; identify; analyse; response; monitor; control
PMAJ (PMCC) P2M	*"…the management process to identify and evaluate project risks from program and project schemes and plans and to devise and initiate most appropriate responses thereto in order to raise project visibility" (Ohara, 2002)*	Process; identify; evaluate; response; project visibility
AIPM	*"…the processes concerned with identifying, analysing and minimising the consequences of adverse events. The risk management process is completed through review of the plan and recording of lessons learnt" (AIPM, 2008b)*	Process; identify; analyse; consequences; review; record; lessons learnt
IEEE Standard for Software Life Cycle Processes - Risk Management	*"A continuous process for systematically identifying, analysing, treating, and monitoring risk throughout the life cycle of a product or service" (IEEE, 2001)*	Process; systematic; identify; analyse; treat; monitor; life cycle

Table 3.15: Professional bodies definitions risk management

3.3.4 A Summary of the Definitions of Risk Management

Based on the above reviews, the definition of risk management varies from one publication to another. However, there were some similarities in terms of the processes involved and the way risk management was described. Table 3.16 provides a summary of keywords and terminologies used in defining risk management. Using this table, risk management has been found to be about:

- systematic/structured/coordinated/disciplined/directed/controlled processes
- identifying, analysing, evaluating, treating, monitoring or tracking, reviewing, the risks

Additionally, the definition of risk management may include the following:

- continuous process, a culture or environment to achieve context, goals or objectives
- a process of making decision, communicating or consulting

Keyword from the Definitions of Risk Management	Name of Author	Name of Standard/ Document	Name of Governmental Unit/ Department	Name of Organisation	Name of Institution/ Society
Systematic/ Structure/ Coordinated / Disciplined Processes	Cooper et al. (2005) Edward & Bowen (1998)	PD ISO/IEC Guide 73:2002 BS ISO 31000:2009 BS 31100:2008 ISO/IEC 16085:2006 BS 6079-2:2000 AS/NZS 4360:1999 HB436:2004 DRMF 2005 CSA 1997	IRMF Canada 2001 DoD 2006 DAU 2011 US White Book 1997 NASA 2002 COSO 2004 HM Treasury 2004 Strategy Unit 2002 NAO 2000 NAO 2008 OPM CIPFA 2004	SEI 1994	APM BOK 2006 PRAM 2004 PRINCE 2009 IRM 2002 FERMA 2003 PMBOK 2004 P2M 2002 AIPM 2008 IEEE 2001
Continuous		ISO/IEC 16085:2006 BS/IEC 62198:2001 BS 6079-2:2000			
Direct/ Control		PD ISO/IEC Guide 73:2002 BS ISO 31000:2009 BS 31100:2008 BS/IEC 62198:2001 AS/NZS 4360:1999 HB436:2004 DRMF 2005 CSA 1997	NASA 2002 NAO 2008		PMBOK 2004
Context/ Goal/ Objective	Edward & Bowen (1998)	BS ISO 31000:2009 BS 31100:2008 AS/NZS 4360:1999 HB436:2004 DRMF 2005			
Culture/ Environment	Cooper et al. (2005)	AS/NZS 4360:1999 HB436:2004 DRMF 2005	NAO 2008	SEI 1994	
Identify	Edward & Bowen (1998)	ISO/IEC 16085:2006 BS ISO	IRMF Canada 2001 DoD 2006 DAU 2011		PRINCE 2009 PMBOK 2004 P2M 2002

		31000:2009 BS 31100:2008 BS/IEC 62198:2001 BS 6079-2:2000 BS 6079-2:2000 AS/NZS 4360:1999 HB436:2004 DRMF 2005	US White Book 1997 NASA 2002 COSO 2004 HM Treasury 2004 Strategy Unit 2002 NAO 2000 NAO 2008 OPM CIPFA 2004		AIPM 2008 IEEE 2001
Analyse	Edward & Bowen (1998)	ISO/IEC 16085:2006 BS ISO 31000:2009 BS 31100:2008 BS/IEC 62198:2001 BS 6079-2:2000 BS 6079-2:2000 AS/NZS 4360:1999 HB436:2004 DRMF 2005 CSA 1997	DoD 2006 DAU 2011 NASA 2002 NAO 2008		PMBOK 2004 AIPM 2008 IEEE 2001
Evaluate		BS ISO 31000:2009 BS 31100:2008 BS/IEC 62198:2001 BS 6079-2:2000 BS 6079-2:2000 AS/NZS 4360:1999 HB436:2004 DRMF 2005 CSA 1997	US White Book 1997 NAO 2000 NAO 2008 OPM CIPFA 2004	IRGC 2005	P2M 2002
Assess			IRMF Canada 2001 HM Treasury 2004 Strategy Unit 2002 NAO 2000	SEI 1994	PRINCE 2009
Treat		ISO/IEC 16085:2006 BS 31100:2008 BS/IEC 62198:2001 BS 6079-2:2000 BS 6079-2:2000 AS/NZS 4360:1999 HB436:2004 DRMF 2005	NAO 2008		APM BOK 2006 IEEE 2001
Mitigate			DoD 2006 DAU 2011 HM Treasury 2004 Strategy Unit 2002		
Monitor/ Track	Edward & Bowen (1998)	ISO/IEC 16085:2006 BS ISO 31000:2009 BS 31100:2008 BS/IEC 62198:2001 BS 6079-2:2000 BS 6079-2:2000 AS/NZS 4360:1999 HB436:2004	HM Treasury 2004 Strategy Unit 2002 NAO 2008 DoD 2006 DAU 2011 NASA 2002	IRGC 2005	PRAM 2004 PMBOK 2004 IEEE 2001

		DRMF 2005			
Review	Edward & Bowen (1998)	BS ISO 31000:2009 BS 31100:2008 BS/IEC 62198:2001 AS/NZS 4360:1999 HB436:2004 DRMF 2005	HM Treasury 2004 Strategy Unit 2002		PRAM 2004 AIPM 2008
Decision-making/ Decision	Edward & Bowen (1998)		NASA 2002 SEI 1994		
Opportunity	Cooper et al. (2005)	AS/NZS 4360:1999 HB436:2004 DRMF 2005			APM BOK 2006
Effect	Cooper et al. (2005)	AS/NZS 4360:1999 HB436:2004 DRMF 2005	COSO 2004		
Life Cycle		ISO/IEC 16085:2006			IEEE 2001
Communicating		BS ISO 31000:2009 BS 31100:2008 AS/NZS 4360:1999 HB436:2004 DRMF 2005 CSA 1997	IRMF Canada 2001 NASA 2002		
Consulting		BS ISO 31000:2009 BS 31100:2008 AS/NZS 4360:1999 HB436:2004 DRMF 2005			
Understand/ Understood			IRMF Canada 2001		APM BOK 2006 PRAM 2004
Act/ Action			IRMF Canada 2001 US White Book 1997 Strategy Unit 2002 SEI 1994	IRGC 2008	
Select			US White Book 1997		
Implement			US White Book 1997	IRGC 2005	PRINCE 2009
Reduce/ Prevent			US White Book 1997		
Plan			NASA 2002		PRAM 2004 PRINCE 2009
Likelihood			NASA 2002		
Appetite			COSO 2004		
Assurance			COSO 2004 OPM CIPFA 2004		
Strategy			COSO 2004 SEI 1994		
Judge			HM Treasury 2004 Strategy Unit 2002		
Ownership			HM Treasury 2004		
Address			NAO 2000		
Respond/ Response			OPM CIPFA 2004		PRAM 2004 PRINCE 2009

					PMBOK 2004 P2M 2002
Remedy				IRGC 2008	
Avoid				IRGC 2008	
Transfer				IRGC 2008	
Retain				IRGC 2008	
Close					PRAM 2004
Adjust					PRAM 2004
Measure					PRAM 2004
Lessons learnt					AIPM 2008

Table 3.16: Summary of keywords and terminology used to define risk management

3.3.5 Definitions of Uncertainty

The Concise Oxford Dictionary defines uncertain as *"Not certainly knowing or known; not to be depended on; changeable…"* (Sykes, 1977). This means that uncertainty only happens when there is a lack of knowledge regarding what the future holds. A review of the US White Book showed that although no specific definition of uncertainty was found in the document, uncertainty was said to result from partly known or unknowable information [(Presidential/Congressional-Commission, 1997), p.88]. Further investigations were made regarding other standards and guidelines, and the research found that unlike risk, uncertainty has not been broadly defined in most of the documents. Table 3.17 indicates that only seven (7) documents provide their specific definition of uncertainty.

Organisation	Definition of Uncertainty	Identified Keywords
BS ISO 31000:2009	*"...the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood"[(BS-ISO-31000, 2009)p.2]*	Deficiency; information; knowledge; consequences; likelihood
APM BOK 2006	*"...a state of incomplete knowledge about a proposition. Usually associated with risks and opportunities" [(APM, 2006b)p.163]*	Incomplete; knowledge; risk; opportunity
HM Treasury-Orange Book 2005; Green Book 2003	*"...the condition in which the number of possible outcomes is greater than the number of actual outcomes and it is impossible to attach probabilities to each possible outcome" [(HM-Treasury, 2005)p.8; (HM-Treasury, 2003)p.105]*	Outcome; impossible to attach probability;
CIRIA 2005	*"...vagueness or ambiguity inside or outside the project that leads to insecurity about values or risks or project objectives" [(Weatherhead et al., 2005) p.13]*	Vagueness; ambiguity; insecurity; risk; objectives
CMU-SEI 1994	***"…**an event may or may not happen" (Higuera et al., 1994)*	Event; may or may not happen

Canada DRDC 2007	*"...the degree of variability in the possible values associated with an event" (Mandel, 2007b)*	Variability; values
IRGC 2008	*"...a lack of clarity or quality of the scientific or technical data"[(IRGC, 2008b)p.16]*	Lack of clarity; data

Table 3.17: Definitions of uncertainty by various organisations

The earlier discussions prove that the term uncertainty has been associated with the definition of risk itself in a number of documents through the usage of the terms "consequence" and "likelihood". The research argues that uncertainty should not be misconstrued as risk and thus, associating risk in it terminologies is contradictory to K-K propositions. However, the research found a twofold definition of uncertainty in a number of documents. For example, the APM BOK (2006), BS 31000, CIRIA (2005) and the Canadian Government described uncertainty as a lack of knowledge, incomplete information or ambiguity, this is in agreement with K-K propositions.

On the other hand, the Orange Book (2005) and Green Book (2003) justify the belief that uncertainty does not involve mathematical probabilities, and thus, should not be misconstrued as risk. These documents emphasise that the magnitude the future outcomes may be greater than estimated, thus it is not possible to assign probabilities.

3.3.6 A Summary of the Definitions of Uncertainty

Based on the above discussions, the definitions of uncertainty are summarised in Table 3.18. The table identifies uncertainty as about:

- deficiency, incomplete, vagueness, ambiguity, insecurity, variability and lack of clarity of information, knowledge, values or data

Additionally, the definition of uncertainty may include the following:

- consequences and likelihood and of an event to happen
- risk and opportunity
- impossible to attach probability

Keyword from the Definitions of Uncertainty	Name of Author	Name of Standard/ Document	Name of Governmental Unit/ Department	Name of Organisation	Name of Institution/ Society
Deficiency/ Incomplete/ Vagueness/ Ambiguity/ Insecurity/ Variability/ Lack of clarity	N/A	BS/ISO31000:2009	DRDC 2007	CIRIA 2005 IRGC 2008	APM 2006
Information/ Knowledge/ Values/ Data	N/A	BS/ISO31000:2009	DRDC 2007	IRGC 2008	APM 2006
Consequences/ Likelihood/ Outcome	N/A	BS/ISO31000:2009	HM Treasury 2005 HM Treasury 2003	CMU-SEI 1994	N/A
Risk	N/A	N/A	N/A	CIRIA 2005	N/A
Opportunity	N/A	N/A	N/A	N/A	APM 2006
Impossible to attach probability	N/A	N/A	HM Treasury 2005 HM Treasury 2003	N/A	N/A

Table 3.18: Summary of keywords and terminology used to define uncertainty

The research found that definitions of uncertainty are still lacking and that it is not given fair attention in most documents. Only eight documents provided a definition of uncertainty whilst the majority of the documents associated uncertainty with risk in many ways; this is described as follows:

a) Risk results from uncertainty.

P2M asserts that a project is affected by the presence of uncertainty [see (Ohara, 2002, Ohara, 2005)]. It argues that uncertainty causes risk due to unclear information, thus it requires appropriate measures to manage risks. Besides that, BS ISO 31000:2009, BS EN ISO 17666:2003 and PRAM (2000:p.3) indicate that uncertainty produces an exposure to risk.

b) Risk and uncertainty can be quantified.

The affiliation of risk and uncertainty continues to be discussed and practiced by many organisations; such practice has been documented in the standards and guidelines [see (Presidential/Congressional-Commission, 1997) (Ohara, 2005) (BS-EN-ISO-17666, 2003)]. For example, the P2M claimed that quantifying risk and uncertainty are regarded as one of the project objectives, whilst the US White Book argued the unlikelihood in ranking risks without quantifying uncertainty.

c) Risks are subject to uncertainty.

There are multiple versions of risk definitions, indicating that risk is characterised and associated directly to uncertainty [see (HM-Treasury, 2005, HB436, 2004, HM-Treasury, 2003)]. The considerations of the effect of uncertainties are indispensable, despite the fact that appropriate measures have been taken to manage risk.

d) Risk as similar to uncertainty, having negative and positive aspects.

There are at least four standards or guidelines which claim that both risk and uncertainty are inherent in projects and include positive and negative features [see (BS6079-1, 2010, BS-ISO-10006, 2003, BS-EN-ISO-17666, 2003, COSO, 2004a)]. Positive aspects are opportunities while negative aspects are risks or threats. The difference is that risk is managed to minimise the negative impact and maximize the opportunity for enhancement, whereas uncertainty can be accepted. The standards did not testify as to how uncertainty is managed. This demonstrates that although risk is said to be similar to uncertainty, the management of the concepts are not normalised.

The lack of knowledge to justify any action which can be taken complicates the process of managing uncertainty. Two standards; namely, The US White Book and BS 31100:2008 argued that risk management is able to address risk and uncertainty through its structured process. Risk management processes were found to be the basis in managing uncertainty, due to the various exposures, such as financial and social.

3.4 Project Risk Management (PRM)

In the late 1950s, scheduling and risk management tools were acquired to assist in planning. The concept of risk management became evident in the 1980s and was extended into the management of projects [see (Morris, 1997, Winch, 2007)]. Kähkönen (2006) argued that risk management is gradually being acknowledged as a research and development topic relating to project management. Besides that, significant research has been conducted on the upper side of risk management as well as its downside; In 2004, Winch (2007) asserted that David Hillson presented the idea of opportunity management as the upside or positive side of the EU, where one has to think as to what benefit should be gained from the risk under study. The role of risk management for projects is to improve project performance through systematic identification, appraisal and management of project-related risk (Chapman and Ward, 2003).

This section provides a broad view of PRM, including its conceptual processes. It examines the various approaches to the risk management process, particularly in relation to project management. These processes are derived from existing standards, frameworks, and guidelines. These processes will be compared with others, in terms of the steps and stages to study the similarity and differences. This section will also briefly discuss the available tools and techniques for PRM.

3.4.1 The Rise of PRM

The concept of governance was introduced within corporate risk management practices in the 1990s as a result of the growing interest in the insurance and banking sectors since the 1970s [see (McHugh and Hogan, 2011)]. Consequently, the development of corporate governance has led to the introduction of various codes for government, such as the Cadbury Report (1992), the Greenbury Report (1995), the Hampel Report (1998), the Turnbull Report (1999), OECD Principles of Corporate Governance (1999), EASD Principles and Recommendations (2000) and the Sarbanes-Oxley Act (2002), particularly in the UK, in other European nations and in the USA. These codes were developed to improve governance and control by enhancing the accountability and responsibility of companies to stakeholders value, performance and competitiveness (Cleland and Ireland, 2002a). This has resulted in the establishment of risk management standards by various standards organisations and guidelines, or best practices by governmental bodies such as the Strategy Unit, Cabinet Office and, HM Treasury (UK), NASA and DoD (USA), the treasury Board of Canada Secretariat.

At present, the concept and application of PRM are acknowledged as a main element of project management (Kähkönen, 2006). Additionally, Cooper et al. (2005) claimed that it had become a significant topic and has been actively addressed by many governmental agencies and professional project management associations. For example, in the UK, it started in 1985 when the Ministry of Defence (MoD) instructed all defence projects and programmes to use a formal approach to risk management (Hillson, 2012). According to Grimaldi *et al* (2012), the contributions towards risk management for projects have started since the1990s, focusing on the establishment of it processes. This includes the Project Uncertainty Management (PUMA), the Multi-Party Risk Management Process (MRMP), the Shape, Harness and Manage Project Uncertainty (SHAMPU), the Two Pillar Risk Management (TPRM), the Project Risk Analysis and Management (PRAM), the Risk Analysis and Management for Projects (RAMP) and the Active Threat and Opportunity Management (ATOM).

In Hillson (2012), Peter Simon highlights that the perception of risk as purely downside has changed with the publication of the revised PRAM guide, published in 1997, which documented that risk has its positive side - known as opportunity. The same year saw the publication of the PRM book by Chapman and Ward that was restructured to adopt PRAM, followed by the publication of PMBOK guide from PMI. In 1998, RAMP, which took a whole life cycle perspective, was published. These guides have been revised accordingly to reflect the development of knowledge and the changes in management practices. For example, in 2000, the PMBOK's risk process was revised to be consistent with PRAM guidelines. Meanwhile, the UK government has considered the management of project risk and opportunity in its Management of Risks (MoR) guide, which was introduced in 2002 [see OGC, 2002].

The purpose of PRM is to obtain better project outcomes in relation to the project's schedule, costs and performance (Cooper et al., 2005a). The APM (2006a) asserts that PRM manages both, the individual risk and the overall project risk, in order to optimize project success by maximizing opportunities and minimizing threats. The process of PRM is more than just the process of identifying, analysing and treating and monitoring the risks; it has become a comprehensive management approach, important to the process of project management. In fact, it has become an integral part of the project management body of knowledge (APM, 2006a, PMI, 2004).

The fundamental to PRM is that there is a real project plan that can be implemented, perhaps with certain mitigation. Loch et al. (2006) argued that PRM pre-plans contingencies and flexibility around the project plan, and hence, this approach only works with identified risks and does not address novel or innovative projects, in which unforeseeable uncertainties may appear. Additionally, Loch et al. (2006) observed that the PRM approach works on known probabilities and the foreseeable range of things that can happen, and through PRM, the project team can improvise the project plan when unforeseen events arise.

3.4.2 The Need for PRM

As discussed earlier in this chapter, it has been argued that projects are temporary, unique by their nature, and have clear or defined objectives. Therefore, in order to achieve project goals or objectives, the APM (2004) emphasized the use of risk management as an integral part of good management practice. According to Cooper et al. (2005), risk management minimized the risk of not achieving objectives by providing insight, knowledge and confidence in making decisions through a structured framework. Cooper et al. (2005, p.2) reported that many managers undertake such activities, but do not use the term 'risk', and yet, still achieve a successful outcome. However, they added that this could not be generalized, as poorly managed project risks may have a negative impact upon the achievement of project objectives. Therefore, it is important that organisations adopt a consistent framework for better management of project risks and promote transparency and effective communication within project organisations. The PRAM guide (APM, 2004) placed emphasis on ‘project risk’ rather than risk, stating that it is an accumulated joint effect of a number of risk events and other sources of uncertainty.

Risk management has become a critical element in strategic planning for parties involved in new relationships and patterns of service provision (Cooper et al., 2005a). According to Cooper et al., it also supports consistent and justifiable decision-making, as well as generating an audit trail of the documented information. The rationale of PRM is to ensure that all significant risks are identified and understood in terms of their potential consequences and likelihood; their priority settings are assessed while resources are allocated, and their treatment strategies are implemented cost-effectively [(Cooper et al., 2005a), p.13].

3.4.3 The Process of Managing Risks

Mainstream risk management provides four basic or conceptual steps, namely; risk identification, risk assessment, risk response, and risk review and risk monitoring. However, these steps may vary depending on individual or organisational use. For example, the INSEAD team introduced their terminology – identify, classify, manage and embed – into the system (Loch et al., 2006). Meanwhile, Cooper et al. (2005, p.3) adopted a different approach, dividing the process into three key elements for effective management of risks: the core process, which consisted of identifying, analysing, assessing, developing plans to manage them; the allocation of responsibility to risk owners, the party that can manage the risks well; and the assurance that the costs incurred to manage the risks were proportionate to the importance of the project.

Based upon the review made on the literature related to PRM, the process for managing risks involves systematic management activities, which includes risk identification, risk analysis, risk evaluation, risk treatment and risk monitoring and control.

a) Risk Identification

Identification is the process of determining what, how and why things happen (Cooper et al., 2005b), as well as documenting their characteristics (PMI, 2004).

b) Risk Analysis

The systematic use of available information to determine the magnitude and consequences of an event should it occur; it usually involves a variety of modelling and mathematical techniques (Cooper et al., 2005b). It is also a process of prioritising risks and numerically analysing the effects on the overall project objectives (PMI, 2004).

c) Risk Evaluation

Risk evaluation is a process of determining the tolerable level of risk. The input helps develop responses for treating risks according to their priority (Cooper et al., 2005b).

d) Risk Treatment

In this stage the information, gathered and developed earlier, will be used to establish responses and implement them appropriately according to the significance and importance to the project (Cooper et al., 2005b).

e) Risk Monitoring and Control

According to the PMI's PMBOK (2004), this is the stage whereby risks are tracked to monitor the residual risks, as well as identifying new risks, thus the process is continuous.

3.4.4 Various Approaches to the PRM Process

The development of scheduling and risk management tools has led to the application and practice of risk management for projects since the 1950s (Morris, 1997) and the principles have been applied within the area of the management of projects (Winch, 2007). Since then, the application of risk management has developed due to the growing importance of planning and the complexity of projects (Raz and Hillson, 2005), which has led to the development of standards, frameworks, and guidelines to promote its practices. These documents are intended to help the organisations and the industry to adopt and implement risk management principles for their organisations. The research reviewed fifteen (15) different documents, which are used to manage risk for projects. These documents include national and international standards (AS/NZS 4360, BS 6079-3, BS/IEC 62198, BS/ISO 31000, IEEE Std. 1540, ISO/IEC 16085, and CAN/CSA-Q850-97), project and project management related risk management guidelines (PRM Guidelines, PMBOK, PRAM Guide, RAMP, CMU/SEI-94-SR, and NASA NPR 8000.4A), and two other guidelines (MoR and DoD). MoR provides a generic yet comprehensive process of risk management which can be used at strategic, programme, project and operational level and therefore suitable to be included in this comparison. The DoD publishes its risk management process as guidance for the acquisition process. Although it is mainly used for acquisition programme, it specifies risk management is an important project management decision-making and therefore relevant for this research.

a) AS/NZS 4360

The AS/NZS 4360 is a generic standard, which is readily applied to various sectors or industries, such as defence [see (Gaidow and Boey, 2005)]. However, it only describes an overall approach to risk management, and, nothing is mentioned about project-specific issues (Cooper et al., 2005a).

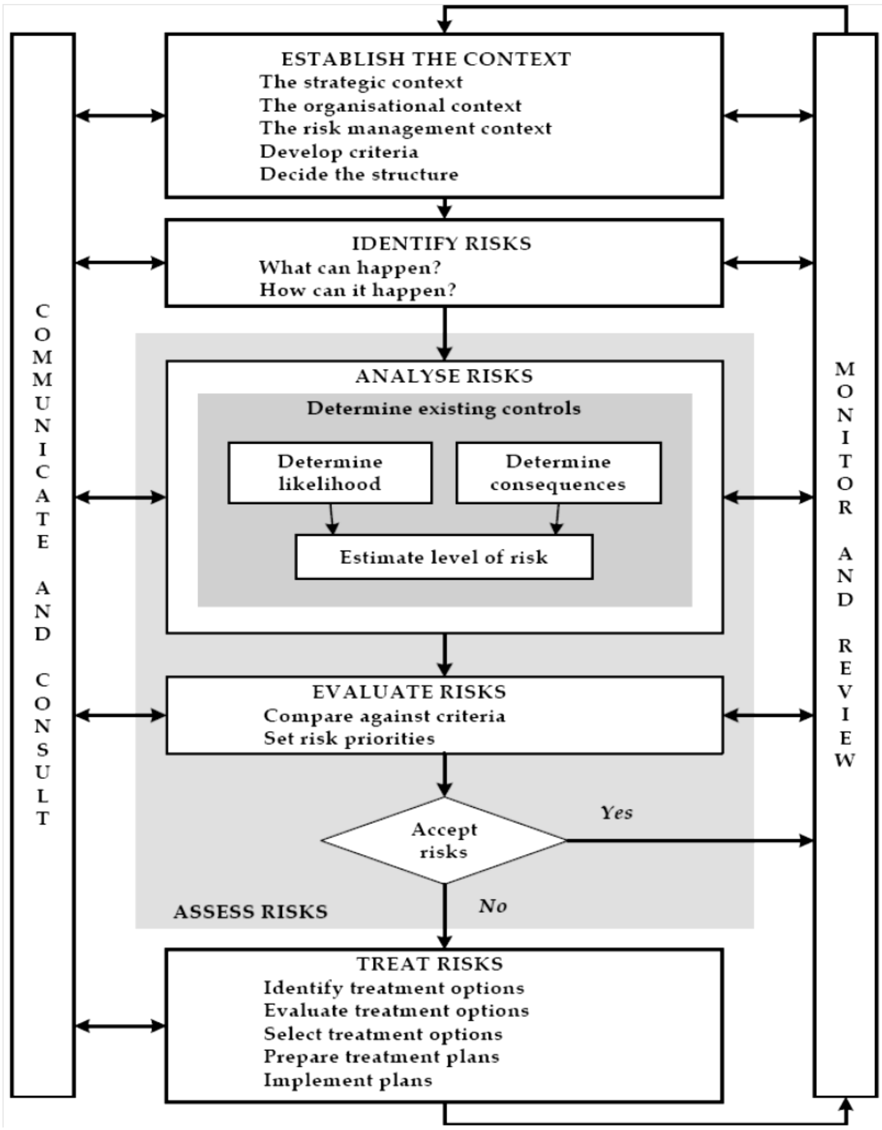


Figure 3.1: AS/NZS 4360:1999 - Risk Management Process
Source: (Flyvbjerg et al., 2005, AS/NZS-4360, 1999)

b) PRAM Guide

This guideline has been formulated by a team of academics, consultants and practitioners and was written within a fully integrated project management environment. According to Cooper et al. (2005), the PRAM guide is a stand-alone guideline which connects the risk management process with detailed techniques or methods. The PRAM guide (APM, 2004) clearly states that although the process can be implemented at different levels of detail, it all depends on the degree of maturity of organisational risk capability. It also provides details of the techniques of PRM; but it includes detailed tasks and activities of projects. It guides project managers throughout the project life cycle, with direct communication to management. In this guide, the term 'project risk' is used rather than only 'risk', as an accumulation of a number of individual risk events and other sources of uncertainty. Therefore, it is the project risk that has to be focused on at the overall project level (APM, 2004).

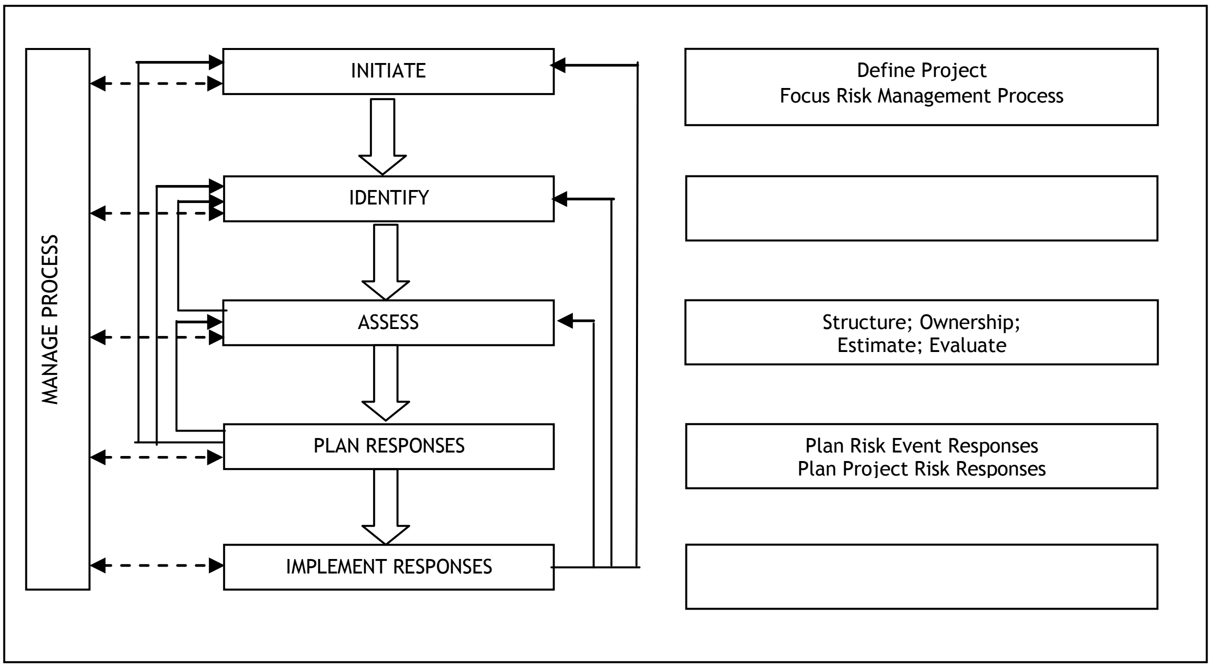


Figure 3.2: PRAM Guide: risk management process. *Source: (APM, 2004)*

c) PMI PMBOK®

PMBOK® is a set of project management standards and best practices of which PRM is central, to guide project managers regarding detailed techniques and processes. It is one element of the knowledge areas in project management, integrating management process and risk into comprehensive and detailed techniques as guidance for all projects. The process consists of six steps: namely, RM planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control. Chapter 11 of PMBOK® provides details of the PRM process, which details a structured framework for practitioners (Cooper et al., 2005a), presented as a flow diagram. However, although explicitly identified as PRM, there is no specific definition of risk management found in PMBOK®. Cooper et al. (2005) criticizes this standard, in that the details of risk management are unclear compared to the AS/NZS 4360, and its qualitative risk analysis and quantitative risk analysis are not directly linked.

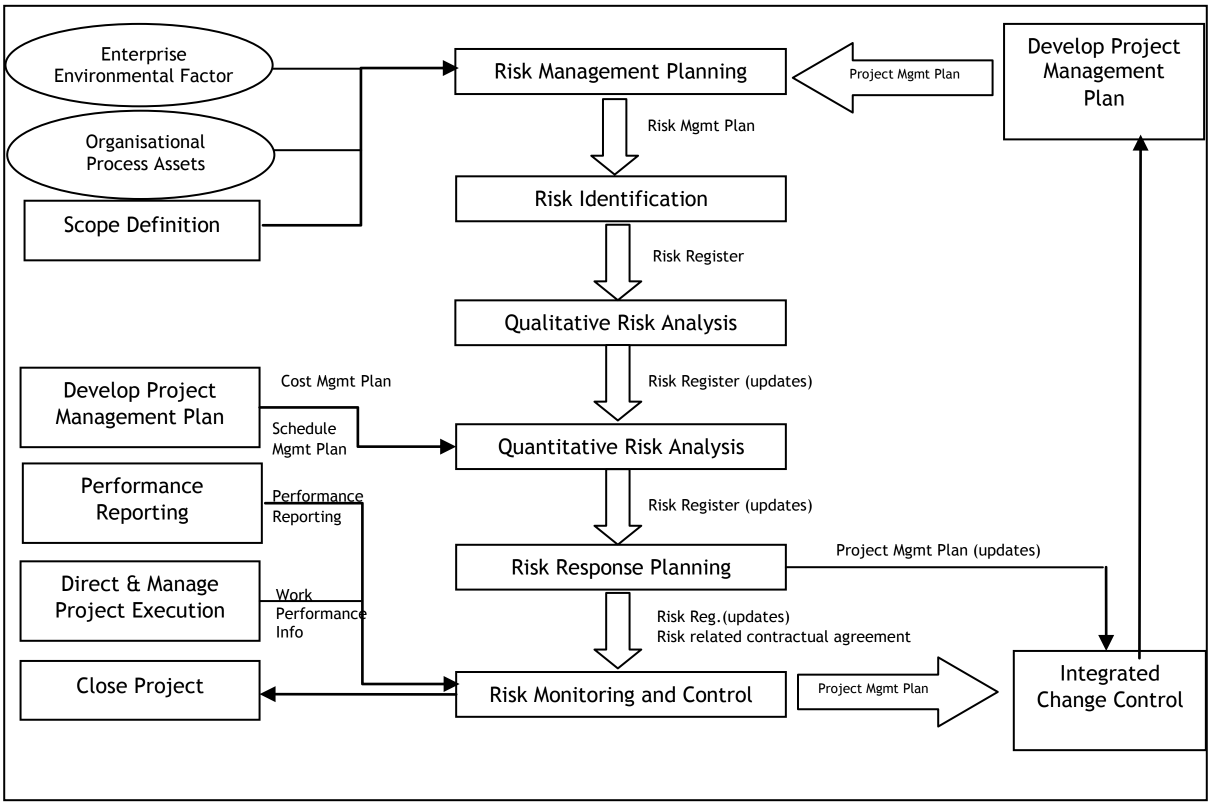


Figure 3.3: PRM Process Flow *(Source: PMI, 2004)*

d) RAMP- Risk Analysis and Management for Projects

RAMP is a joint publication of the Institution of Civil Engineers (ICE), the Faculty of Actuaries and the Institute of Actuaries. The idea of RAMP is based on evidence from a survey by the Confederation of British Industry in 1994 (ICE et al., 2002), which reported that only a quarter of the manufacturing industry assessed risks quantitatively, whilst the majority relied on subjective judgement. RAMP methodology involves a systematic risk management process in capital investment projects throughout the life of a project; divided into four activities; namely, process launch, risk review, risk management, and process close-down. RAMP criticizes the other existing approaches inasmuch as they are inadequate in following through from analysis to the control stage once the projects are implemented; they also concentrate on asset creation rather than higher risks in any stages, such as operating (p.10). The other approaches focus on easily quantified risks, without proper judgement, with little attention to changing risk exposure. They have an unsatisfactory method of combining risks, and are inconsistent in analysing and dealing with risks for differing projects (p.10). Although RAMP has described the process under four main activities with various sub-activities within each activity, it is very unusual to have risk review and risk management as separate activities. In addition, the risk review itself consists of risk management activities, such as: identify, evaluate, mitigate, assess, plan response and communicate mitigation strategy. In the risk management activity, the RAMP framework includes implementing strategy and plans, and controlling risks. The process ends at process close-down, whereby the investment outturn has been assessed, and the process has been communicated.

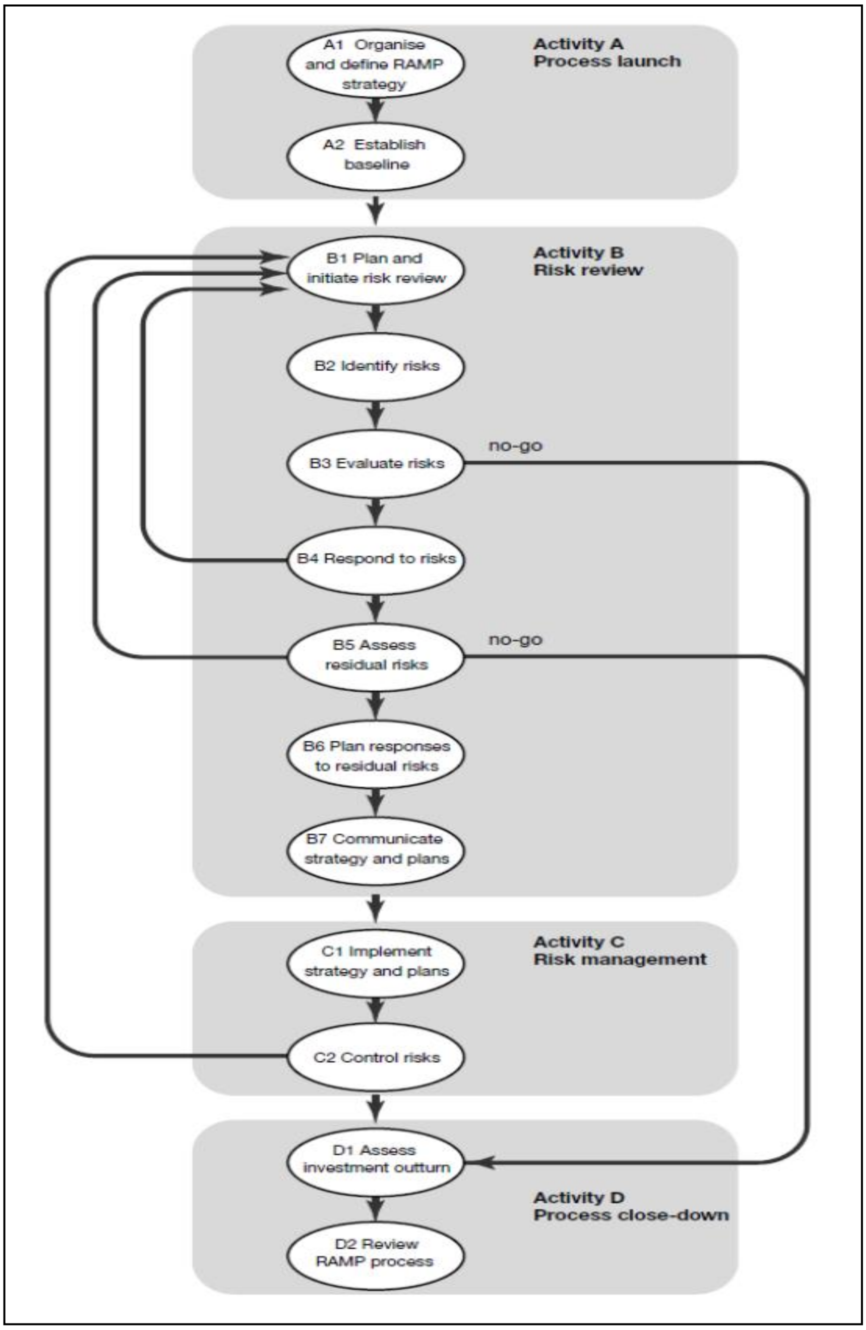


Figure 3.4 : RAMP process flowchart *(Source: (ICE et al., 2002))*

e) MoR – Management of Risk Framework

Formerly owned by the UK's OGC, MoR is now jointly owned by the Cabinet Office and AXEOLS. First published in 2002, MoR targets public sector organisations and is viewed from four perspectives: strategic, programme, project, and operational. Additionally, its strategic approach to risk management includes governance, recognising that it is a subset of any organisation's internal control (OGC, 2007a).

Cooper et al. (2005) highlighted that MoR is similar to PRAM guides, which separates detailed implementation from specific tools and methods; its wide coverage found to be as good as the PRAM guide. MoR is one of the renowned sub-brands of the Best Management Practice, other than PRINCE2, MSP, MoP, MoV, P3O and, P3M3. OGC was the owner of these products since 2000 and, in June 2010, the UK's government announced a reorganisation of which the custodian moved to the Cabinet Office[5]. MoR is developed with four main processes, which are: identify, assess, plan, and implement, these are presented in the form of circling arrows. Communication is placed in the middle as it is the key to the successful implementation of MoR (OGC, 2007a), communicating all activities and the findings to the higher level (see Figure 3.5).

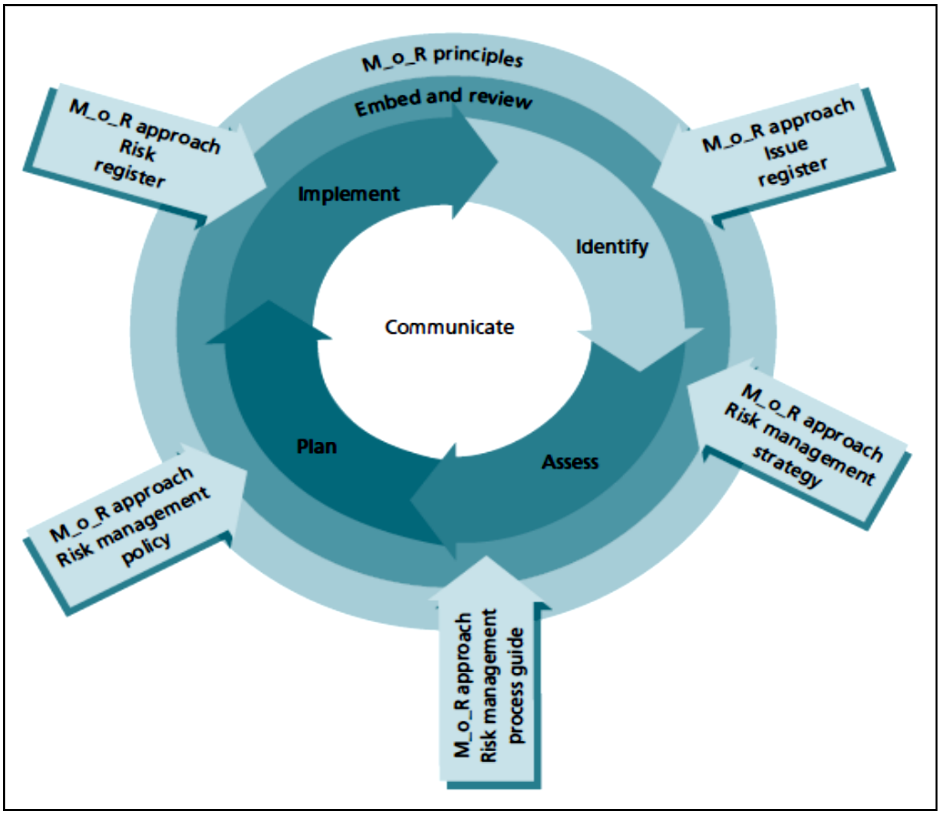


Figure 3.5: MoR framework *[Source: (OGC, 2007a) p.4]*

[5] Best Management Practice (http://www.best-management-practice.com/About-Us/), accessed 29/08/2013.

f) *BS 6079-3:2000 – Project Management – Part 3: Guide to the Management of Business-Related Project Risk*

This standard is one of the three-part standards on project management, published by the BSI. It describes the process of managing risks through a framework that can be applied to any business activity, presented in a schematic form, with a generic question to be asked at each stage as guidance [see (BS6079-3, 2000)]. This standard also discusses the levels of decision making; namely strategic, tactical, and operational. The standard has six stages, categorised into two broad phases. The first concentrates on defining the scope and identifying the risks whilst the second is about assessing, treating and communicating. Unlike other approaches, this standard provides treatment strategies, not only for threats but also for opportunities, considered as measures to ensure that opportunities occur. The measures are facilitating, involving facilitators, enhancing likelihood, and enhancing consequences.

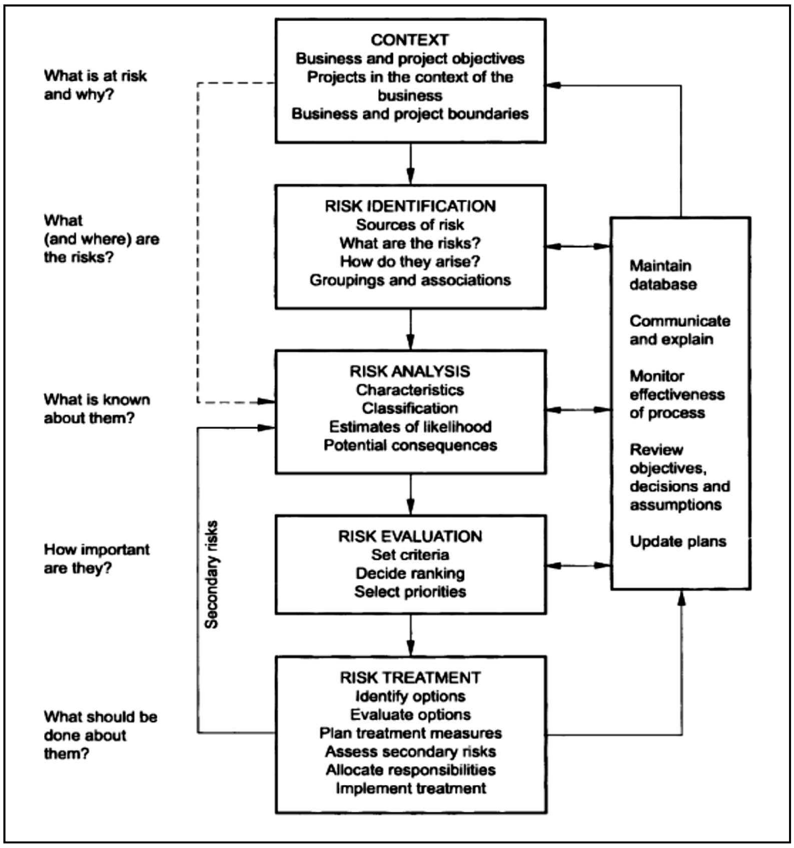


Figure 3.6: The risk management process *[Source:(BS6079-3, 2000)]*

g) BS IEC 62198:2001 - Project Risk Management

BS IEC 62198:2001 is a specific standard for project risk management and its application; although applicable to any project with technological content, it does not include safety-related issues [see (BS/IEC-62198, 2001)]. The standard provides a holistic view of the PRM process and sub-processes, including the factors which influence the processes. It also stresses the importance of open communication for effective and successful risk management. The standard is similar to AS/NZS 4360:1999 and the process is used by Cooper's PRM guidelines [see (Cooper et al., 2005a)]. Figure 3.7 provides a summary of the PRM process by BS IEC 62198:2001.

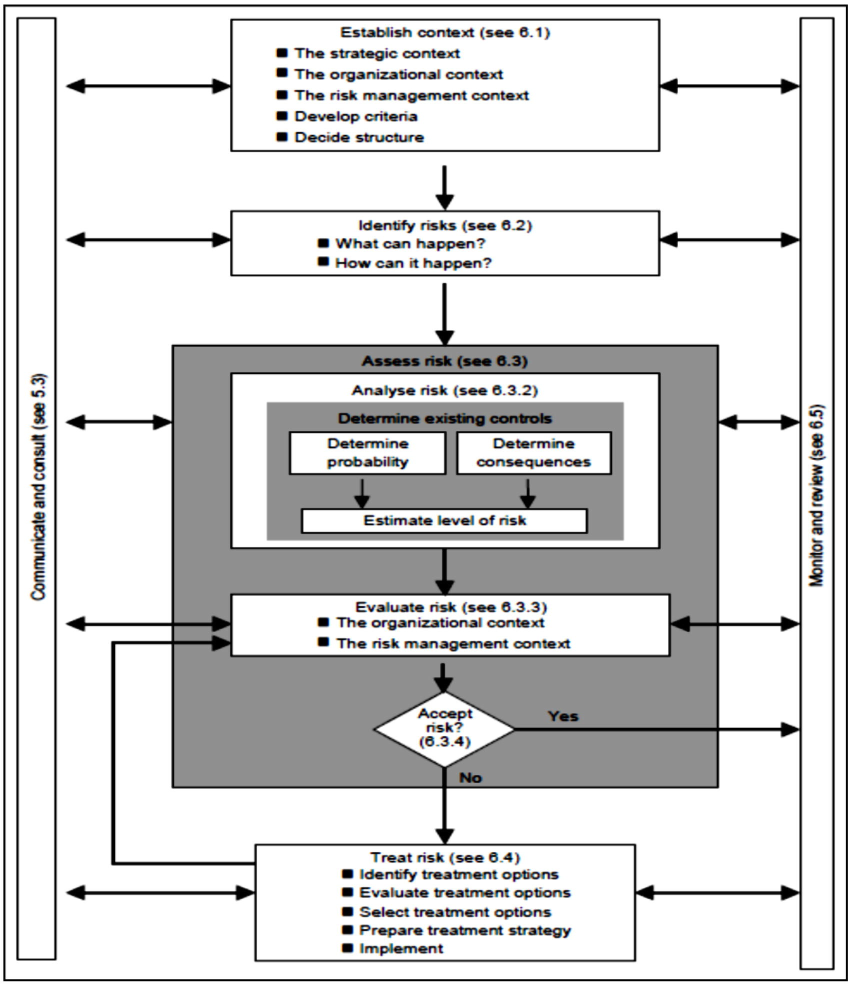


Figure 3.7 : Project risk management summary *[Source:(BS/IEC-62198, 2001)]*

h) BS ISO 31000:2009 – Risk Management – Principles and Guidelines

This is the latest risk management standard published by the ISO, it is very generic and is applicable to any sector or industry, regardless of the type of risk. However, although it is non-specific, the standard does not promote a single format of risk process. Figure 3.8 shows the risk management process by BS ISO 31000:2009. The process is similar to AS/NZS 4360:1999, BS IEC 62198:2001 and the PRM guidelines. The standard also mentions that its publication harmonizes existing standards and guidelines with common approaches and techniques to deal with risks. However, the only difference is that instead of clustering around the analysis and evaluation stage as risk assessment, this standard has included identification within the same cluster. This means that risk assessment is the overall process of identifying, analysing and evaluating the risk.

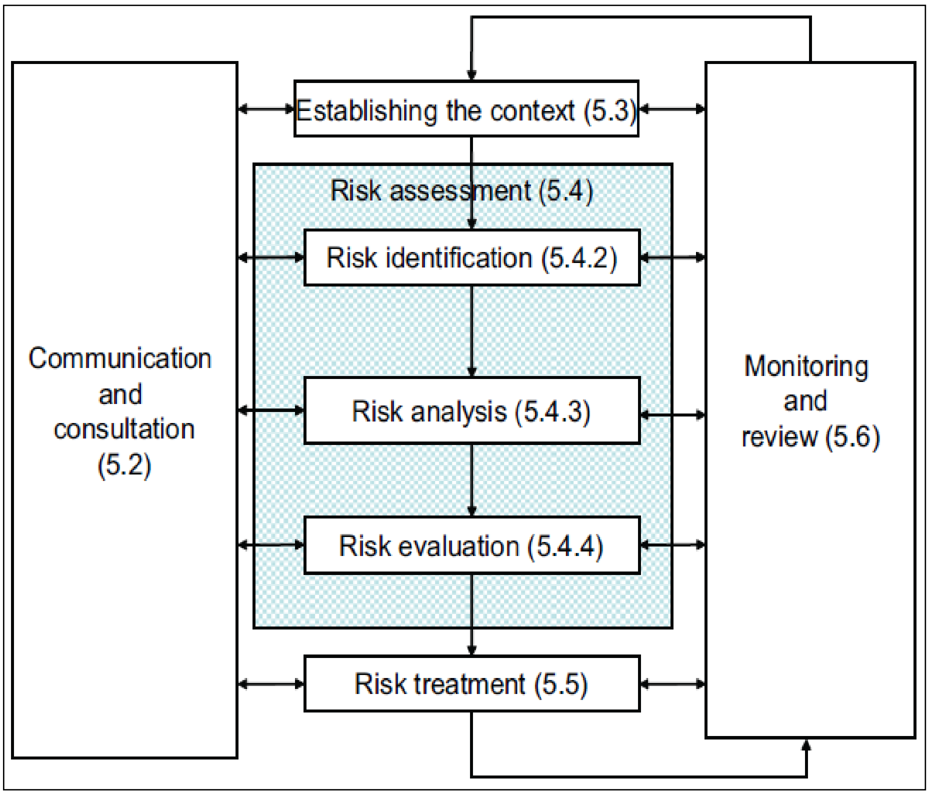


Figure 3.8: Risk management process *[Source:(BS-ISO-31000, 2009)]*

i) BS 31100:2008 – Risk Management: Code of Practice

The BS 31100:2008 provides generic guidance to risk management principles and practice, and can be adopted by any organisation. Like other approaches, this standard serves only as guidance; its application has to be tailored to the nature and environment of specific organisations.

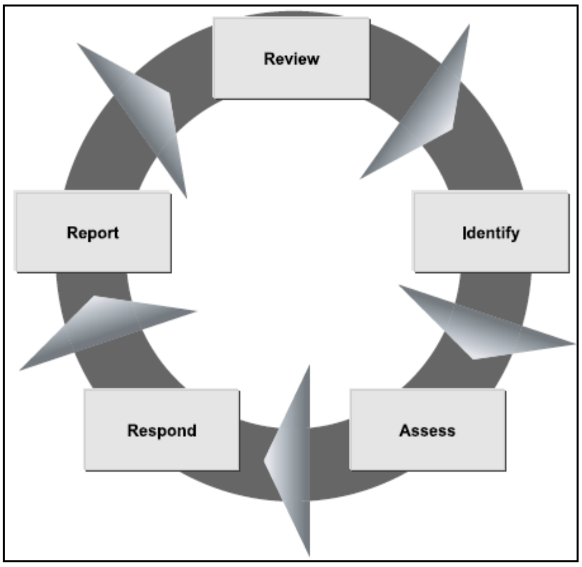


Figure 3.9: Risk management process *[Source: (BS-31100, 2008b)]*

j) **IEEE Standard 1540-2001:** *IEEE Standard for Software Life Cycle Processes – Risk Management;*

ISO/IEC 16085:2006 (IEEE Standard 16085-2006): Systems and Software Engineering – Life cycle process – risk management

The IEEE Standard 1540-2001 was developed by the IEEE Societies and the IEEE Standards Association (IEEE-SA) Standards Board. This standard was approved by the American National Standards Institute (ANSI) and reproduced by ISO and is known as ISO/IEC 16085:2006 (IEEE Std. 16085-2006). Its publication was intended for the management of risks within the software life cycle processes. It does not provide a detailed technique of risk management because the focus is directed towards defining the process as a whole. However, it does claim to be suitable for adoption by all appropriate projects.

Unlike other approaches, the process flow is illustrated in a unique schematic diagram with informative feedback loops at all stages (refer to Figure 3.10) ,each risk profile is analysed, treated, and monitored. However, the absence of the risk identification and risk evaluation stages make the process incomplete. The “plan and implement risk management” stage establishes the context of the risk management process by identifying risk champion or risk manager, risk category, type of analysis required, and method of prioritising and treating. Risk identification and risk evaluation are not stand-alone, but included as part of the “perform risk analysis" stage. The effectiveness of the process is arguable, mainly because risks are only identified at the later stage. It focuses on the process; the evaluation stage is placed towards the end by evaluating the risk management process as a whole rather than for a particular risk.

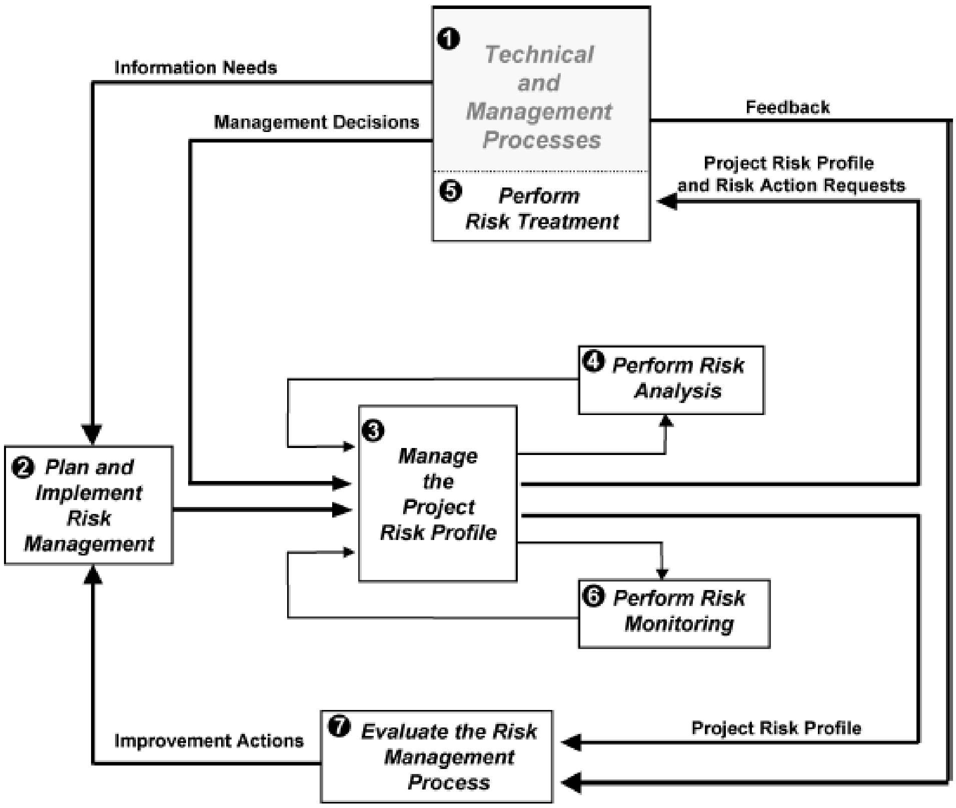


Figure 3.10: Risk management process model (informative) *[Source:(IEEE, 2001, ISO/IEC-16085, 2006)]*

k) CAN/CSA-Q850-97 – Risk Management: Guidelines for Decision-Makers

CAN/CSAQ850-97 is a national standard, produced by the Canadian Standards Association, and approved by the Standards Council of Canada. It is an amalgam of other guidelines and models published in Canada, the US and the UK. Saner (2005) adopted this standard as one of the main reference points to discuss the international risk management standard for the Canadian Government Directive on Regulating. This standard focuses on assisting the decision-making process by incorporating both risk perception and risk communication in the management of any kind of risk (CAN/CSA-Q850, 1997). It does not provide any technical tool for analysing, evaluating or controlling risk. As in any standard or guideline, the risk management process is iterative and summarized into six (6) stages, as shown in Figure 3.11 and Figure 3.12. The decision diamond is a special feature of this standard, which provides three potential decisions between steps namely “end", “go back", and “next step and/or take action". Based on Figure 3.11, preliminary analysis and risk estimation is clustered within the risk analysis stage. Meanwhile, risk assessment is the combination of risk evaluation and risk analysis, whereas risk management is the overall process from initiation through to action and monitoring of risks. Risk communication regarded at every stage in the process. The detailed model (Figure 3.12) provides a brief but important explanation of the activities involved during each stage.

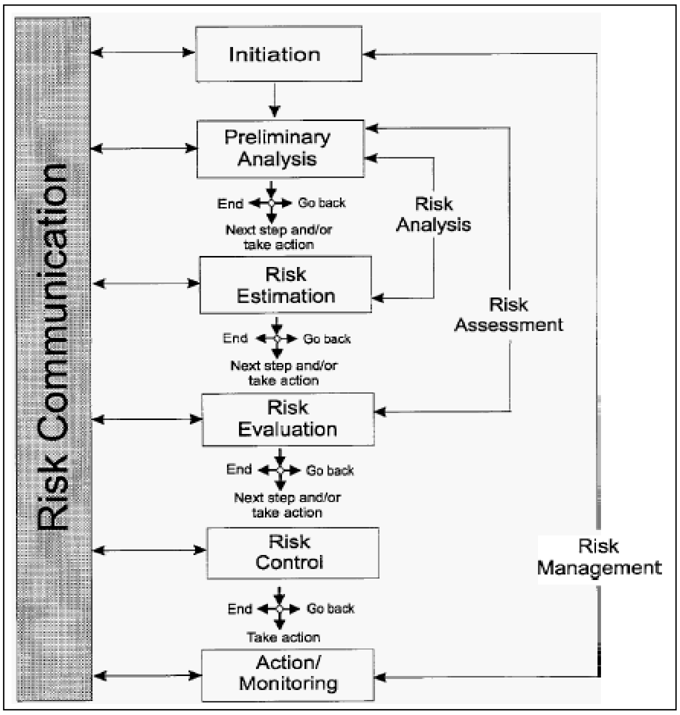


Figure 3.11: Risk management decision-making process – simple model
[Source:(CAN/CSA-Q850, 1997), p.6]

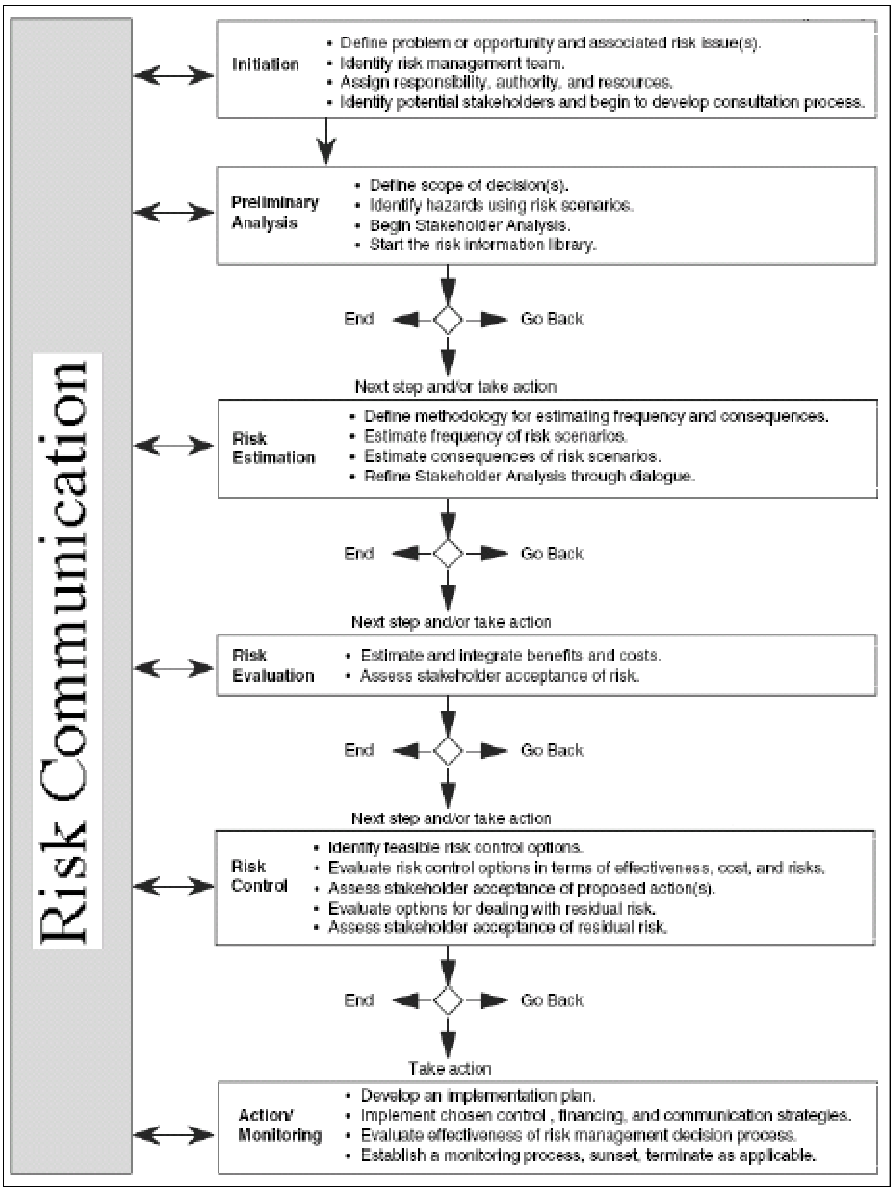


Figure 3.12: Risk management decision making process – detailed model
[Source:(CAN/CSA-Q850, 1997, COSO, 2004a)]

l) Risk Management Guide for DoD Acquisition – The US Department of Defense

This guide was published to assist the DoD and the contractors in managing risks effectively during the entire acquisition process (DoD, 2006a). Risk management helps to achieve the objectives, thus is critical to the successfulness of its acquisition programme. The guide emphasizes the importance of risk identification to everyone involved in the acquisition process. Although not mandatory, it encourages the implementation which can be tailored to fit other acquisition programmes. Besides identification, it also focuses on risk mitigation planning and implementation planning, rather than avoidance, transfer, or assumption (DoD, 2006a). The guide criticizes some publications that use “risk assessment” as an umbrella term for both risk identification and risk analysis because, according to the DoD (2006, p.7), these activities are critical to risk management and hence should be separated. The guide has a simple diagram which illustrates the risk management process- this is laid down in a sequence to facilitate the understanding (refer Figure 3.13).

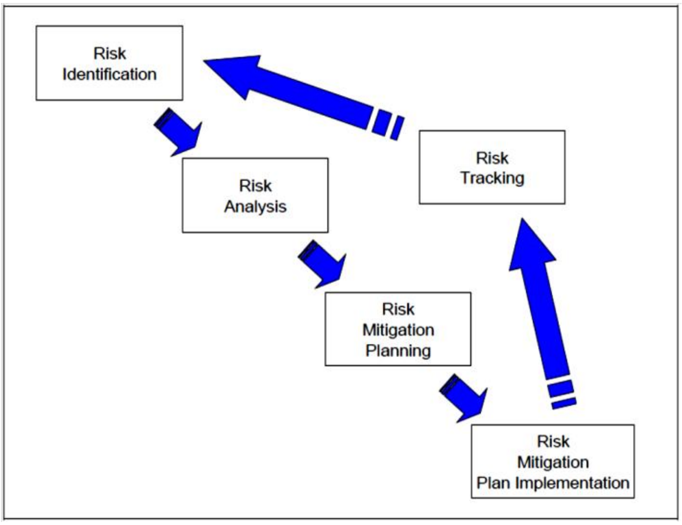


Figure 3.13: Risk management process *[Source: (DoD, 2006a), p.4]*

m) CMU/SEI-94-SR-5: Team Risk Management: A New Model for Customer-Supplier Relationships

This guideline was developed based upon studies conducted by the Software Engineering Institute (SEI), Carnegie Mellon University (CMU), which focused on developing a shared product vision [see (Higuera et al., 1994)].to adopt risk management principles to manage programmes or projects SEI uses the term “risk management paradigm”, illustrated through a set of continuous activities and depicted in the form of functions backed by processes, methods, and tools. It proposes an integration of project management and risk management, known as “integrated project management” (refer Figure 3.14). According to the SEI, risk management looks ahead in the project and adds a structured approach for the identification and analysis of risk planning ((Higuera et al., 1994), p.10). The Team Risk Management (TRM) incorporates team-oriented activities involving the customer-supplier relationships in the risk management activities. SEI provides users with a scenario comparison between the TRM and general risk management activities, including a list of advantages of TRM (p.17). Based on Figure 3.14, the first two stages see the merging of viewpoints from customer and supplier, whereby they share their respective understanding of the project risks and establish joint information regarding the project. During the identification stage, risks are jointly identified before they become problems (Higuera et al., 1994). However, the TRM model ignores the importance of the first two stages, whereby the joint team share their respective vision and understanding, including setting and establishing the context of the project. These processes are not iterative and only happen once throughout the system.

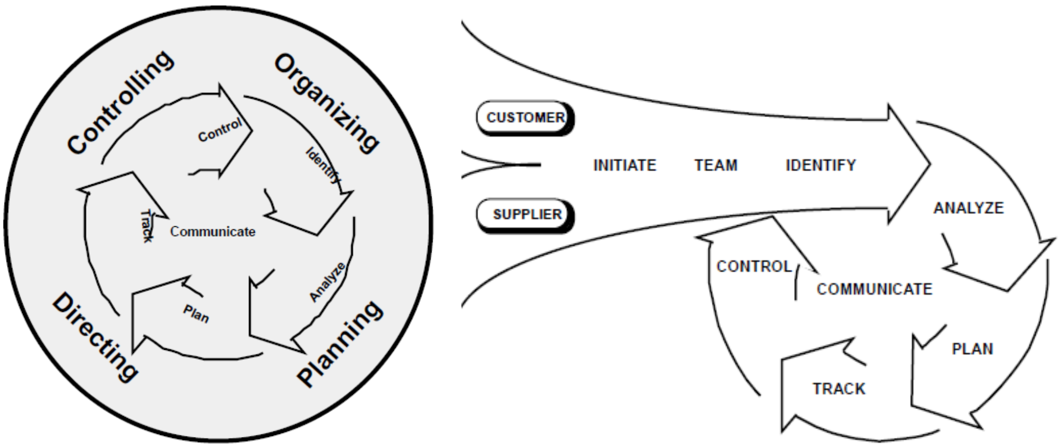


Figure 3.14: Integrated Project Management (Left) & The Team Risk Management model (Right) *[Source: (Higuera et al., 1994), p.10 & p.13]*

n) NPR 8000.4A(2008-2013): NASA Procedural Requirements- Agency Risk Management Procedural Requirements

Unlike any of the other approaches, compliance with the NASA Procedural Requirements (NPR) is mandatory for NASA and its programmes and projects. This NPR provides a dual definition of risk management from two integrated processes called “Risk-Informed Decision Making” (RIDM) and “Continuous Risk Management” (CRM). According to the NPR, the integration aims to foster proactive risk management through better informed decision-making and effective management and implementation of the CRM. Additionally, it serves as a basis for establishing internal controls to mitigate risks (NASA, 2008). RIDM has three activities involving decision alternatives; CRM continuously manages risks relating to design, plans and processes (refer Figure 3.15). NPR's risk management process is also iterative, and thus CRM has to provide feedback to RIDM. Likewise, the CRM has six stages, which is almost similar to SEI's TRM model. All these stages, roles and responsibilities and the requirements for risk management are discussed in detail in the NPR.

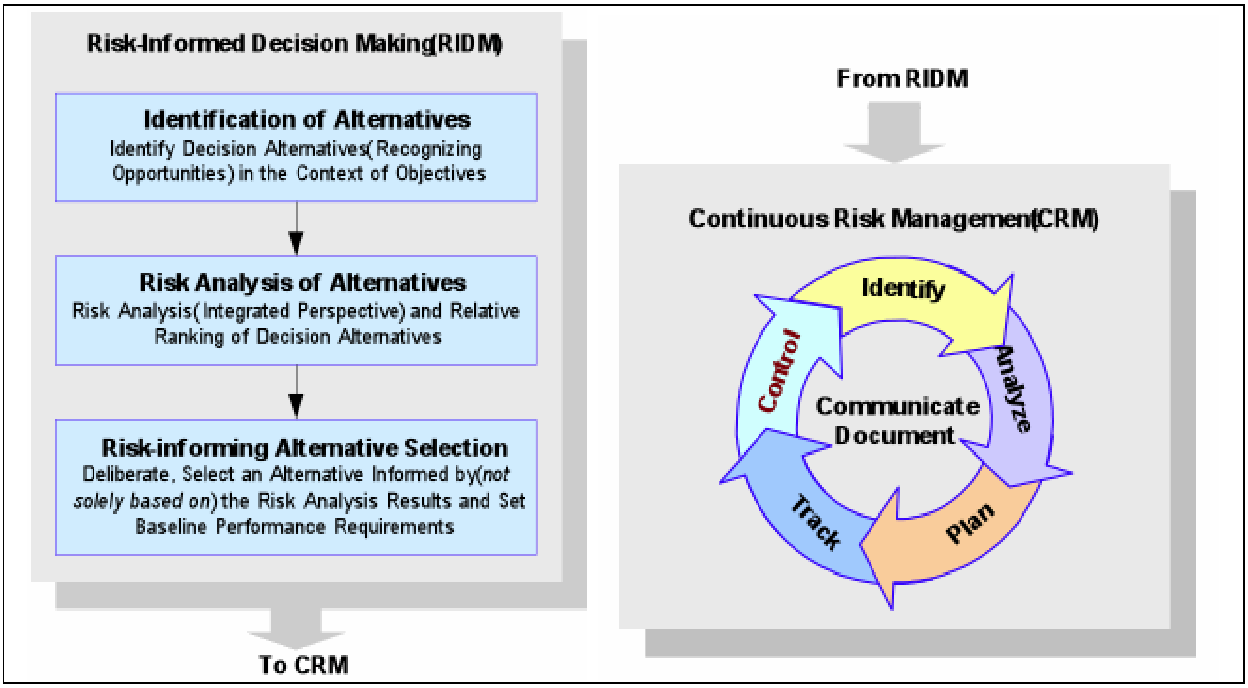


Figure 3.15 : Risk-Informed decision Making (Left) & Continuous Risk Management (Right)
[Source:(NASA, 2008), p.9-10]

3.4.5 A Comparison of the Steps or Stages Within the PRM Process

The number of steps or stages may vary from one standard or guideline to another, with the maximum being eight steps. Table 3.19 provides a summary of the steps and stages of the risk management process, which has been extracted from the various standards and guidelines discussed earlier.

Standard/ Guideline/ Author	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8
PRM Guidelines (Cooper et al., 2005a)	Establish context	Identify	Assess-(Analyse)	Assess-(Evaluate)	Treat the risks	Monitor & review	Communicate & consult	-
AS/NZS 4360 (AS/NZS-4360, 1999)	Establish context	Identify	Assess-(Analyse)	Assess-(Evaluate)	Treat the risks	Monitor & review	Communicate & consult	-
PMI's PMBOK® (PMI, 2004)	RM planning	Identify	Qualitative analysis	Quantitative analysis	Response planning	Monitor & control	-	-
PRAM Guide (APM, 2004)	Initiate-Define scope	Initiate-Focus RM	Identify	Assess-structure, ownership	Assess-estimate, evaluate	Plan responses-risk event & project risk	Implement responses & monitor	Manage process
MoR (OGC, 2007a)	Identify-context	Identify-risks	Assess-estimate	Assess-evaluate	Plan-responses	Implement-action	-	-
RAMP (ICE et al., 2002)	A: Process launch-plan, organise & launch process	A: Process launch-establish baseline	B: Risk review-plan, initiate, identify	B: Risk review-evaluate, mitigate, assess	B: Risk review-plan & communicate response	C: Risk management-implement strategy	C: Risk management-control risks	D: Process close down-assess outturn, review RAMP process
BS 6079-3:2000	Context	Risk identification	Risk analysis	Risk evaluation	Risk treatment	Monitor and review	Maintain database	Communicate & explain
BS IEC 62198:2001	Establish context	Identify risks	Assess risks-analyse	Assess risks-evaluate	Treat risk	Monitor & review	Communicate & consult	-
BS ISO 31000:2009	Establish context	Risk assessment-identification	Risk assessment-analyse	Risk assessment-evaluate	Risk treatment	Monitor & review	Communicate & consult	-
IEEE Std 1540-2001	Technical & mgmt processes	Plan & implement RM	Manage project risk profile	Perform risk analysis	Perform risk monitoring	Perform risk treatment	Evaluate RM process	-
ISO/IEC 16085:2006 (IEEE Std. 16085-2006)	Technical & mgmt processes	Plan & implement RM	Manage project risk profile	Perform risk analysis	Perform risk monitoring	Perform risk treatment	Evaluate RM process	-
CAN/CSA-Q850-97	Initiation	Preliminary analysis	Risk estimation	Risk evaluation	Risk control	Action monitoring	Risk communication	-
DoD (US) 2006	Risk identification	Risk analysis	Risk mitigation planning	Risk mitigation plan implementation	Risk tracking	-	-	-
CMU/SEI-94-SR-5	Initiate	Team	Identify	Analyse	Plan	Track	Control	Communicate
NASA NPR 8000.4A	Identification of alternatives	Risk analysis of alternatives	Risk-informing alternative selection	Identify	Analyse	Plan	Track	Control, Communicate

Table 3.19: Steps or stages of PRM process by various organisations

a) Stage 1: Establish the Context, Define Scope, RM Planning.

Projects need to be defined clearly in order to have a common understanding, whereas risk management needs to be planned, applied and tailored to the specific project needs. The purpose of this stage is to decide the scope, objectives and context for the process, subsequently ensuring the level, type and visibility of risk management which corresponds to risk and project importance [see (PMI, 2004, APM, 2004)]. Establishing the context or baseline is the process of obtaining information about the planned activity, including the objectives and underlying assumptions, to develop a structure for risk identification. At this stage, the inputs required are project documents, such as the project management plan and the project scope statement (PMI, 2004). The output will be a concise statement of project objectives and specific criteria for success (Cooper et al., 2005a), the methodology to perform risk management and, the roles and responsibilities (PMI, 2004).

b) Stage 2: Identify Risks

Risk identification is the process of determining a future event that may or may not happen, which will affect the objectives which have been set out. It is conducted by examining the associated root cause and existing conditions. The US DoD (2006b) indicated that the main purpose of identification is to answer the question *"What can go wrong?"* It is a creative task which aims to extract objective information through various methods, and therefore, all parties that are likely to be affected by the decisions should be involved; the effectiveness is determined by their skills and experience [see (BS6079-3, 2000, APM, 2004)]. Information can be gathered via the lessons learnt from previous risk management exercises, thus this information should be validated to ensure the accuracy of the description which has built up. The PRAM guide argued that not all risks could be identified early, and new risks can appear as the project progresses. Therefore, the residual risks must be identified as part of the response stage. The inputs are similar to stage 1 above, except that there is now a risk management plan needed whilst the output will be a risk register (PMI, 2004). Additionally, according to PMI's PMBOK®, the risk management plan should include the assignment of roles and responsibilities, the provision for risk management activities in the budget and schedule, and the categories of risk.

c) Stage 3: Assess, Analyse and Evaluate Risks.

There are various approaches to this stage adopted by the organisations. For example, risk analysis and risk evaluation were considered as part of risk assessment in AS/NZS 4360, and in the PRM guideline. Risk assessment was also performed in separate tasks in the OGC's MoR framework and within PRAM guidelines. Meanwhile, BS 6079-3:2000 had an evaluation stage to assess risks which was divided into two levels; the likelihood of occurrence, and the potential consequences. The research argued that the risk analysis stage was part of, if not the same as, the risk assessment, because according to the standard, analysis involved the establishment of the likelihood and consequences of the risks.

i. Risk Assessment

During the assessment process, identified risks will be prioritised according to their likelihood and consequences by analysing and evaluating each risk. The aim is to increase the understanding of each identified risk for effective decision-making. It is performed either qualitatively using the 'probability-impact' (P-I) matrix, or quantitatively, using 'probabilistic estimation', or a combination of both methods (APM, 2004). Each risk should be assessed in accordance with its probability of occurrence and potential impact in terms of the level of threat or opportunity to improve the stated objectives.

ii. Risk Analysis

The DoD (2006, p.11) indicates that risk analysis answers the question *"How big is the risk?"*, by considering the likelihood and the root cause occurrence, as well as the consequences if such a risk event occurs. It determines the possibility of the risk events which may occur and their magnitude or consequences (Cooper et al., 2005a). Meanwhile, the OGC's MoR framework adopted the term ‘estimate’ instead of ‘analyse’, at this stage, the threats and opportunities are estimated in terms of their probability and impact (p.52). The common methods and techniques used to conduct risk analysis include qualitative analysis, which is based on nominal scales of likelihood and consequences; semi quantitative analysis using numerical values to derive quantitative risk factors; and quantitative analysis, which is performed on risks that have been prioritised by the qualitative process (PMI, 2004). The use of quantitative analysis was said to be very much dependent upon the nature and quality of the data, and the accuracy of assumptions made [see (BS6079-3, 2000)].

iii. Risk Evaluation

Risk evaluation is the process of estimating the significance of the risk (Cooper et al., 2005a). The analysed risks are compared and arranged according to their priorities, based on the scores. According to the MoR framework, this task allows for the net effect of the identified threats and opportunities to be understood upon prioritisation (p.52). Each risk is assigned with a manager or owner, who will be responsible to monitor and update on its status. The output of these processes will be a list of prioritised risks, which are loaded or updated into the risk register, together with their impact upon their occurrence on the objectives. The risk register is a form of repository or a live record that documents the latest information for each risk, along with their action plans.

d) Stage 4: Response or Treatment of the Risks.

Risk response or treatment is the process of determining a suitable response to the risks which have been identified and assessed earlier, in order to minimize their exposure. Cooper et al. (2005, p.17) advised that actions must be taken to avoid the risks, otherwise, the processes of identifying and assessing the risks conducted would be meaningless.

Detailed action plans for each risk are developed at this stage: attention to this stage is important in order to avoid surprises should a risk materialise. This includes identifying options to reduce the likelihood or consequence of the risks using a matrix; determining the potential benefits and cost for the options, and selecting the best possible options. The purpose is to minimize the impact of threats and to maximize or exploit opportunities, in order to achieve objectives. The strategies for treating risks depend on the nature of the risk. Cooper et al. (2005) criticised the guidelines as they only provided general suggestions without detailing specifics on the strategies to respond to risks. For example, PMBOK provided different strategies in responding to threats and opportunities. Strategies for threats or negative risks include: to avoid, transfer or mitigate, whilst to exploit, share and enhance are three strategies suggested for opportunities or positive risks (PMI, 2004). The US DoD uses "risk mitigation planning" to address potential unfavourable consequences; this is achieved through four mitigation options, namely; avoiding, controlling, transferring, and assuming. The PRAM guide argues that such activities or processes should only be taken when the project manager is convinced that the response is efficient in achieving the expected gain (APM, 2004). A risk register is required to conduct the response planning and, at the end of this process, an updated version of the register is produced, as well as a project management plan and risk-related contractual agreements.

The following are examples of strategies for treating risks suggested by various authors, standards and guidelines.

i. Risk prevention, risk avoidance, or risk elimination strategy involves changing of scope to remove the risk, abandoning goals associated with the risk, or changing the project management plan, by eliminating threats and isolating objectives from the impact of risk [see (OGC, 2007a, PMI, 2004, BS6079-3, 2000)].

ii. Impact mitigation includes contingency planning, quality assurance, regular audits and checks, contract terms and conditions. According to BS 6079-3:2000, a contingency plan is also known as reducing consequences.

Another method suggested by the standard is the possibility reduction-changing the project approach by identifying the causal links between the threat and impact and intervening to mitigate such occurrences.

iii. Risk sharing, such as the insurance and liquidated damages clauses in contracts, transfers part of the risk to other parties -either in part or in full- with another stakeholder. There are four types of transfer categories suggested by the OGC (2007); insurance, self-insurance, insurance captive: such as participating in the insurance portfolio of parent organisation, and contractual transfer. However, Cooper et al. (2005) argued that the risk allocation risk process is called risk sharing, and not risk transfer, because in all contracts, risks are shared between the parties involved and are not transferred entirely.

iv. Risks are retained if they cannot be avoided or transferred, or when it is costly to do so. In such circumstances, organisations become risk takers, either by default or statutory obligation, or consciously doing so, and therefore, they should be managing the risks appropriately (Cooper et al., 2005a).

Besides treating negative risks or threats, BS 6079-3:2000 (p.14) provided four measures to treat opportunities.

i. Facilitating – specific project approaches are chosen to enhance the outcome benefits for the stakeholder.

ii. Involving Facilitators – stakeholders should be involved to facilitate the occurrence of the opportunity.

iii. Enhancing Likelihood – this involves changing the project approach and examining the causal links between opportunity and project.

iv. Enhancing Consequences – plans are developed in order to take full advantage of any opportunity that occurs.

e) Stage 5: Monitor and Review

The monitoring and reviewing processes should be continuous to ensure that risks are identified and managed with appropriate planning. The nature of risk may change as projects are executed and therefore; this process keeps track of the identified risks and those on the watch-list, re-analyses existing risks, monitoring residual risks, as well as reviewing risk responses (PMI, 2004, p.264). PRAM guide includes monitoring as part of its 'implement response' process to allow for any appropriate adjustment to be made on the risk response. The MoR framework relays it differently, saying that this is an implementation step through which the planned risk management actions are implemented and monitored for their effectiveness. Additionally, activities relating to addressing the effectiveness of the risk management process and determining whether it fulfils the scope, have been included as part of the response stage by the PRAM guide, rather than as a separate stage. Nevertheless, it includes another stage called "manage process", whereby it is ensured that the whole risk management process is effective and performed through formal or informal and regular reviews.

Meanwhile, the PRM guidelines clearly indicate that risk monitoring and reviewing activities can be linked with other management processes, such as the routine management meeting cycle, through which significant project phases and milestones are reviewed (Cooper et al., 2005a). The DoD (2006) uses "risk tracking" as an umbrella term for monitoring risk mitigation plans, reviewing the status, displaying the status within the risk reporting matrix, communicating to all affected stakeholders, and also alerting management (p.20). The input needed for this process, among others, include the risk management plan, risk register, performance reports; the outputs include an updated risk register and project management plan, and recommended corrective and preventive actions (PMI, 2004).

f) Stage 6: Communicate and Consult.

As part of these activities, risks are reported regularly to the management, presenting their current status, including treatment and further action. By communicating the risk, it can help others to understand the benefits of effective risk management and the organisation's risk appetite (OGC, 2007a). Additionally, it ensures that the parties involved are fully informed and the lessons learned are transferable so unpleasant surprises can be avoided.

3.4.6 Tools and Techniques of PRM

Most management processes involve the usage of various tools and techniques to assist in their undertaking, including PRM. Techniques are methods of carrying particular elements of the process cycle; tools are commonly known as generic software products used by organisations to carry out the techniques efficiently (APM, 2004). The PRAM guide provides guidance on the issues of selecting appropriate tools and techniques suitable for any circumstances. Firstly, according to the PRAM guide (p.93), any selected technique should take account all key elements of the risk cycle. It criticizes the usage of sophisticated techniques without rigorous risk identification and response processes. Furthermore, it has to be made clear that some techniques are only suitable during the earlier stages, whilst others are applicable for later use. The use of any tool or technique is costly, and, therefore its usage must be justified in terms of potential benefits.

Additionally, the chosen techniques should be easily communicated in order to deliver the benefits. Then, should the combination of qualitative and quantitative techniques be adopted, the organisation must ensure that there are logical connections between them and they are consistent. Last, but not least, the PRAM guide indicates that the techniques used should complement other disciplines integrated in the risk process, such as planning and leadership. Tables 3.20(a) and 3.20(b) – provided in the PRAM guide- present various techniques for the risk management process.

Item	Technique	Also used for:		Applicability		Resources	
		Risk Assessment	**Risk Control**	**Pre-Project Approval**	**Post-Project Approval**	**Time and/or Cost**	**Expertise Required**
A	**RISK IDENTIFICATION**						
1	Assumption analysis	P	L	G	G	L	L
2	Constraints analysis	P	L	G	L	L	L
3	Checklists	N	N	P	G	M	L
4	Prompt lists	N	N	G	G	L	L
5	Brainstorming	L	N	G	G	L	M
6	Interviews	G	P	P	G	M	M
7	SWOT Analysis	L	P	P	L	L	M
8	Stakeholder analysis	P	L	G	L	M	M
9	Project monitoring	P	G	N	G	L	L
10	Nominal group technique	L	N	G	L	L	M
11	Delphi technique	L	N	P	L	M	H
12	Technology readiness level	P	L	P	L	H	H
13	Peer review	L	N	G	L	L	H
14	Team members report	L	L	L	G	L	L

G = Good- strong application
P = Potential application
L = Limited application
N = Not applicable
H = High resource requirement
M = Medium resource requirement
L = Low resource requirement

Table 3.20(a): Various risk identification techniques.
[Source: (APM, 2004), p.118]

Item	Technique	Also used for:		Applicability		Resources	
		Risk Assessment	**Risk Control**	**Pre-Project Approval**	**Post-Project Approval**	**Time and/or Cost**	**Expertise Required**
B	**RISK ASSESSMENT**						
1	Probability assessment	N	N	G	G	L	L
2	Impact assessment	N	N	G	G	L	L
3	Descriptions meta-language	P	P	P	G	L	M
4	Influence diagrams	P	P	G	L	M	M
5	Risk breakdown structures (RBS)	G	L	G	P	M	H
6	Probability-impact (PI) matrix	N	N	P	G	L	L
7	Risk improvement potential	N	N	G	P	M	M
8	Risk impact windows	N	P	N	P	M	M
9	Expected value	N	N	P	G	L	M
10	Risk register	N	G	P	G	M	L
11	Roll-up indicators	N	L	L	G	H	L
12	Probability distributions	L	N	G	P	M	H
13	3-point estimates	P	N	G	P	M	H
14	First-pass quantitative model	P	L	G	L	L	M
15	Monte Carlo analysis	P	L	G	P	M	H
16	Correlation	L	N	G	P	L	H
17	Post-response	N	P	P	G	M	H

	analysis						
18	Decision trees	N	G	P	L	M	H
19	Sensitivity analysis	P	P	P	L	M	M
20	Knowledge-based models	G	L	G	N	H	H

G = Good- strong application *H = High resource requirement*
P = Potential application *M = Medium resource requirement*
L = Limited application *L = Low resource requirement*
N = Not applicable

Table 3.20(b): Various risk assessment techniques
[Source: (APM, 2004), p.119]

3.5 Summary

3.5.1 Project and Project Management

A project is known as a temporary endeavour which consists of coordinated and controlled activities, with a predetermined start and end point. It is undertaken to create unique deliverables as it involves value creation. A project is never executed in exactly the same context, and thus it is managed differently with tasks that have not been done previously. Meanwhile, project management means many things to many people, its definition continuously being developed by interested parties to enhance the profession. The growth of project management has been heavily practitioner-led and covers a broader perspective within the modern economy. Various organisations or bodies have spent significant efforts in producing BoKs and competency standards for project management; these are used as a guide, for training and certification, to recognise those who have met the set requirement by the relevant bodies.

Although the research found a variety of definitions for project management, the general understanding is relatively similar through the identified keywords. Theoretically, project management is defined as an art or an ability to convince others that the results are achieved based on planned actions, with the main concern of achieving project objectives. On the other hand, practitioners and professionals define it as a management process; which includes planning, organising, controlling, and monitoring, through the application of appropriate knowledge (technical and managerial), as well as tools and techniques to support the process. Accordingly, these keywords have been adopted by organisations like the ISO and the BSI to define project management. Although it has been defined differently, project management is about managing the activities systematically throughout the project to deliver the intended and tangible goals. It also involves planning which is usually loaded with unknowns, ambiguities, estimates and assumptions, and tends to take in risk and uncertainty.

Using the reviews, the research summarizes the definition of project management to be as follows:

“A defined or structured process that organises, delegates and manages the activities of planning, monitoring, controlling, delivering, motivating, reporting, and reviewing required to achieve project objectives, mission and goals. It involves the application of relevant knowledge, skills, tools and techniques by the project team”.

3.5.2 Risk and Risk Management

The definitions of risk are found to be inconsistent, varying from one document to another. From the reviews, the majority of documents adopted similar keywords in defining risk, such as “probability," *“consequences,"* and “objectives". *“Likelihood”* was also found to be a synonym for *“probability".* Meanwhile, the research also found that other words have been associated with the definition of risk, such as chance, consequences, impact, threat, opportunity, uncertainty, hazard, harm, and objective. However, opportunity or positive were rarely used, as risk has generally been associated as negative or with adverse outcomes.

The research found that there is no consistency in the definition of risk. Although risk has been defined as a probability or likelihood of an event happening in most documents, it has also been defined as uncertainty or an uncertain event. The documents are largely grounded on the expected value, thus does not make a distinction between risk and uncertainty, like what K-K had proposed. Selecting inappropriate document to use will lead to poor decision making because decision makers will only choose the best alternative - that which maximises his utilities. This indicates that the decision maker is not rational, thus violates the EUT. Likewise, risk management was also found to have various definitions, but described similarly by the documents. To summarize, risk management is a systematic, or structured, or coordinated, or disciplined, or directed, or controlled process. It involves the process of identifying, analysing, evaluating, treating, monitoring or tracking, and reviewing the risks. It is a continuous process of decision making, communicating or consulting; It is a culture to achieve context, goals or objectives.

3.5.3 Risk, Uncertainty and their Affiliations

Unlike risk, the definition of uncertainty was found to be lacking in most reviewed standards and guidelines. Uncertainty is defined as a lack of knowledge, incomplete information, or an ambiguity and immeasurable; which in turn are in accordance with K-K propositions. The research defined uncertainty as *"…the deficiency, incomplete, vagueness, ambiguity, insecurity, variability and lack of clarity or information, knowledge, values or data".*

However, the majority of the documents acknowledged uncertainty as similar to risk, thus contradicting the K-K proposition discussed earlier. Based on the reviews made on the documents, uncertainty was found to be affiliated with risk in the following ways:

a. Risk results from uncertainty.
b. Risk and uncertainty can be quantified.
c. Risk is subject to uncertainty.
d. Risk is similar to uncertainty, having negative and positive aspects.
e. Uncertainty has risk and opportunity.

3.5.4 Project Risk Management (PRM)

PRM is acknowledged as an integral part of project management (including its BoKs) and a major interest of various organisations. Its purpose is to obtain better project outcomes in relation to a project's schedule, costs and performance. PRM is "a structured process of understanding and managing project risks successfully through the minimisation of threats and the maximisation of opportunities". PRM processes include risk management planning, identification, analysis, responses, and monitoring and control. However, the PRM was criticised for its planned contingencies and flexibility regarding the project plan, and, therefore it only worked with identified risks and on known probabilities, upon which the project team can improvise the project planning. Additionally, it does not address innovative projects in which unforeseeable uncertainty may appear.

The adoption of a consistent framework for PRM helps to promote transparency and effective communication within project organisations. Although there are managers that undertook such activities but do not use the term ‘risk’ and yet resulted in successful activities, the research argued that poorly managed project risks may have a negative impact to the project objectives. PRM supports consistent and justifiable decision making. It ensures that all significant risks are identified and understood in terms of their potential consequences and likelihood; their priority settings are assessed while resources are allocated, and their treatment strategies are implemented cost-effectively.

The Mainstream PRM Processes

There are four basic or conceptual stages in mainstream risk management, known as: risk identification, risk assessment, risk response, and risk review and monitoring (see Figure 3.16). The terminology adopted to describe the risk management process may vary depending on individual or organisational use. For example, the INSEAD team introduced their terminology for risk management: identify, classify, manage and embed, into the system. The team also provided four conceptual stages for PRM which is shown in Figure 3.17. Meanwhile, Cooper et al. (2005, p.3) provided a different approach for the effective management of risks by dividing the processes into three core processes, as illustrated in Figure 3.19. These exceptional processes described the whole activities rather conceptually, compared to the other mainstream processes.

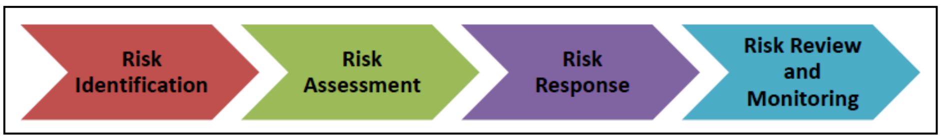


Figure 3.16: The mainstream stages of the PRM process

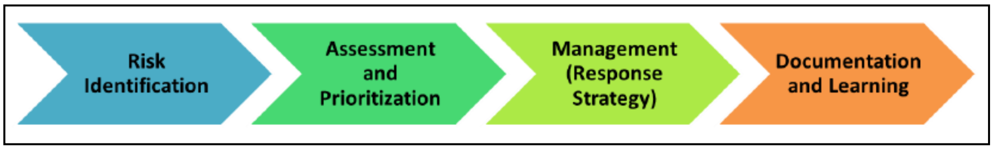


Figure 3.17: INSEAD's conceptual stages of the PRM process
Source: Loch et al. (2006:p13)

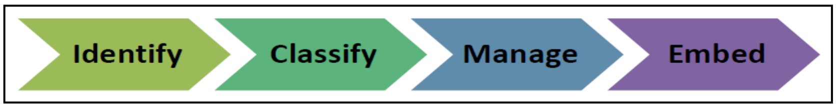


Figure 3.18: INSEAD's terminology for risk management
Source: Loch et al. (2006)

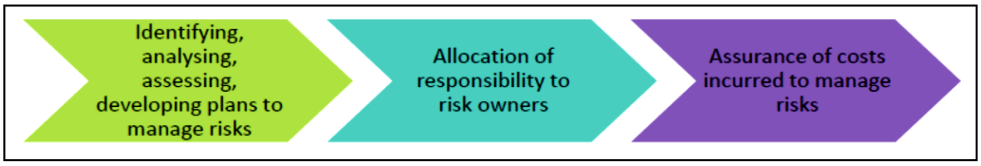


Figure 3.19: Three key processes for effective management of risks
Source: Cooper et al. (2005:p3)

Based on the reviews made on the literature relating to PRM, the process of managing risks is divided into risk identification, risk analysis, risk evaluation, risk treatment and risk monitoring and control, and is explained as follows:

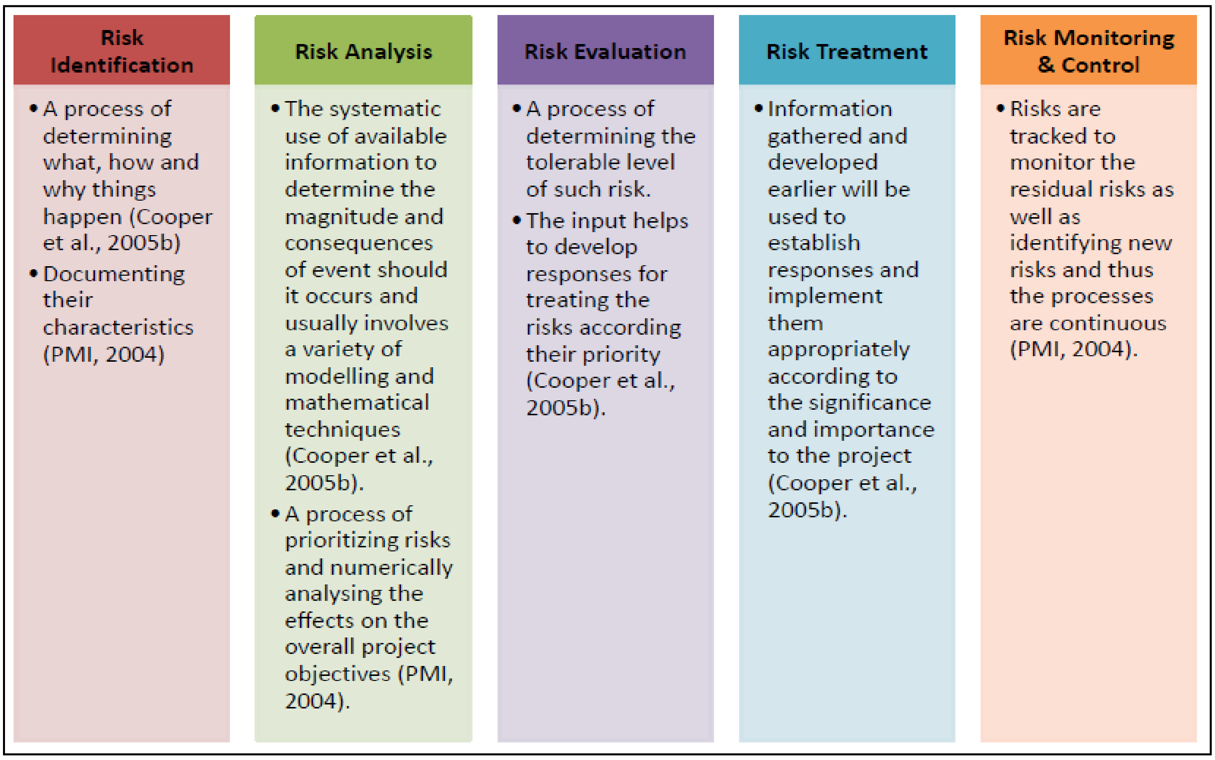


Figure 3.20: Summary of the conceptual process for managing risks

3.5.5 Various Approaches to the PRM Process

Based on the reviews conducted on the PRM approaches, five out of fifteen documents have eight steps [see PRAM guide, RAMP guide, BS 6079-3:2000, CMU/SEI-94-SR-5 and, NASA NPR 8000.4A]. These steps are found to be comprehensive and well explained. Ideally, the research proposes that there could be a maximum of eight steps or stages in risk management.

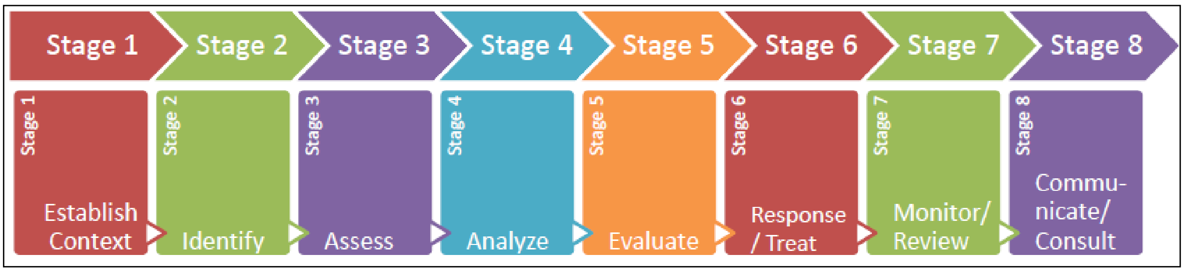


Figure 3.21: Summary of the detailed process for managing risks from various standards and guidelines – eight steps

Not all standards have eight steps for their risk management processes. In actuality, BS 6079:2000 only has seven steps, missing the assessment step in its standard. However, it has a step called "maintain database" as an addition to its monitoring step. The AS/NZS 4360:1999 has only six steps, the assessment step comprising of two separate stages: analyse and evaluate. This is shown in Figure 3.22 below. The same framework has also been adopted by the PRM Guidelines (Cooper et al., 2005b), as well as by BS IEC 62198:2001 and BS ISO 31000:2009.

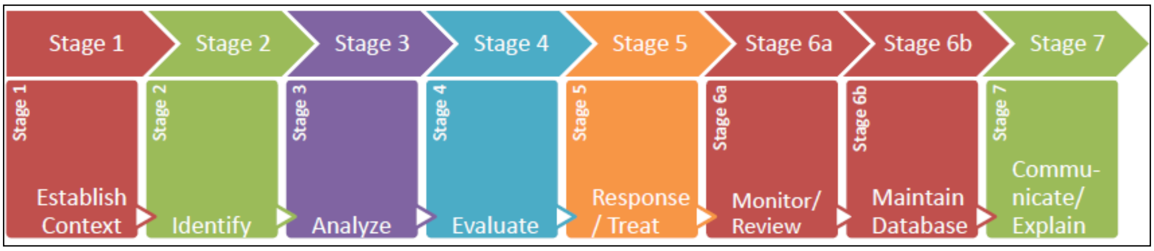


Figure 3.22: The process of managing risks – seven steps
Source: BS 6079-3:2000

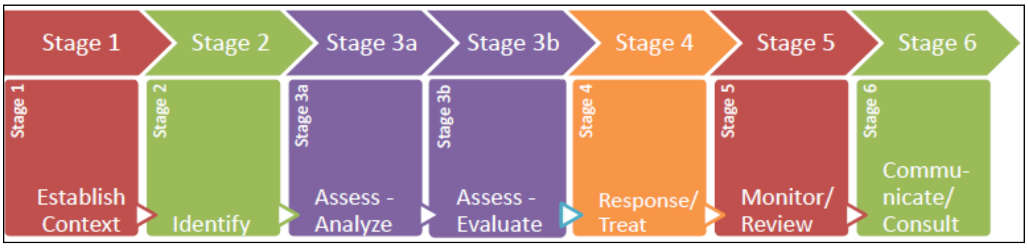


Figure 3.23: The process for managing risks – six steps
Source: AS/NZS 4360:1999; Cooper et al. (2005); BS IEC 62198:2001; BS ISO 31000:2009

The IEEE Standard 1540:2001 and ISO IEC 16085:2006 adopt the CMU/SEI's six-step process. The processes are similar, except that Stages 4 (monitoring) and 5 (response) of the IEEE and ISO/IEC standards mirror the CMU/SEI stages. These approaches differ from the others; they have two sub-processes within the established context process and, their assessment or evaluation processes are deemed to be part of the analysis stage. Meanwhile, NASA's NPR framework also has six steps processes. Its Stage 1 includes a preliminary round of identification of alternatives, analysing and informing the selection of alternatives.

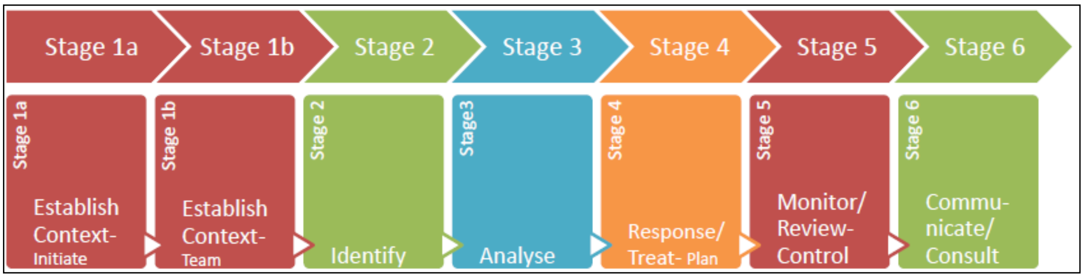


Figure 3.24: The process for managing risks – six steps
Source: CMU/SEI-94-SR-5

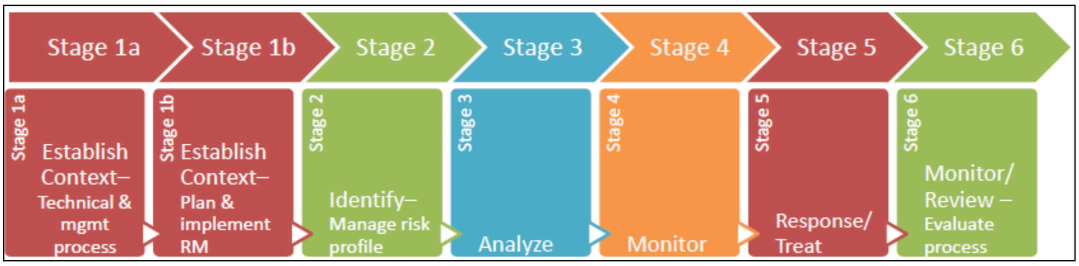


Figure 3.25: The process for managing risks – six steps
Source: IEEE Std 1540:2001; ISO/IEC 16085:2006 (IEEE Std. 16085-2006)

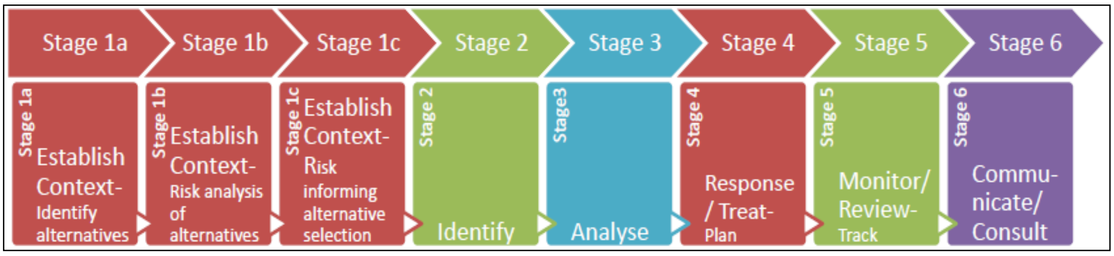


Figure 3.26: The process for managing risks – six steps
Source: NASA NPR 8000.4A

The PMI's PMBOK, the MoR and the PRAM Guide have five steps in their risk management processes. The PMBOK's analysis stage therefore does not consider assessment and evaluation as part of its main process. On the other hand, the MoR does not include analysis as part of its main process, but has assessment stage which is separated into analyse and evaluate. Meanwhile, the PRAM guide divides its assessment step into two groups: structure and ownership, and estimate and evaluate. The response step has also been divided into two; the first, response planning, the second, response implementation and monitoring. Stage 5 is where the whole process is being managed. The similarity between these three approaches is that none include communicate and consult steps in their process.

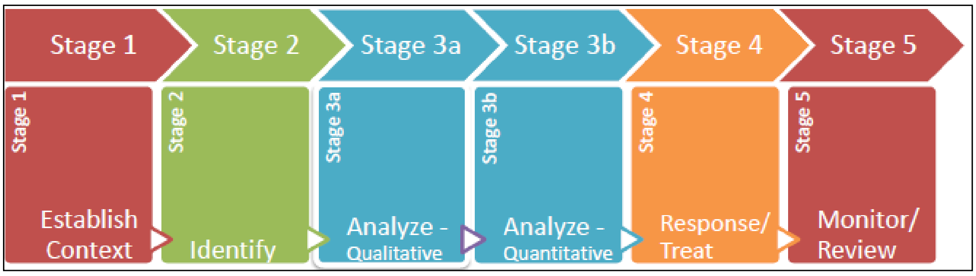


Figure 3.27: The process for managing risks – five steps
Source: PMBOK® (PMI, 2004)

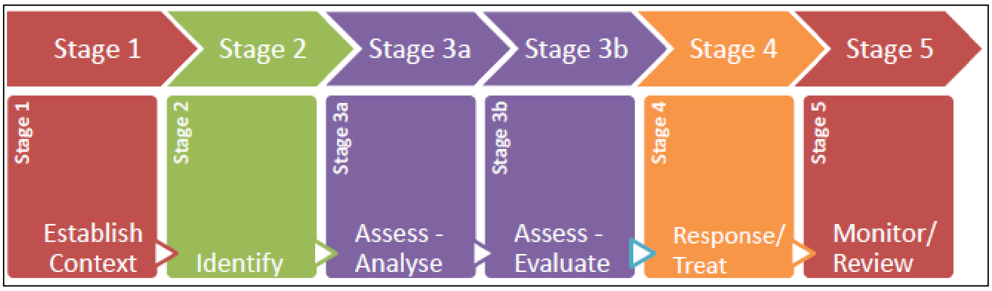


Figure 3.28: The process for managing risks – five steps
Source: MoR (OGC, 2007a)

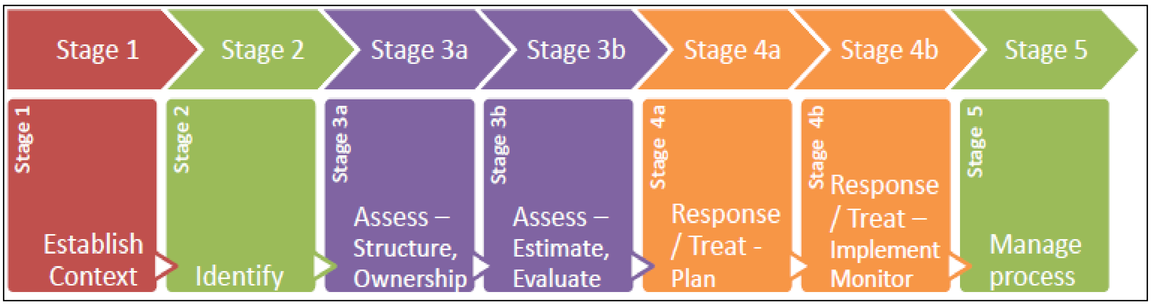


Figure 3.29: The process for managing risks – five steps
Source: PRAM Guide (APM, 2004)

There are four steps in the RAMP framework, identified as A (establish context), B (identify and assess), C (respond/ treat) and D (monitor/ review). The research summarises that the RAMP processes comprises of five stages, shown in Figure 3.31. It does not have an analysis stage but its assessment stage includes review, evaluation and mitigation activities. It also separates risk response into review (communicating) and manage (implementation), whilst the monitoring stage is divided into control and close down.

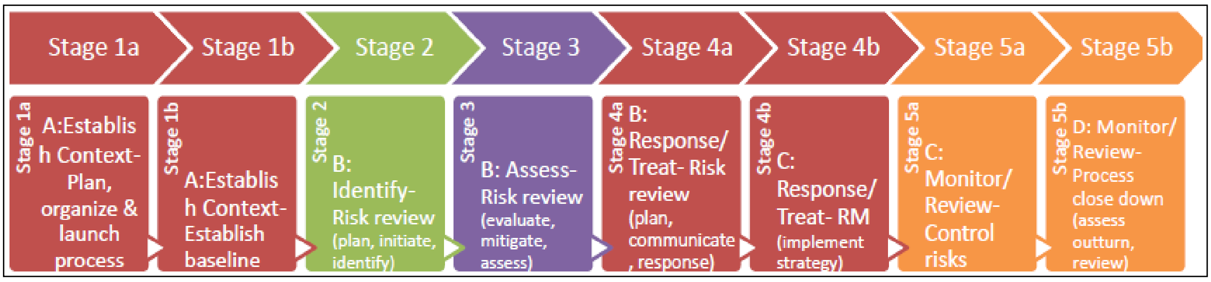


Figure 3.30: The process for managing risks – five steps
Source: RAMP (ICE et al., 2002)

The Canadian standard was lacking on a clear identification step. It began with the initiation stage, which was considered as establishing context; it resumed with preliminary analysis, and was followed by the estimation and evaluation of risks. Furthermore, it has two monitoring stages, divided into risk control and action monitoring.

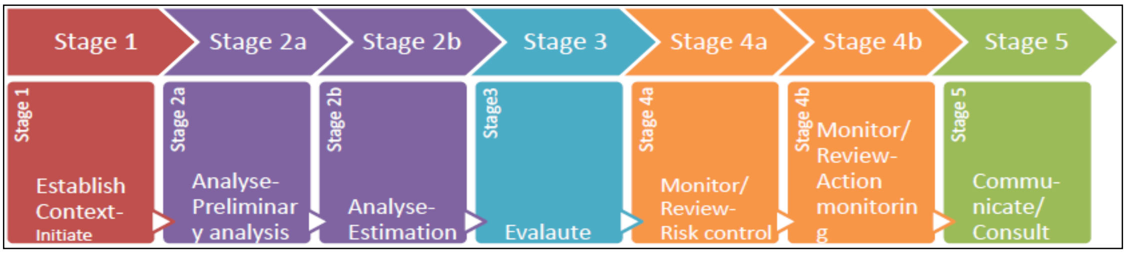


Figure 3.31: The process for managing risks – five steps
Source: CAN/CSA-Q850-97

The US DoD is the only source of information which provides a four-step process. It starts off with an identification stage, followed by analysis. However, it has two separate response stages, divided into mitigation planning and the implementation of the mitigation plan. The last stage is tracking, which is considered as a monitoring and review process.

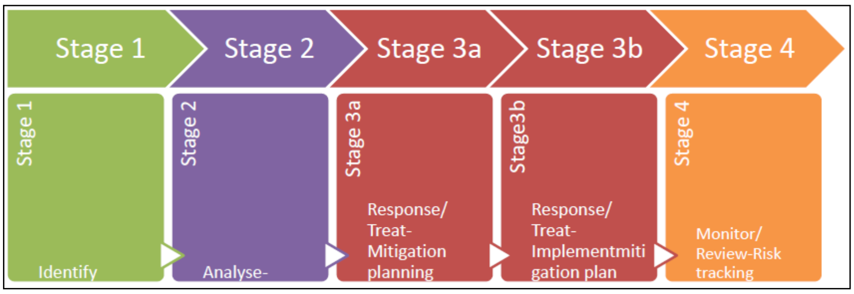


Figure 3.32: The process for managing risks – four steps
Source: DoD (US) 2006

3.5.6 Summary of the Conceptual PRM Process

From the discussion, it can be summarized that a comprehensive and well explained risk management process can have up to eight clear stages. Figure 3.33 below provides a summary of the processes, including the clear purposes and activities within each step. The summary is intended to assist the users to better undertake each process.

The process starts with establishing the context or baseline, before proceeding to the identification of risks. This will increase the understanding of the scope, responsibilities, environment, and the project objectives. The assessment, analysis, and evaluation stages suffered the most as they were interpreted and implemented differently across various standards and guidelines. However, with this theoretical PRM process, each step is a stand-alone; the activities to be conducted are clearly specified. The next steps are response, monitor/ review and communicate/consult. The dotted lines reflected the dynamic process of risk management, whereby reviews could be conducted once each step is completed; new risks could occur, which need to be managed through the same process. It uses different colours to differentiate between the steps, excepting the assess, analyse and evaluate steps. This is to reflect the involvement of quantitative and qualitative methods, suggesting that these steps could be conducted separately using different methods and with different purposes, rather than, as in many guidelines, regarded similarly and even overlapping the other. Peter Campbell in Hillson (2012) criticised risk management as being talked about more than implemented, whereby people are overly optimistic about the future event, lacking clear understanding and philosophy behind each of the steps in the risk management process. The focus is towards identifying more pros than cons; more benefits over costs; and being optimist that risk will be managed successfully. People are biased towards the optimism that risk could be managed simply by allocating financial contingencies to account for the eventuality of something that could go wrong. Such biases can be overcome through the use of a structured and well explained framework for risk management. This conceptual process can therefore address this problem and provide a better understanding of how risk can be managed.

Tools and techniques are used to assist the PRM process. Tools are commonly known as generic software products used to carry out the techniques efficiently, whilst techniques are methods of carrying out particular elements of the process. Besides considering the costs of the tools and techniques, their selection must also be appropriate to the particular stages, as some of them may only be suitable during the earlier stages, others may be used later. However, understanding of the process is more vital than over reliance on tools, models or systems thus a comprehensive framework to manage risk would be beneficial. The proposed PRM process is theoretical and has yet to be tested, thus its limitation is yet to be discovered. However, the research foresees that the implementation will depend on the risk culture across the organisation. The understanding of the process is more vital than being over reliant on the models or systems; therefore this conceptual process is developed to include the purposes and activities within each step.

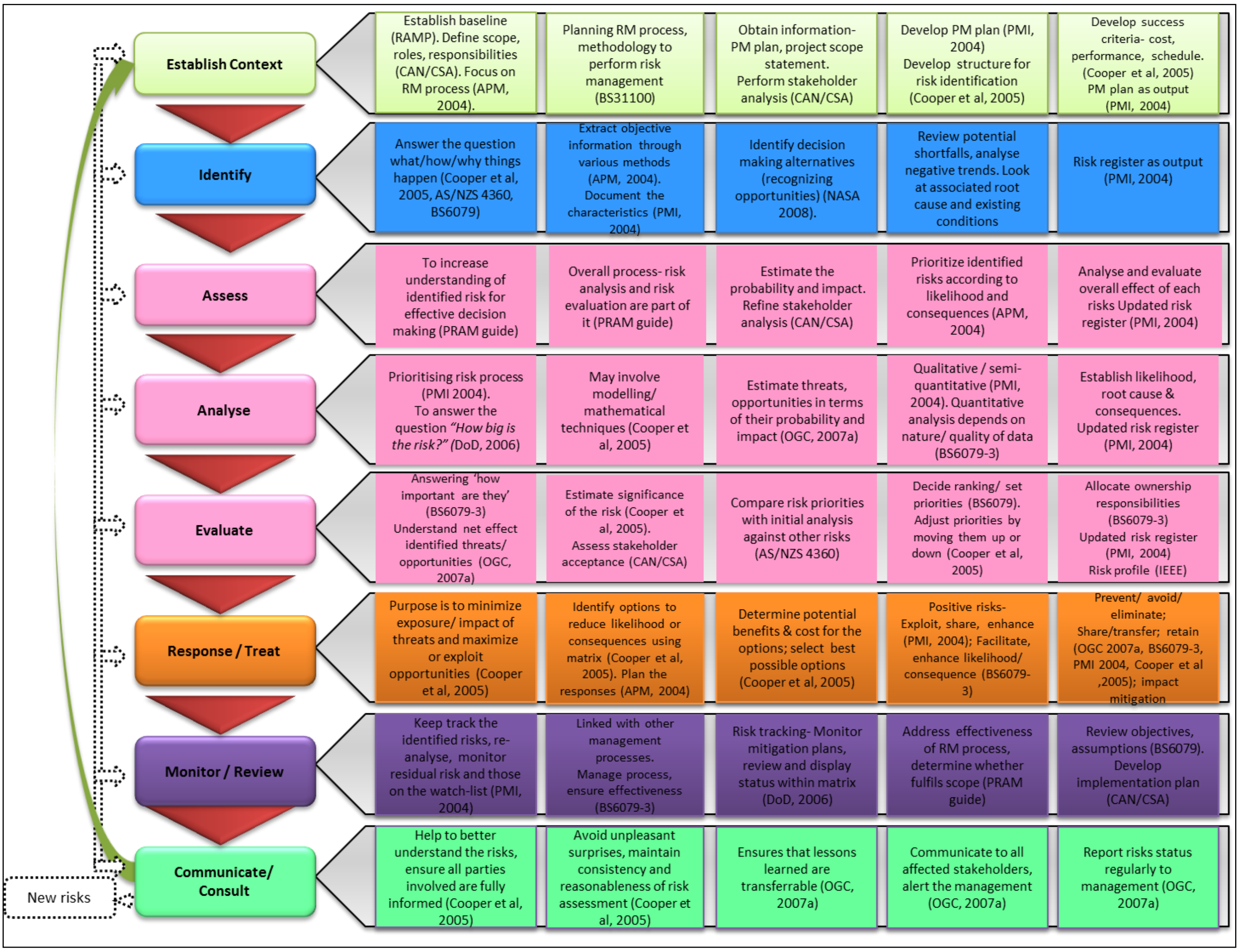


Figure 3.33: Summary of the conceptual processes of managing risks for projects *(Developed by author)*

3.5.7 Summary of the Various Approaches to PRM

This research found similarities between the three PRM approaches: Chapman and Ward, the INSEAD team and David Hillson, especially concerning the basis of their ideas. They adopted the theories of similar authors, particularly those relating to the area of people's behaviour in making decisions.

Chapman and Ward, and also David Hillson, adopted Kahneman and Tversky's theories and ideas regarding the economic theory relating to risk and uncertainty and decision making. Meanwhile, the INSEAD team and David Hillson's concept of PRM originate from von Neumann and Morgenstern's concept of utility function, risk attitude and game theory. These groups also adopt Herbert Simon's theory on rationality, decision making and problem solving. Besides these, the INSEAD team and David Hillson's researches are also linked to Fishburn's EUT on decision making under risk and uncertainty. Last, but not least, Goldratt's theory of constraints (TOC) in project management was adopted by Chapman and Ward and the INSEAD team. Although not related to the EUT, Goldratt's TOC is, in fact, related to people's behaviour in the decision-making process. Based on these backgrounds, the research concluded that these groups have emerged from the EUT, particularly relating to the behaviour and rationality in making decisions.

Besides these three approaches, the research reviewed multiple documents relating to project management, risk management and project risk management for the definitions and processes. These are the standards, guidelines and frameworks used globally to manage risks. From the reviews, the definition of project management can be summarised as *"a defined or structured process that organizes, manages or delegates the required activities of planning, monitoring, controlling, delivering, motivating, reporting, and reviewing, to achieve the project objectives, mission, and goals. It involves the application of relevant knowledge, skills, tools, and techniques by the project team"*. Meanwhile, risk suffers the most as it was found to be defined inconsistently. On the one hand, risk is defined according to the K-K proposition, which is *"a probability or likelihood of an event to occur; the consequences will affect or impact either positively or negatively"*. On the other hand, risk is also defined as *"an uncertainty, or an uncertain event, or the effect of uncertainty",* which contradicts with the K-K proposition: that there is no basis to calculate the probability of an uncertain event due to a lack of knowledge.

Although the definition of risk management varies in the publications, the research concluded that it is about the *"systematic/ structured/ coordinated/ disciplined/ directed and controlled process of identifying, analysing, evaluating, treating, monitoring or tracking and reviewing the risks. It is a continuous process, a culture, or an environment to achieve context, goals or objectives. It is a process of making decisions, communicating, or consulting"*. The definition of uncertainty suffers from fair attention by many. It is defined as *"a deficiency, incomplete, vagueness,* *ambiguity, insecurity, variability, and lack of clarity of information, knowledge, values or data. It may include the consequences and likelihood of an event to happen, risk and opportunity".* However, the research found it is impossible to attach probability to uncertainty.

This research also compares the steps or stages of the PRM processes which were extracted from fifteen documents and summarised in Table 3.19. These documents were considered based upon their general applicability to projects. Upon examining these documents, this research found that the risk management processes are understood in many ways, and are presented differently, from five to eight steps. The documents are lacking on clear and concise explanation as to how these processes work systematically. A comprehensive process should consist of clear steps, supported by brief explanation on the activities, tools, techniques as well as the expected outcome. The research proposed that in order to have a better understanding of the processes, clear steps or stages are helpful and therefore, an eight-stage process will be further analysed. The processes were taken from five documents which have eight processes namely, the PRAM guide, the RAMP process, the BS6079-3:2000, the CMU-SEI-94-SR-5 and, the NASA NPR 8000:4A. The processes involved are: establish context, identify, assess, analyse, evaluate, response or treat, monitor and review and, communicate and consult. In addition to these processes, the research also proposes to include the purpose, activities and tools and techniques involved within each process, as presented in Figure 3.33. It is hoped that this generic process will help to better understand the overall concept of PRM which can be applied to all projects in any industry.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

This chapter addresses the methodology which is utilised to achieve the research objectives. The research adopts a semi-structured interview methodology; this will be conducted with the middle and higher management personnel involved in managing project risks. It seeks to uncover and understand the practice of PRM by utilising experiences of individuals attached to particular projects; it will later develop a framework to explain this. The organisations are selected based on the criteria which has been set out earlier, and categorised according the United Nations' International Standard Industrial Classification (ISIC). Two modes of interviews have been adopted for this research: face-to-face and telephone interviews. The interview questions were designed in the form of an '*aide-memoir'*, which were used as a guide throughout the interview sessions. Interviews were recorded, transcribed and organised using NVivo software for analysis.

4.2 Research Methodology: Qualitative Study

This section briefly explains the qualitative research methodology which has been adopted for this research. It discusses the background and nature of qualitative research used for this thesis.

4.2.1 Background and Nature

This research investigates as to how organisations manage risk and uncertainty for their projects. The investigations comprises of understanding the concepts of risk, uncertainty and opportunity; the risk management and project management standards and guidelines adopted and their processes. It is also expected that other themes will be uncovered, as highlighted by other qualitative researchers such as Cavana et al. (2001) and Cresswell (2008).

Qualitative research is defined as *"an empirical, socially located phenomenon, defined by its own history, not simply a residual grab-bag comprising all things that are 'not quantitative"* (Kirk and Miller, 1986 in Silverman, 2001:47). Qualitative researchers such as Lawson (1988) and Wong (2008) emphasised that this methodology went beyond numbers; it generated in-depth knowledge from the descriptive, unstructured text-based data. Bringer et al. (2004) argued that there was no formula for the writing-up process; hence it required different analytical strategies.

A research is acknowledged for bringing some set of assumptions into the research paradigm and guiding the researcher in adopting an appropriate research approach (Sarantakos, 2005). According to Sarantakos, the ontological perspective of qualitative research paradigm advocates that the reality is not objective and is socially constructed. It assumes that there is a need to study how people perceive the world (not the world itself) because perception or understanding governs action and has real consequences. Perceptions or understanding of the practitioners are also said to be related to culture (Reisinger, 2009). Moreover, Samovar et al. [see (Samovar et al., 1981)] assert that the similarity in the peoples' perceptions reflects the culture in how they understand a particular issue. From the epistemological perspective, this research seeks to understand how people interpret the world, focusing on meanings and developing ideas through induction from data (Easterby-Smith et al., 1991). Meanwhile, Miles and Huberman [see (Miles and Huberman, 1994a)] suggest that there is a need to define the unit of analysis for a research. The unit of analysis for this research is the practitioners (such as the risk managers and project managers) or the social reality, which is the phenomenon to be studied with regards to their understandings on the concept of risk and uncertainty.

Qualitative research is chosen to understand the context of project risk and uncertainty management implementation. Silverman (2001) emphasised that qualitative methods would provide a deeper understanding of the concepts; the research, in accordance with this view, avoids statistical techniques. Furthermore, the exploratory nature of qualitative study allows the researcher to focus on organisations' current practices of project risk management. It is also important for the researcher to address the research question and be consistent with Marshall and

Rossman, allowing for the researcher to develop justifications for the chosen approach [see (Marshall and Rossman, 1995)]. This research also adopts Marshall and Rossman's approach to conducting qualitative research, by organising all data, generating themes using software, categorizing, explaining, as well as preparing write ups.

4.3 Qualitative Research in Risk Management

As discussed in Chapter 1, the research aimed to formulate a project risk management (PRM) framework by evaluating the current understanding and practices of organisations in varying industries in the UK. Underpinned by the interpretive and positivist paradigms, this research seeks to discover and understand the current practice of PRM processes using experiences of individuals attached to project organisations, and later develops a structure which explains the understanding based on the study. Similar paradigms have been used by other researchers in the area of project management [see (Shenhar and Dvir, 1996, Pollack, 2007, Bredillet, 2010, Bredillet, 2004, Oyegoke, 2011)].

The term organisation for this research refers to project organisation, in accordance with the suggestion by Reich et al. (2013:938). They emphasise that many theories on organisations apply in whole or in part to projects (Reich et al., 2013); and revealed that the term organisation also means project (p.940). Organisations (or project organisations) utilise projects as a means to achieve strategic market needs through implementing project governance and project-based management which will also raise the visibility of project management expertise [see (Chinowsky, 2011, Bryde, 1995)]. The argument that project organisation is a form of organisation is supported by many researchers [see (Middleton, 1965, Ekinsmyth, 2002, Lundin and Söderholm, 1995, Hovmark and Nordqvist, 1996)] because it enables all personnel involved to participate in project from the inception and also to have influence to the project. Therefore, it is difficult to distinguish or draw a line between project, project organisation and permanent organisation features.

This research will be conducted through semi structured interviews with the managers involved in the management of project risks. The samples or the interviewees are attached to differing organisations and from various industries, such as aerospace and defence, oil, gas and petrochemical, water, energy and power, telecommunications and construction; and comply with the following criteria:

a) Organisations that produce clear engineered products.

b) Organisations that have design, engineering and construction processes.

c) Organisations which have project management and/or risk management practices in place.

Unlike quantitative research which typically requires the sample to be randomly selected, samples for qualitative research are generally non-random, purposeful and small in numbers (Merriam, 1998). Various techniques were used to compile a list of potential interviewees from varying organisations. Firstly, the researcher managed to acquire assistance from the Institute of Risk Management (IRM), UK, to circulate the research request among its members. Secondly, the requests were distributed to those participating in seminars and events organised by the IRM and the Association for Project Management (APM) in the Northwest of England region. Additionally, organisations, which are part of the professional institutions, associations and societies linked to the related industries, contacted individuals and contact persons via email. Requests were also sent to the relevant companies listed in the Financial Times FT500; their email addresses were lifted from either the company websites, or those of the related institutions and associations.

Snowball sampling approach has been used through recommendation or referral made by the initial interviewees. This approach adopted when there is no specific list available to choose the potential respondents or difficult get hold of a respondent. This research managed to secure twenty-six interviewees from differing organisations and industries to participate; twenty-two of which were face-to-face interviews, four conducted by telephone interviews.

4.3.1 Categorisation of Industries

Using the latest revision of the International Standard Industrial Classification of All Economic Activities (ISIC, Rev. 4) published by the United Nations Statistics Division, the organisations are categorised according to industry. The industries are aggregated into twenty one sections and are tabulated as follows:

Section	Description
A	Agriculture, Forestry, Fishing
B	Mining and Quarrying
C	Manufacturing
D	Electricity, Gas, Steam and Air Conditioning Supply
E	Water Supply, Sewerage, Waste Management and Remediation Activities
F	Construction
G	Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles
H	Transportation and Storage
I	Accommodation and Food Service Activities
J	Information and Communication
K	Financial and Insurance Activities
L	Real Estate Activities
M	Professional, Scientific and Technical Activities
N	Administrative and Support Service Activities
O	Public Administration and Defence; Compulsory Social Security
P	Education
Q	Human Health and Social Work Activities
R	Arts, Entertainment and Recreation
S	Other Service Activities
T	Activities of Households as Employers; Undifferentiated Goods-and-Services Producing Activities of Households for Own Use
U	Activities of Extraterritorial Organisations and Bodies

Table 4.1: ISIC Classification of Industries *[Source: (ISIC, 2008)]*

The ISIC is chosen because it represents a comprehensive structure of economic activities that have been agreed internationally. The economic activities are categorized alphabetically into different sections, from A to U. Each section is further divided into divisions, groups and classes, with a number as the coding method. For example, Section F is for construction and construction of buildings, which is aggregated differently than ‘construction of roads and railways'. This can be explained further below:

Division	Group	Class	Description
Division 41			**Construction of Buildings**
	410	4100	Construction of buildings
Division 42			**Civil Engineering**
	421	4210	Construction of roads and railways
	429	4290	Construction of other civil engineering projects

Table 4.2: Example of classification and aggregation by ISIC
[Source: *(ISIC, 2008)*]

Based on the ISIC aggregation, the research found that issues may arise regarding the overlapping of the Sections to which a particular organisation belongs. For example, an organisation producing defence-related products belongs to two different sections of industry, namely, Section 'C' (Manufacturing) and Section 'O' (Public Administration and Defence). Therefore, the research decided to maintain both sections in order to establish more accurate results during the analysis.

4.3.2 Empirical Data – Interviews

According to Rapley (2001:p317), an *"interview is an economical means of getting access to topics and to get people to think-out-loud about the topics discussed".* This section provides the techniques which were adopted to collect the data. Interview is the primary source of data for this research; there were two modes of interview adapted for this research: *face-to-face* and telephone. The actual duration of the interviews ranged from half hour to two hours.

As discussed in chapter 1, previous research on PRM was conducted within various industries, such as automotive manufacturing, construction, and information technology (IT). For example, Greene (2002) conducted semi-structured interviews with senior managers within a single organisation in the construction industry; Baccarini *et al* (2004) interviewed the IT project managers in Western Australia. Kutsch and Hall (2009) investigated the practices of PRM in the IT industry through semi-structured interviews with the IT project managers. The research has found, however, that no PRM research investigated and compared the practice of PRM in multiple industries. Therefore, it is important that this research adopts the semi-structured interview method in multiple settings, exploring the context and current understanding of PRM in different industries.

4.3.2.1 Face-to-Face Interviews

Face-to-face interviews constitute the main mode for this research. This allows the interviewer to adapt the questions and to clarify any doubts and issues. During the face-to-face interviews, Cavana et al., (2001) affirms that the interviewer has an option to rephrase a question that was not understood by the interviewee [see (Cavana et al., 2001)]. Twenty-two face-to-face interviews were successfully conducted, eighteen were conducted at the interviewee's office; two were conducted at the places of their choosing; another two were conducted at the Manchester Business School, as the interviewees happened to have other commitments nearby.

4.3.2.2 Telephone Interviews

Telephone interviews were conducted when the potential interviewee and the researcher had difficulty in agreeing on meeting dates. Additionally, the telephone interviews were conducted with the interviewees who were demographically difficult to meet due to financial and time constraints for travel. A total of four telephone interviews were conducted for this research.

Holt (2010) and Stephens (2007) have debated the contribution made by the various modes of research. Holt (2010) argued that telephone interviews were an ideological, methodological and practical mode of interviewing; Sturges and Hanrahan (2004) believed that this mode could be a useful method for qualitative studies. According to Holt (2010:113), the use of the telephone should be considered as a preferred alternative to face-to-face interviews. Additionally, telephone interviewing provides an opportunity to obtain data from potential participants who are reluctant to participate visually (Sturges and Hanrahan, 2004). Holt (2010) stressed that telephone interviews provided comfort and convenience to the interviewee, its success dependent upon the skills of both the interviewer and the interviewee.

4.3.2.3 The Process of the Interview

An interview is a social interaction, thus the researcher need to mediate the interview relationship (Stephens, 2007). All interviews were scheduled in advance to allow for the potential interviewees to prepare useful information prior to the interview. According to Stephens (2007), such an approach provides contextual awareness and an increased enthusiasm during the interview. The research found that the following issues are pertinent in conducting telephone interviews:

a) Interruption

During the interview, it was impossible to control any direct interruptions. The interviewee's incoming telephone calls were an obvious issue for this research, as they interrupted the momentum and enthusiasm for sharing and gaining important information. The flow was affected, and some ideas might have been altered or lost during the duration of the interruption.

b) Topic Control

The research found it very challenging to exercise a good control over the conversation and hold the flow through predicting further questions to be asked, as highlighted by Rapley (2001), especially in earlier interviews. This might have interrupted the conversation, altered the probing nature or shape of the conversation (Stephens, 2007). The enthusiasm to explain further might come to a frustrating end when the thoughts are interrupted with other unrelated questions. This became less of a challenge with the experience of conducting interviews.

c) Lack of Visual Communication

Emotional context, expressions, reactions and non-verbal communication could not be recorded through telephone interviews. Stephens (2007) has highlighted that due to the absence of visual communication, both parties are unable to respond to expressions of confusion or interest. Additionally, due to the lack of visual cues, the interviewee would take instant non-response as a request to continue to speak (Stephens, 2007).

d) Controlling the Environment

The issue of an uncontrolled environment is pertinent to the quality of the recorded information. Interviewees were always asked regarding their readiness to proceed. According to Stephens (2007), the interviewee needs space and time to prepare their environment prior to the interview; this would make them feel comfortable throughout the session. One particular example relating to this arose in the research: an interview had to be put on hold for a few minutes to allow for an incoming telephone call to be taken by the interviewee; this was an uncontrollable factor.

From the interviews, the researcher found that although there are some exceptions for telephone interviews, the outcome from the face-to-face and telephone interview modes revealed no significant difference, which is in agreement with the findings of Sturges and Hanrahan (Sturges and Hanrahan, 2004). As mentioned earlier, none of the previous research on PRM was conducted in multiple industries. Therefore, the variation in the nature of the projects by sector provides the research with considerable amount of data from differing practices which might significantly influence the findings.

4.3.2.4 Versions of Interview Data

The following table illustrates three different versions of data, specifying the type of knowledge each pursues, and the different research tasks they set (Silverman, 2001).

	Status of Data	Methodology
Positivism	Facts about behaviour and attitudes	Random samples, Standard questions, Tabulations
Emotionalism	Authentic experiences	Unstructured, open-minded interviews
Constructionism	Mutually constructed	Any interview treated as a topic

Table 4.3: Three versions of interview data (*Source: Silverman, 2001: 87*)

Travers (2001) argued that positivists favour the use of quantitative methods, especially in researching large-scale phenomena. This is supported by Silverman (2001) who indicated that for positivism, the primary issue is to generate data, which are valid and reliable. On the other hand, 'emotionalism' refers to the technique in which interviewees are considered to be the subject and data are collected through unstructured, open-ended interviews based on in-depth observation (Silverman, 2001). Meanwhile, Silverman pointed out that for 'constructionism', both interviewers and interviewees are always actively engaged in constructing meaning; the interviewer construing the value of the information.

Travers (2001) suggested that qualitative methods could also be interpretive. Interpretivist data employs a qualitative method to address the meaningful character of human group life, and understand societies' own actions, which includes representativeness. This is where positivists differ from interpretivists; the former spend time devising sampling procedures, the latter might want to know how the society understands or the representativeness (Travers, 2001). Based on the above comparisons, this research is inclined towards that of an interpretivist approach. This is due to the nature of the research, which attempts to explore the context of current practices and understanding of the concept of risk and uncertainty, as well as project risk management.

4.3.2.5 Interview Questions

In this section, the research attempts to provide an explanation of the semi-structured interview method adopted. It is important that the interview questions are designed in such a way that it provides a framework for the collection and analysis of data (Bryman, 2001). According to Cresswell (2008), the design of qualitative study is to explore the central phenomenon and the emerging process of the study in question. Thus, the central phenomenon for this research is the understanding of the concepts of risk and uncertainty, whilst the emerging processes explore any new themes or patterns in managing risk and uncertainty for projects.

The interview questions are designed according to the issues and ideas drawn from reviewing the literature. The challenge for the researcher was to make sure that the questions were neutral and not leading. Furthermore, the questions were to encourage interviewees to speak about the topic with little prompting as possible from the interviewer, as highlighted by Rapley (2001).

The interview questions were in the form of an '*aide-memoire*', and used as an interview guide to deal with topics. The interviewee has a great deal of leeway and was allowed to respond freely (Bryman, 2001). The '*aide-memoire*' was designed according to factors drawn from the review of the literature, and divided into five sections, namely, Sections A, B, C, D, and E.

Section A covers the organisation's practice of project management, which includes PMOs, standardized processes, project governance and their impact on the project. Section B is about risk management. The questions include the definition of terms, risk management function, and the general understanding of risk and uncertainty and their management in the organisations. Meanwhile, Section C covers the process of managing risk and uncertainty which has been adopted in the organisation. Experience and results from the practice of managing risk and uncertainty are the main focus of Section D. The interviewees were asked to share their views and comment upon their current practices of managing risk and uncertainty for projects in Section E. The full '*aide memoir*' is provided in Appendix A.

This '*aide-memoire*' helps to address the achievement of the research aims and objectives. It was prepared to support and convey the underpinning issues related to the concept and processes of managing risk and uncertainty for projects. According to Marshall and Rossman (1989), an exploratory study addresses the questions relating to the level of understanding of the phenomena and the variety of patterns, themes and categories.

4.3.2.6 Requests for an Interview

The interview requests were prepared to suit the research requirements, in terms of the research aims and objectives. Additionally, there was a supplemental attachment which provided the guidelines and scope of the research, covering the practice of project management and risk management within their organisations. The research has highlighted previously that the interviews were to be audio recorded instead of note taking only, to eliminate the possibility of losing important information relating to the research. The requests were approved by the supervisors prior to distributing to the potential organisations. The interviews were conducted with project managers, risk managers, and other managers responsible for the risk management processes in the organisation. The sessions were guided by the '*aide-memoire*' and lasted from half hour to two hours, depending on the information discussed.

4.3.2.7 Record of Interview Questions

The informants were interviewed at their convenience so that they could spare their time to share information freely. Interviews were recorded using a digital voice recorder, enabling for the details provided to be transferred to a computer. Alongside the voice recorder, field notes were used as an additional method. Field notes are useful in clarifying terminology or aspects of the interview context. According to Poland (1995:306), this may have a bearing on how statements are heard or interpreted, provided that the field notes are not a "gold standard", against which to assess transcription, thus they are necessarily partial interpretive accounts. These formal and informal methods are in accordance with the method suggested by Cresswell (2008).

4.3.2.8 Sources of Data

Interviews are the main source of data for this research; all interviews were recorded and transcribed into texts using Microsoft Word and later were transferred into selected qualitative research software, i.e. NVivo. Each transcript represents an organisation and is identified as an internal source in NVivo, whereby its contents are used as a reference for coding. The data were organised through NVivo's index roots system called 'free nodes' and 'tree nodes'. The difference between these nodes is that tree nodes allow coding to be made in a hierarchical manner, whilst free nodes are non-hierarchical and the data can be explored freely and reorganized into tree nodes as required. NVivo facilitates the process of analysing the data and allows the data to be interpreted into a defined code.

Many strategies, of which coding is one, have been adopted by qualitative researchers (Maxwell, 2005). Although it has been argued by Maxwell (2005) that there is more to qualitative study than coding or categorization, this activity is an important step in analysing qualitative data (Beekhuyzen et al., 2010). It involves linking, breaking up and disaggregating the data, thus the data are seen as a category and not a research event (Beekhuyzen et al., 2010, Morse and Richards, 2002).

4.3.2.9 Issues in Data Collection

Despite several methods being employed, there were still some issues and difficulties experienced in collecting data for this research. The responses to the requests were very low; only twenty-six interviews were successfully conducted. A number of prospective interviews had to be postponed and finally cancelled due to the informants' failure to commit to a time. Due to the confidentiality issue, several informants could not discuss or disclose information relating to risk management guidelines and procedures; others had time constraints for the interviews. This resulted in a time limitation for the interview, and a lack quality of information shared in the research.

4.3.3 List of Interviews According to Industry

The list of interviews conducted for this research is given in Table 4.4a and Table 4.4b. Table 4.4a outlines the interviewees' background. Table 4.4b provides the classification and aggregation of industries according to the ISIC Classification of Industries, to be adopted during analysis. Each interviewee was assigned a number for easy identification. Additionally, the nature of business to which they belong is identified; instead of the organisation's actual name, conforming to the requirement set by the university's research ethics committee and the interviewees' requests not to disclose any individual or organisations name. The research conducted interviews with project managers, risk managers, project directors and other managers responsible for the risk management processes in the organisations. Managers are chosen for this research due to their experiences in managing project risk and their capacity to make good decisions. From the interview, the research found that these managers had between ten to thirty-seven years of working experiences.

Intervie-wee	Position Held	Academic/ Professional Qualifications	Years of Holding Current Post	Total Years of Experience	Interview Date (F/T)*	Interview Duration
001	Risk & Value Manager	MSc Const Law & Arbitration	> 10	25	21-Jul-09 (F)	01:19:33
002	Director, Independent risk consultant	MA,PhD, Mathematics, Astrophysics	6	28	09-Sep-09 (F)	01:09:45
003	Manager	PhD, Electrical & Nuclear, MIRM		>25	10-Sep-09 (F)	01:27:53
004	General Manager	MSc & PhD, Project Mgmt, BSc (Hons), Civil & Structural Eng.	3	23	24-Sep-09 (F)	01:28:45
005	Business Risk Manager, Financial Planning & Analysis	B.Sc (Hons), Mechanical Eng., M.Sc, Reliability Eng. & Safety Mgmt, MBA	3	14	17-Sep-09 (F)	02:08:28
006	Risk Manager	MSc Quality Mgmt, Statistical Methods & Reliability; BSc, Software Eng.; Intl Dip. in Risk Mgmt (IRM)	3	10	17-Sep-09 (F)	01:21:01
007	Commercial Director	Oceanography & Geology	5	14	25-Sep-09 (F)	01:34:02
008	Project Manager	Engineering (BSc)	4	22	04-Dec-09 (T)	00:42:47
009	Project & Risk Manager	Management Science (BSc)	>10	35	14-Jan-10 (F)	01:44:29
010	Manager Risk & Insurance	ACII, Chartered Insurance Practitioner	7	37	11-Jan-10 (F)	01:14:10
011	Competency Development Manager	NA	3	37	18-Dec-09 (F)	01:20:18
012	Capital Risk Manager	Civil Engineering (BSc)	4	14	15-Jan-10 (F)	01:51:00
013	PMO Leader	NA	>15	>25	09-Feb-10 (T)	00:58:49
014	Risk Manager	M.o.Sc, Applied Physics & Electrical Engineering	8	26	11-Feb-10 (F)	01:09:01
015	Group IT Assurance Manager	MBA, MSc IS, BSc Economics, BSc Geography & Town Planning	3	13	12-Feb-10 (F)	01:45:30
016	Head of Resilience (former Director, Risk Management)	MA, Engineering, Chartered Engineer	12	30	22-Feb-10 (T)	01:19:09
017	Framework/Project Manager	NA	7	NA	22-Feb-10 (F)	01:32:22
018	VP Project Office	NA	NA	NA	25-Feb-10 (T)	00:27:42
019	Program Control Lead	APM	NA	>20	26-Feb-10 (F)	01:47:14
020	Risk Manager	Production/ project	>15	25	03-Mar-10 (F)	01:09:29
021	Risk Manager	MSc Project Management	10	28	04-Mar-10 (F)	01:01:21
022	Head of Internal Audit	BSc.Eng, MEng Proj.Mgmt, MIIA Internal Audit	2	13	05-Mar-10 (F)	01:39:45
023	Project Director	MIET (Electricity)	8	>20	17-Mar-10 (F)	00:35:29
024	Controls Director of Projects	Engineering (BSc), PE, IMechE	7	>15	18-Mar-10 (F)	00:28:12
025	Head of Internal Audit	Chartered Accountant, ICAEW	2	13	25-Mar-10 (F)	01:04:18
026	Risk Manager	MSc Risk Mgmt	5	12	20-Jul-10 (F)	01:07:19

Table 4.4(a): Interviewees' background
* Note: (F) = Face-to-face interview; (T) = telephone interview

Interviewee	Business Type	United Nation's Industry Classification - Industry 1	United Nation's Industry Classification - Industry 2
001	Railway/Train operations	H - Transportation and storage	
002	Consultancy-construction, RM	F – Construction	M - Professional, scientific and technical activities
003	Power-nuclear; Consultancy-construction	D - Electricity, gas, steam and air conditioning supply	M - Professional, scientific and technical activities
004	Capital investment-eng & const	F – Construction	M - Professional, scientific and technical activities
005	Railway/Train operations	H - Transportation and storage	
006	Railway/Train operations	H - Transportation and storage	
007	Consultancy-eng & const	F - Construction	M - Professional, scientific and technical activities
008	Railway/Train operations	H - Transportation and storage	
009	Manufacturing-defence aircraft	C – Manufacturing	O - Public administration and defence; compulsory social security
010	Mining-natural resources	B - Mining and quarrying	
011	Water supply & sewerage	E - Water supply; sewerage, waste management and remediation activities	
012	Airport operations	H - Transportation and storage	
013	Manufacturing- defence aircraft	C – Manufacturing	O - Public administration and defence; compulsory social security
014	Mining-petroleum	B - Mining and quarrying	
015	Services	F – Construction	N - Administrative and support service activities
016	Manufacturing- defence aircraft	C – Manufacturing	O - Public administration and defence; compulsory social security
017	Construction	F – Construction	
018	Manufacturing- defence aircraft	C – Manufacturing	
019	Manufacturing-defence submarine	C – Manufacturing	O - Public administration and defence; compulsory social security
020	Manufacturing-defence submarine	C – Manufacturing	O - Public administration and defence; compulsory social security
021	Construction	F – Construction	
022	Power-transmission/distribution	D - Electricity, gas, steam and air conditioning supply	
023	Mining-petroleum E&P technology, refining	B - Mining and quarrying	
024	Water supply & sewerage	E - Water supply; sewerage, waste management and remediation activities	
025	Manufacturing- defence aircraft	C – Manufacturing	O - Public administration and defence; compulsory social security
026	Manufacturing- defence aircraft, Turbines; Power-nuclear	C – Manufacturing	D - Electricity, gas, steam and air conditioning supply

Table 4.4(b): Organisation’s classification and aggregation

4.3.4 Issues and difficulties

This section discusses the issues, problems and difficulties in engaging with the interview as well as the subsequent process, which is transcribing. Problems and issues relating to the interview methodology have been discussed at length by scholars from different perspectives (Roulston et al., 2003). The anticipation of an interview ensures that the researcher acquires a good quality narrative. The process of interview is highly dependent on the skills and interactional context between the researcher and the respondent. Additionally, the interview data are not preconceived prior to the interview itself, and there is no assurance of what will occur (Roulston et al., 2003). However, the number of researchers who have received formal training in interviewing is low, and a novice researcher will only be able to obtain quality data. Therefore, Roulston et al. emphasise that it is only through experience and practice that a novice researcher will be able to obtain quality data.

4.3.4.1 Issues with Interview Methodology

In conducting this research, the following are among the issues and difficulties encountered throughout the process of interviewing; these concur with the ideas of Dean and Sharp (2009:13).

a) Recording difficulties

   Recording difficulties can be due to several reasons. One source of difficulty can be the quality of the recording device. This idea is supported by Poland (1995). To overcome this issue, the researcher took pre-emptive action by using a high-quality digital voice recorder, also suggested by Poland (1995:300). Digital devices provide quality recording, which is vital during the transcribing process. The research adopted the strategy set by Poland (1995:304) in order to ensure a high quality interview.

Strategy	Method
Equipment	Use electrical outlet and external microphone whenever possible
	Always check the battery and bring additional batteries if required. Some electronic devices can be connected directly to a computer to charge the battery
	Device should be in good condition and always checked before the interview
Before the Interview	Choose a quiet interruption-free place
	Place the device close to the respondents and speak loud enough so that the information is clear
	Set the device on a stable surface
	Test the recording system
During the Interview	Speak loudly and not too fast
	Ask the respondent to speak clearly
	Make a test with the respondent, then rewind and listen to check as to whether the respondent is speaking distinctly. If not, speak louder and clearer
	Correct any mechanical or personal problems before continuing
	Do not rustle papers, cups, or bottles near the device
	At the end of the interview say "This is the end of the interview with..."
After the interview	Listen to the device, make notes to list proper names or pseudo-names and unfamiliar terminology
	Keep device safe and do not expose it to extreme temperatures

Table 4.5: Strategies to ensure high quality of recorded interview

[Adapted from Poland (1995:304)]

b) Temporal factors

According to Dean and Sharp (2006), interviews are genuinely abridged or postponed because of unexpected events. The researcher experienced several cases of interviews being postponed and a few cases of cancellation due to the unavailability of the potential interviewees in committing for the interview sessions. These events affected the impetus to conduct the interviews. Therefore, the researcher had to be prepared for such uncertainty.

c) Individual differences in the ability to recall past events and to communicate them.

The interviewee's competence has been criticized by Dean and Sharp (2006), particularly in strategy research, because the interviewee represents the organisation and thus produces the data in favour of their organisation (Alvesson, 2003). At times, interviewees could not provide sufficient information concerning their process of risk management, and instead provided general information concerning certain issues. Imperfect interviews may result in conflicting accounts of past events, and produce biased or inadequate views as the interviewee conveys their own viewpoint (Dean and Sharp, 2006).

d) Cultural issues about what may be discussed.

The issue of culture results from the differences in intra-organisational cultures and perceptions within the organisation of the nature of the interview subject [see (Miles, 1979, Reisinger, 2009)]. Additionally, not all personnel in the organisation will agree to a recorded interview due to personal or other classified issues (Dean and Sharp, 2006). In a few cases, the interviewees were unable to disclose some information due to the nature of their projects, which were restricted, especially the defence-related industries.

4.4 Data Analysis

Qualitative data analysis is defined as *"the process of systematically searching and arranging the interview transcripts, observation notes, or other non-textual materials that the researcher accumulates to increase the understanding of the phenomenon"* (Wong, 2008:14). Wong added that data were often subjective, consisting of in-depth information, which is usually presented in text form, pictorial display, audio, video or other multimedia materials. According to Miles (1979), qualitative data are attractive in the sense that they are rich, full, earthy, holistic, and real; their face validity seems flawless; they preserve a chronological flow; they experience minimum retrospective distortion; and they offer a precise way to assess causality in organisational affairs. However, Schönfelder (2011) argued that qualitative data are messy and tend to grow rapidly from a few pages of interview transcripts or field notes into a huge pile of information. Therefore, there will be different conclusions drawn from the data analysis, depending on the methodological framework used (Wong, 2008).

Analysing qualitative data will allow the researcher to organise and categorise according to patterns (Auld et al., 2007). In addition, it acts as a means to manage the data (Schönfelder, 2011, Lawson, 1988), and ensures that the relevant phenomena are analysed to find commonalities (Basit, 2001). The objectives of analysing qualitative data are to determine the categories, relationships and assumptions based on the respondent's view of the world (Basit, 2001), and to deconstruct blocks of data through fragmentation and combine them into related categories (Jones, 2007). This can be done through the coding technique.

4.4.1 Coding

The data for this research is split into manageable pieces and needs to be reconstructed to reflect the view of reality (Beekhuyzen et al., 2010). This systematic process is referred to as coding. Coding or categorizing the data, which is one of the crucial aspects of analysis, requires the researcher to identify the meaningful segments of text between the less valued data (Lawson, 1988). Additionally, Morse and Richards agree that coding must be done properly to link data and ideas and to justify the interpretation of ideas (Morse and Richards, 2002).

The research adopted one of Miles and Huberman's (1994) methods for creating a code, which is called *in vivo* coding. This method involves coding the data without *a priori* knowledge and labelling; the researcher having little information about the research (Miles and Huberman, 1994b). The information from interview transcripts is coded and these codes are collected into categories. This process ends when the categories have developed some meaning, which is called re-contextualizing (Jones, 2007).

Coding is performed with the assistance of computer software for qualitative research, namely, NVivo. The use of computer-assisted software is common for quantitative data analysis and has only recently been developed to aid the analysis of qualitative data (Buchanan and Jones, 2010). Moreover, the use of software in qualitative research has been supported by notable researchers (Morse and Richards, 2002, Miles and Huberman, 1994b, Silverman, 1993). Although software does assist analysis, Buchanan and Jones (2010) agree that the researcher must still collect data and add their tasks, (such as deciding what to code and how to conceptualise it), manually. The argument being, that software is merely a tool to facilitate the analysis to become more effective and efficient (Buchanan and Jones, 2010).

4.4.2 NVivo

As discussed above, once all the interviews data have been transcribed, the research adopts Marshall and Rossman's systematic approach to initiate data analysis for qualitative research. Similarly, other authors have also embraced this process [see (Patton, 1987, Guba, 1978, Boyatzis, 1998). The process includes organising all data, generating and categorizing main themes and sub-themes, managing them by looking at the regularities or patterns, and interpretation of the patterns in a way that contributes to the development of knowledge.

NVivo software is adopted to assist the researcher in qualitative data analysis and to safeguard the validity and reliability of the data as well as its findings. NVivo was chosen due to it being designed for researchers who wish to display and develop rich data in dynamic documents (Richards, 1999). It supports the management of research activity within and across phases, which can be revisited regularly as the research project matures (Bandara, 2006). Furthermore, it allows the researcher to import and code textual data, edit, retrieve, review and re-code the data. According to Bandara (2006), data are arranged as documents, data that one analyses in the study; and nodes, locations to store ideas and categories. Nodes hold all the information that has been coded under distinct categories. According to Jones (2007), the functions of NVivo can be categorized into three main elements, namely, coding, conceptualisation, and data management. The detailed breakdowns of the functions are as follows (Jones, 2007):

a) Coding – analyse documents, multiple categories or concepts, auto coding.
b) Conceptualisation – memos, data-bytes, conceptual models, hypothesis testing.
c) Data management – search, assay, reports.

For this research, NVivo was found to be the most suitable computer software due to the large number of interview transcripts; each interview took from half hour to two hours. Additionally, the researcher took a longer time to code each transcript and to form the coding structure. These factors were carefully looked into prior to the decision to choose NVivo. The same factors have been discussed by Auld *et al*. (2007).

NVivo is a new-generation of computer aided qualitative data analysis software (CAQDAS). CAQDAS has been widely used in qualitative research (Dean and Sharp, 2006). There have debates as regards to utilising CAQDAS to analyse qualitative data, especially concerning its suitability (Bringer et al., 2004, Schönfelder, 2011). However in reality, CAQDAS packages are only used by researchers with a firm understanding of their methodology and an awareness of the limitations of the programme. NVivo has been developed by Qualitative Solutions Research (QSR), and it has evolved from the Non-Numerical Unstructured Data, Indexing, Searching, and Theorizing or NUD*IST, which then became N3, and later NVivo (Auld et al., 2007, Basit, 2001, Bazeley, 2002, Bringer et al., 2004). NUD*IST was the first non-statistical programme to provide real assistance to qualitative researchers (Richards, 2002, Richards, 1999) in retrieving text from data, and allowing users to code and develop a tree structure system (Jones, 2007). It was created by Professors Lyn Richards and Tom Richards in 1981 (Bringer et al., 2004, Bandara, 2006). NVivo stands for NUD*IST VIVO and was named 'in, vivo' coding, that is, assigning a category from the participant's words. Based on NUD*IST4 (Richards, 1999), NVivo was developed in 1999 to provide the same services as NUD*IST, but in a more refined way (Bringer et al., 2004).

The researcher found that NVivo aids analysis, by coding data according to two main themes: project management and risk management practices, and further classifying them into various sub-themes. This is useful for identification, indexing, or data retrieval during analysis (Auld et al., 2007, Bandara, 2006, Wiltshier, 2011).

Tree nodes

Two leading themes were identified from the literature review- namely, project management and risk management,-they refer to the main area of this research. Project management and risk management are used as a basis for data analysis and are placed as the first level of tree nodes. The second level of tree nodes was derived from the interview sections and sub-sections. The first area of the interview questions covers project management, with sub-sections on project management practices; project management issues; project management office (PMO); project management processes; and project procurement and contract. The second area, which covers risk management, has sub-sections on current practices; project and risk management; risk management in general; risk, opportunity and uncertainty; as well as standards, guidelines and frameworks. These sub-sections are also based on the literature reviews conducted. Figure 4.1 provides an example of the tree nodes related to this research: risk management and project management. The sources' column indicates the number of the source, which, in this case, is the interviewees and the references' column, which indicates the number of references coded from the interview transcripts. There are twenty-six interview transcripts from the twenty-six interviews conducted. All interviewees provided information relating to the questions on risk management. However, only twenty-five interviewees answered questions on project management, one mentioning that project management was not in their scope of work, and therefore being unable to provide any information.

Tree Nodes

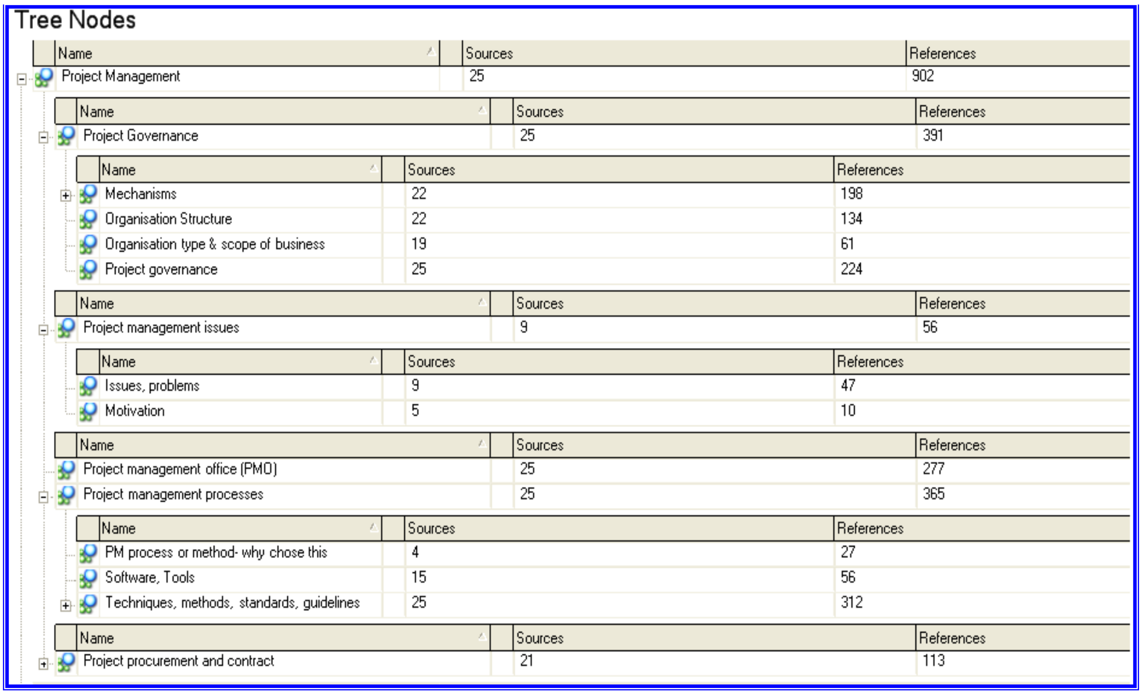
Name	Source	References
Risk Management	26	2300
Project Management	25	655

Figure 4.1: NVivo – Tree nodes on project management and risk management

With the substantial number of interview data, NVivo provides the capability for data management, coding text, retrieving text and testing theory through examination of relationships among nodes. In addition, NVivo allows for quick query processing and managing large quantities of coded data (Auld et al., 2007, Jones, 2007, Sorensen, 2008, Wiltshier, 2011). This allows for ideas and issues to emerge freely, without forcing data into already established categories (Buchanan and Jones, 2010), as well as helping to visualize information from a new perspective (Wiltshier, 2011).

<u>Coding</u>

The coding emerged from the data, using the interviews, and was grouped into the selected second and third-level nodes. Figure 4.2 and Figure 4.3 give details of the first, second and third-level nodes. The data, which are referred to as reference in the nodes, have to be re-read and further coded into third-level nodes. This process is repeated until the data is found to be saturated and cannot be coded further. The coding is supported by the data, and focuses on the interviewees' comments and views rather than preconceived models or hypotheses (Bringer et al., 2006). In order to stay transparent, the coding was done in a straightforward manner; using the interviewee's own ideas and words as reference, and the unit of classification for the analysis as the text.



Tree Nodes

Name	Sources	References
Project Management	25	902
Project Governance	25	391
Mechanisms	22	198
Organisation Structure	22	134
Organisation type & scope of business	19	61
Project governance	25	224
Project management issues	9	56
Issues, problems	9	47
Motivation	5	10
Project management office (PMO)	25	277
Project management processes	25	365
PM process or method- why chose this	4	27
Software, Tools	15	56
Techniques, methods, standards, guidelines	25	312
Project procurement and contract	21	113

Figure 4.2: NVivo – Expanded tree nodes on project management (Levels 1, 2 & 3)

Figure 4.2 depicts the expanded tree nodes on project management. The second level nodes represent five sub-sections, of which one is project governance, within the project management scope, this being derived from the literature reviews conducted. During the interviews, the interviewees were asked questions related to the mechanisms of governance adopted, the organisation structure, the type of organisation, scope of business and type of project governance adopted within the organisation. These are categorised as the third level nodes. Derived from the interview transcripts, it is found that project governance has the highest number of sources (25) and also the highest number of references (224); organisation type and scope of business has the lowest sources (19) and references (61). Another example second level node is project management processes; which include the method or standard, the tools and the techniques adopted as third level nodes.

Tree Nodes

Name	Sources	References
Project Management	25	902
Risk Management	26	2300

Name	Sources	References
Current Practice	26	1431

Name	Sources	References
Risk management function	25	230
Risk management in practice	26	1148
Risk management issues	26	320

Name	Sources	References
Project management & Risk management	13	41
Risk management in general	25	371
Risk, Opportunity & Uncertainty	25	366

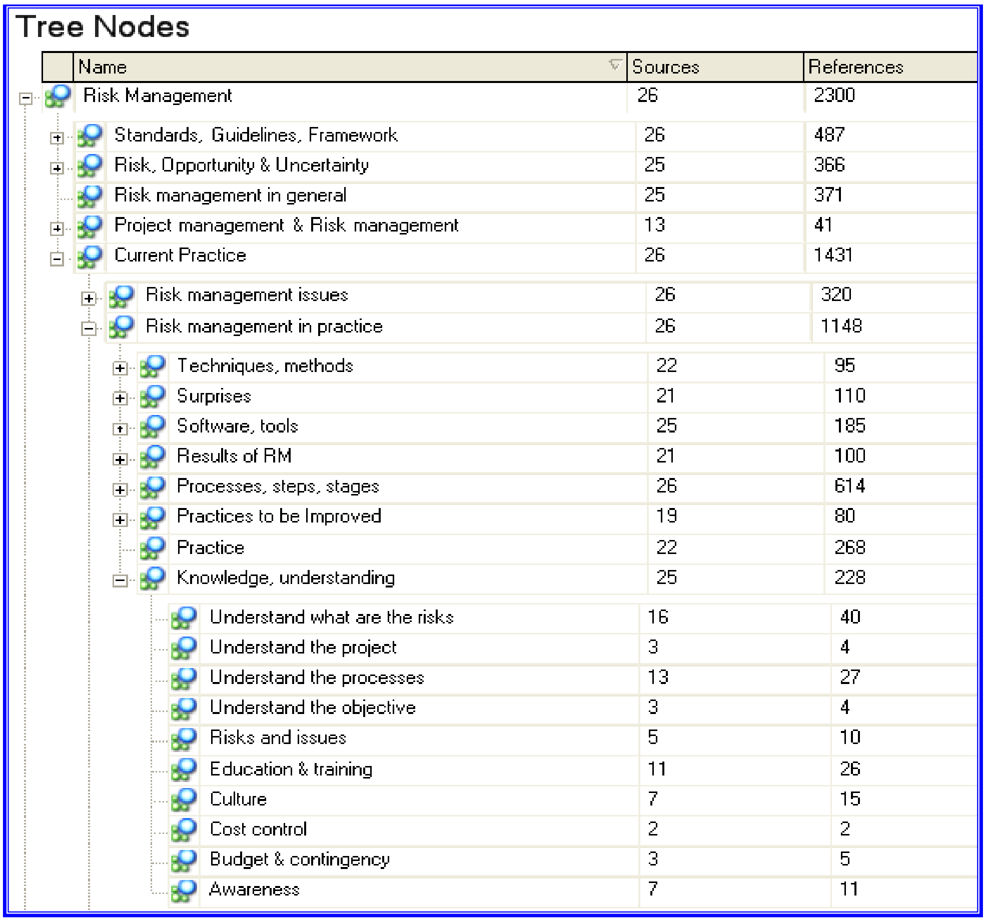
Name	Sources	References
Definition of Risk	25	72
Opportunity Management	24	181
Risk & Opportunity	23	153
Risk & Uncertainty	22	82
Uncertainty	20	85

Name	Sources	References
Standards, Guidelines, Framework	26	487

Name	Sources	References
Available guidelines, frameworks, standards	20	156
Framework, guideline to be used by others	18	60
Framework, standard for industry	21	126
Guidelines, framework, standards used	26	328

Figure 4.3: NVivo – Expanded tree nodes on risk management (Level 1, 2 & 3)

Figure 4.3 depicts the expanded tree nodes on risk management. Similar to project management, risk management has its second and third level nodes. There are five second-level nodes identified: current practices, project and risk management, risk management in general, risk, opportunity and uncertainty- as well as standards, guidelines and frameworks. The interviewees were asked as regards to the risk management function, risk management practice, and risk management issues within their project organisation. These are categorised as the third level nodes, other information from the interviewees are arranged accordingly as references to each of the specific nodes.



Tree Nodes

Name	Sources	References
Risk Management	26	2300
Standards, Guidelines, Framework	26	487
Risk, Opportunity & Uncertainty	25	366
Risk management in general	25	371
Project management & Risk management	13	41
Current Practice	26	1431
Risk management issues	26	320
Risk management in practice	26	1148
Techniques, methods	22	95
Surprises	21	110
Software, tools	25	185
Results of RM	21	100
Processes, steps, stages	26	614
Practices to be Improved	19	80
Practice	22	268
Knowledge, understanding	25	228
Understand what are the risks	16	40
Understand the project	3	4
Understand the processes	13	27
Understand the objective	3	4
Risks and issues	5	10
Education & training	11	26
Culture	7	15
Cost control	2	2
Budget & contingency	3	5
Awareness	7	11

Figure 4.4: NVivo – Tree nodes on knowledge and understanding of risk management

Figure 4.4, above, provides an example of expanded tree nodes on the knowledge and understanding of risk management. Knowledge and understanding are part of the questions related to risk management practice (third level node), and are further broken down into ten categories, from the understanding of what risks are, understanding the project, to the awareness of risk management.

4.4.3 Good Practices and Limitations in Using Software

The research has observed good practice when using software. Generally, the use of software in qualitative research will enhance the quality of textual data derived. However, there are pitfalls that can occur in the application of software, which have been highlighted by Dean and Sharp (2006). A good understanding of the research field is vital to accumulating quality research data. In using software, the research started with the basic structure, namely project management and risk management, and expanded these structures into various sub-themes, in accordance with the questions asked and the information provided by the interviewees. Furthermore, the research found that it is very important to continually revise and update the data to ensure all information is loaded, and structured into the relevant tree nodes. Dean and Sharp (2006) suggested that a good initial tree node leads to more rapid and deeper analysis that can be reviewed continuously. The researcher also made sure that the coding was checked and reviewed by the supervisor. This practice is essential to monitor the quality and relevance of the tree nodes (Dean and Sharp, 2006).

Besides good practice, the researcher also observed several issues and limitations of the use of software. First being, the software does not conduct the analysis, it is only an aid for efficient sorting, interpreting, conceptualising and retrieving (Auld et al., 2007, Basit, 2001, Bringer et al., 2004, Buchanan and Jones, 2010). In other words, the function of the software is merely to support qualitative analysis and not to perform automated analysis (Richards, 1999). Second, unlike quantitative research, the use of software in this research is limited as it does not do the analysis. This is due to the nature of qualitative research itself in terms of the complexity of its rich and unstructured data (Wong, 2008). Third, by using qualitative software, particularly NVivo, the researcher has to take care in choosing theoretical perspectives and analysis techniques to avoid any misrepresentation, which may consequently lead to a negative reputation (Bringer et al., 2004).

4.5 The Research Process

Figure 4.5, below, summarizes the research process used in this research.

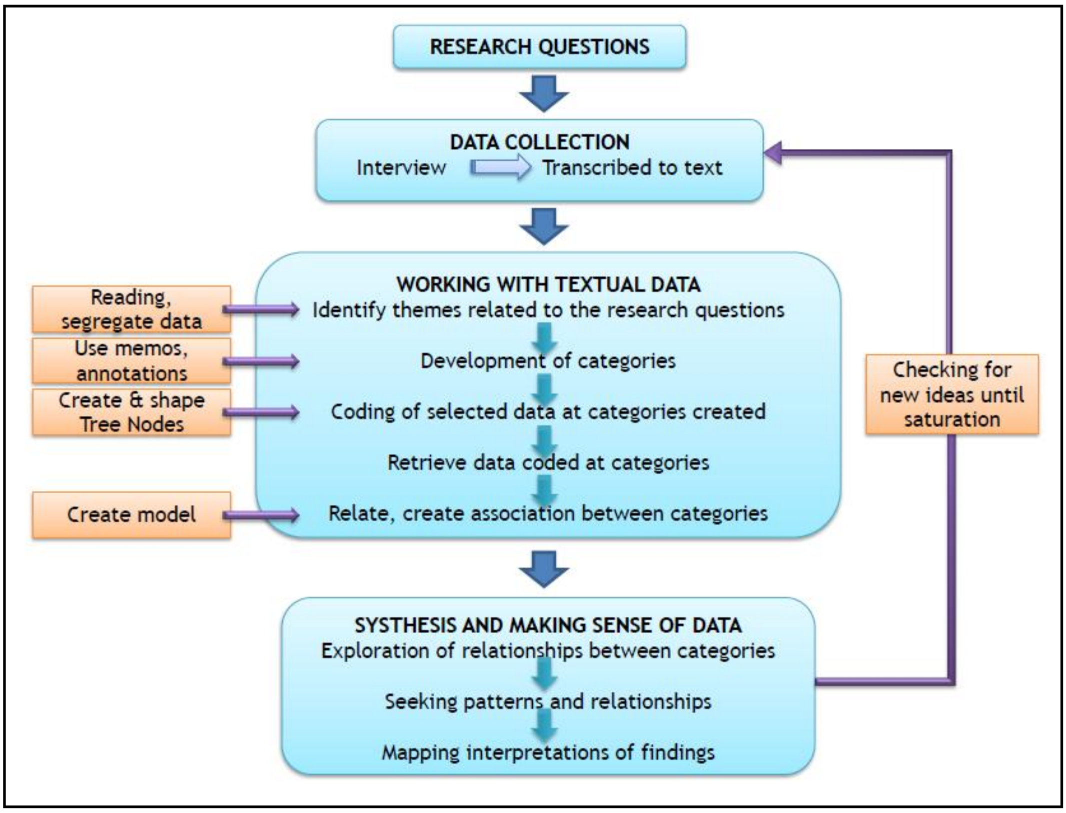


Figure 4.5: Qualitative data analysis flow chart *[Adapted from Wong (2008:15)]*

4.6 Summary

Interview transcripts are very important; they form the data to be analysed in qualitative research. They are verbatim accounts of what transpired in the interview, and, according to Poland (1995), verbatim must be acknowledged as written records and as partial accounts of an interaction experience. Twenty-six interviews were conducted with project managers, risk managers, project directors and other managers in charge in the management of project risks from various sectors of different industries. Such variation in the nature of the projects by sector, will contribute to the richness of data due to the variability of information. Their responses will significantly influence the findings of this research. Transcribing interviews is an interpretive activity and sometimes open to errors. The research adopted a qualitative method, which involved open-ended interviews, using an *aide memoir*, with the managers responsible for managing project risks for their organisation. The interviews were recorded and transcribed and later coded and managed using NVivo software.

NVivo is a qualitative software, which aids data interpretation and analysis by providing a means for easy identification, indexing, coding text, as well as retrieving the data. NVivo provides data management capability, but, as software, does not carry out the analysis. Therefore, it is important that the analysis is conducted carefully to avoid the misinterpretation of data, as this may lead to negative refutation of theoretical perspectives. The next chapter will discuss the findings from the research's data analysis.

CHAPTER 5

FINDINGS ON ANALYSIS:

PART I: RISK, UNCERTAINTY AND OPPORTUNITY

5.1 Introduction

This chapter discusses the findings on the detailed analysis of the interviews conducted. As discussed in the previous chapter, the objectives of analysing qualitative data are to determine the categories, relationships and assumptions based on the respondent's view of the world (Basit, 2001), and to deconstruct blocks of data through fragmentation, combining them into related categories (Jones, 2007). Interviews are the main source of data for this research, and all interviews have been recorded and transcribed into text using Microsoft Word. NVivo is used to facilitate the process of analysing data, allowing it to be interpreted into defined codes. The unit analysis for the coding in tree nodes is the phrase, from the interview transcripts. It is hoped that the findings from the data will contribute to the current knowledge and practice of risk management.

5.2 Definitions of Risk, Uncertainty and Opportunity

The interviewees were asked to define what they understood by the terms risk, uncertainty and opportunity. The process was conducted to evaluate the current understanding and practices of project risk management (PRM) in order to achieve the research aim, which was to formulate a framework for the PRM process. The results of the interviews conducted indicate that there are various definitions of risk, uncertainty and opportunity provided by the respective interviewees. The list of classification and aggregation provided in Chapter 4 (refer to Table 4.4b: Organisation's classification and aggregation) has been used to identify and categorise the interviewees and their industries.

5.2.1 Definitions of Risk

Risk has been defined and described differently by interviewees. These definitions have been categorised according to nodes or themes, which are discussed below:

5.2.1.1 Risk is related to Uncertainty.

The term 'uncertainty' has been used either directly or indirectly to define risk. Risk and uncertainty are observed to be interrelated; they occur as an outcome of each other's occurrence. Earlier investigation concerning the standards and guidelines testifies to this relationship, indicating risk as an uncertainty of the outcome (HM-Treasury, 2004a, Strategy-Unit, 2002b), an uncertainty inherent (BS6079-3, 2000) and an uncertain and adverse consequence (IRGC, 2008a). Meanwhile, ICE at al. (1998), in their RAMP guidelines, identifies uncertainty as a source of risk.

From the interviews, this research found that interrelationships have two domains: risk is the future uncertainty and the uncertainty of achieving objectives. Table 5.1 presents the interviewees' definitions and the similarity of these to the existing standards and guidelines (as discussed in Chapter 3).

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Risk is the future uncertainty	"...risk is future uncertainty" (002) "...risk is an uncertain future event that matters..." (026)	➢ US's Risk Management Guide for defence acquisition (DoD, 2006b) ➢ Canadian's Treasury Risk Management Framework (GoC, 2001) ➢ PMBOK (PMI, 2004).
2) Risk is the uncertainty of achieving objectives	"...my personal view of risk is simply uncertainty in achieving our objectives on a project..." (007) "...uncertainty that might lead to a failure to achieve business objective, strategic objectives..." (015) "...an event, uncertainty that threatens the achievement of any business objective" (024)	➢ BS 31100:2008 ➢ BS/ISO 31000:2009 ➢ BS 6079-3:2000 ➢ Management of Risk: Guidance for Practitioners (OGC, 2007b).

Table 5.1: Risk is related to uncertainty

5.2.1.2 Risk is a Threat or Downside and Have Negative Impacts

Based on the interview data, risk is described as a threat and can result in negative consequences to the business or projects. This corresponds to the definitions provided in the majority of standards and guidelines investigated.

Nineteen (19) interviewees provided the related definitions. Six (6) interviewees defined risk as a threat and nine (9) interviewees relate the impact of risk, should it happen, to having a negative outcome. Interviewee 012 pointed out that they are very clear that risk is the downside, which has a negative impact. Additionally, interviewee 012 indicated that *"...when people are talking about risk it means there is the potential for something to go worse than expected"*. Additionally, risk impacted the achievement of objectives negatively. This research also found that thirteen interviewees associated risk with a negative impact on the objective. According to the data, interviewee 015 was found to have linked risk with the failure to achieve objectives while interviewee 016 mentioned that everything which threatened objectives were a risk. Table 5.2 provides examples of the definitions found from the interviews, and the similarity of their definitions to that in the existing standards and guidelines.

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Risk is a threat and has a negative impact upon the objectives	"Risk to me is any threat or opportunity that could occur in the project's life..." (001) "Risk is a threat to the achievement of business objectives and deliverables likely to result in liability..." (004) "...a risk could be positive or negative. It could be a threat or it could be an opportunity..." (005) "...it's something that would add cost or time or actually have a deficit effect on the quality..." (020) "...an event or uncertainty that threatens the achievement of any business objective" (024) "...some event that might prevent the project to make progress as expected or not reaches its results..." (025)	➢ PRAM Guide (Bartlett et al., 2004) ➢ Team Risk Management (CMU-SEI-94-SR-005:1994) ➢ The Orange Book (HM Treasury, 2004) ➢ Managing Risks in Government Department (NAO, 2000) ➢ NASA' NPR (NASA, 2008) ➢ Strategy Unit, 2002)

Table 5.2: Risk is a threat or downside and has a negative impact on objectives

5.2.1.3 Risk is an Opportunity and have Positive Impacts

Other than being negative, risk also has its upside. The standards and guidelines investigated earlier advocated the idea that there is an opportunity-side of risk, which could offer positive outcomes. Most of these standards and guidelines considered the dual nature of the definition of risk; threat or downside and opportunity or upside. Six (6) interviewees defined risk as having both: threat and opportunity, or having negative and positive outcomes; three of these were from the transportation and storage industry. For example, interviewees 001, 005 and interviewee 006 indicated that risk could be a threat or it could be an opportunity. Meanwhile, interviewee 022 stated that *"...the other side of the coin is what are the opportunities, which should be a positive impact on the project..."*

5.2.1.4 Risk is the Chance of an Event Happening

According to the data, risk is also defined as the *chance or likelihood of something happening*. Risk, should it occur, is regarded as the probability of it happening, the impact being the outcome. The combination of probability and impact provide a means to quantify the occurrences. From the literature reviews, the AS/NZS 4360 (1999) and the DRMF (2005) defined risk as the chance of something happening that will have an impact upon objectives; it is measured in terms of consequences and likelihood. Table 5.3 presents the related definitions and the existing standards and guidelines to which they correspond.

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Risk is the chance of an event happening	"...risk is the chance of specific things happening..." (003) "...quite a high probability of happening or indeed with a very low or apparently minimal probability of happening" (003) "...anything really that has any chance of happening beyond what you've thought about or what you think may happen" (006) "...probability of the fault" (006)	➢ Australian Standards and New Zealand Standards (AS/NZS-4360, 1999) ➢ Australian Defence (DRMF, 2005),

Table 5.3: Risk is chance of an event to happen

5.2.1.5 Risk is a Hazard

Risk was described as a hazard by interviewees 008 and 021 during the interview. Although the amount of data relating to the definition of risk as a hazard is minimal, it will not be disregarded because the IEEE (2001:3) adopts the term ‘hazard’ in their definition (IEEE-SA, 2001). This view of risk is described as negative and therefore, similar to threat.

5.2.1.6 Summary of the Definitions of Risk

From the above findings, the definition of risk can be summarized according to the sub-definitions, as described by the interviewees, and is presented in Table 5.4 below. Based on the table, the majority of the interviewees viewed risk as a threat and as having a negative impact. Meanwhile, there are views that risk is, in fact, an uncertainty, and risk is also an opportunity which has a positive impact upon the objectives. This can be seen through the equal number of views provided by the interviewees. The probability and impact of risk, should it occur, can be measured. This understanding of risk is provided by some of the interviewees. However, the researcher found that although IEEE defined risk as a hazard, only two interviewees described risk as such. Figure 5.1 illustrates the definitions of risk, as given by the interviewees, as well as those provided by the standards and guidelines.

				Definitions of Risk				
Intervie wee	Business Type	Industry		Risk = Uncertainty	Risk = Threat/ Negative Outcome	Risk = Opportunity/ Positive Outcome	Risk = Chance, Probability/ Impact	Risk = Hazard
001	*Railway/Train operations*	H			√	√		
002	*Consultancy-construction, risk management*	F	M	√				
003	*Power-nuclear; Consultancy-construction*	D	M				√	
004	*Capital investment-engineering & construction*	F	M		√			
005	*Railway/Train operations*	H			√	√	√	
006	*Railway/Train operations*	H		√	√	√	√	
007	*Consultancy-construction & engineering*	C	M	√				
008	*Railway/Train operations*	H						√
009	*Manufacturing-defence aircraft*	C	O		√			
010	*Mining-natural resources*	B			√	√	√	
011	*Water supply & sewerage*	E			√	√		
012	*Airport operations*	H	M		√			
013	*Manufacturing- defence aircraft*	C	O		√			
014	*Manufacturing- defence aircraft*	C	O		√			
015	*Services*	F	N	√	√	√		

016	*Mining-petroleum*	B		√	√			
019	*Manufacturing-defence submarine*	C	O		√		√	
020	*Manufacturing-defence submarine*	C	O		√			
021	*Construction*	F			√			√
022	*Power-transmission/distribution*	D			√	√	√	
023	*Mining-petroleum E&P technology, refining*	B	C		√			
024	*Water supply & sewerage*	E		√	√			
025	*Manufacturing- defence aircraft*	C	O	√	√			
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O	√				
	TOTAL			***8***	***19***	***7***	***6***	***2***

Table 5.4: Summary of definitions of risk by interviewees

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

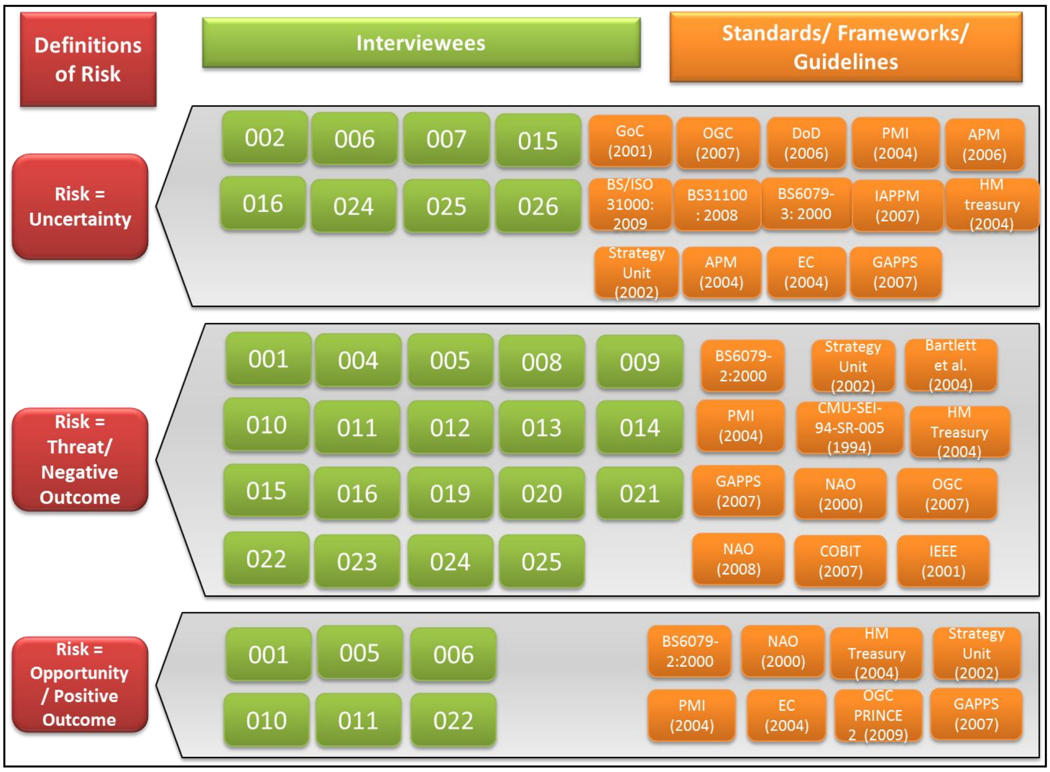


Figure 5.1: Definitions of risks

5.2.2 Definitions of Uncertainty

Similarly, there are different definitions of uncertainty provided by the interviewees. From the interview data, the definitions can be categorised into seven sub-definitions, which are discussed below.

5.2.2.1 Uncertainty is a Variance.

According to interviewee 009, *"...uncertainty is everyday variances"* meaning that it reflects the everyday variances, which will affect objectives if it does occur. There is no other interviewee who recalled the use of this word; the Canadian Department of Defence does however does identify uncertainty as *the degree of variability in the possible values associated with an event (Mandel, 2007a)*. This means that uncertainty has a range of values that demand a systematic approach for managing it. The variance of values in this respect could be *pursuant to a multitude of sources, internally and externally,* as outlined in the PRAM guidelines.

5.2.2.2 Uncertainty is an Unquantifiable and Immeasurable Event

Uncertainty has been classified as an event that is impossible to be quantified or measured. Such interpretation can be associated with the definition in the framework by the Australian defence, which indicates the impossibility of estimating the probability of the outcome [see (DRMF, 2005)]. From the data, this research found that uncertainty cannot be planned (Interviewee 020). Meanwhile, interviewee 006 indicated that uncertainty could not be quantified and the impact could not be measured.

5.2.2.3 Uncertainty as an Unknown Event

Uncertainty has also been described as an unknown event, of which the future is not known. Interviewee 004 mentioned that *"...uncertainty is unknown..."* This definition also corresponds to that in the US White Book, which described that uncertainty occurred from partly known information. (Presidential/Congressional-Commission, 1997b).

5.2.2.4 Uncertainty is an Uncertain Event

Besides being described as an unknown event, uncertainty has also been described as an uncertain event. It is something that may or may not happen, for which people do not know the impact upon projects or businesses. Table 5.5 below provides the definitions of uncertainty, as understood by interviewees. However, there are no related definitions found in the standards and guidelines which match this description.

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Uncertainty is an uncertain event	"...uncertainty is events that you cannot quantify...cannot measure the impact of it" (006) "... uncertainty is so "...uncertainty is an uncertain event that could might or may happen" (001) "...you know something is going to happen but you know that it could be affected by things and you are not quite sure what the outcome would be" (003) "...something we basically can't plan forward, and we know it's aware" (020)	➢ No related document is found.

Table 5.5: Uncertainty is an uncertain event

5.2.2.5 Uncertainty is Risk and Opportunity.

The interview data revealed important results that described uncertainty as risk and as an opportunity with a thin line between them. Uncertainty is found to be the total factor, whilst risk is the downside, and opportunity is the upside. This therefore aligns with the RAMP guidelines that define uncertainty as a source of risk (ICE et al., 1998).

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Uncertainty is risk and opportunity	"Risk is also a form of uncertainty..." (006) "Uncertainty is just we don't know how things are going to evolve...it's got potential upsides and downsides attached to it" (012) "...if I say uncertainty I mean risk and opportunity" (026)	➢ RAMP guidelines (ICE, Actuaries, & Actuaries, 1998).

Table 5.6: Uncertainty is risk and opportunity

5.2.2.6 Uncertainty has Likelihood and Impact.

Uncertainty has also being described to have likelihood and chance of happening. However, should it happen, there will be an impact upon projects or businesses. There is no related definition found in the standards and guidelines, with regards to likelihood and impact, but such a definition only refers to risk. Uncertainty has been described as follows:

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Uncertainty has likelihood and impact	"The uncertainty there is around whether we will be able to deliver...Again, what the likelihood is and what is the impact" (001) "You know that there is a chance of it happening even when it does happen you don't know what that impact will be. So that's what uncertainty is" (006) "...uncertainty is the total range of potential impact" (012)	➢ No related document is found.

Table 5.7: Uncertainty has likelihood and impact

5.2.2.7 Uncertainty is a lack of knowledge.

The interview data suggest that uncertainty results from the lack of knowledge about future events. The standards and guidelines can be used to demonstrate this definition whereby the RAMP guidelines suggest that uncertainty originates from a lack of sufficient knowledge about the probabilities and consequences. The US White Book (1997b) identified insufficient or unknowable information as the source of uncertainty; the IRGC (2008) suggests that uncertainty results from a lack of clarity or quality in data. A lack of knowledge and information are seen to be significant definitions for this research, as provided by the interviewees.

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Uncertainty is a lack of knowledge	"...uncertainty is that you know something is going to happen...you are not quite sure what the outcome...defined by the state of your knowledge and by what you know about it" (003) "Uncertainty....is based on incomplete knowledge" (005) "Uncertainty is just we don't know how things are going to evolve, we don't know how this might materialise..." (012) "...uncertainty is where you are not, if you are not fully, you haven't fully defined the risk then that's where the uncertainty comes in" (018)	➢ RAMP guidelines (ICE, Actuaries, & Actuaries, 1998). ➢ The US White Book (1997b) ➢ IRGC (2008)

Table 5.8: Uncertainty is a lack of knowledge

5.2.2.8 Summary of the Definitions of Uncertainty

From the above data, the definitions of uncertainty can be summarized according to the sub-definitions; these are presented in Table 5.9 below. This research found that that unlike risk, uncertainty has not been defined by many organisations. Only ten organisations provided their definition and understanding of uncertainty. Meanwhile, Figure 5.2 outlines the definitions of uncertainty, given by the interviewees, as well as those provided by the standards or guidelines. Although the data may not be sufficient enough to draw significant findings, the research considers the information important and relevant in achieving the third objective for this research, which is to develop the structure that explains the current understanding of risk, uncertainty and opportunity. It also reflects upon the actual understanding of the concept of uncertainty.

Interviewee	Business Type	Industry		Definition of Uncertainty: Uncertainty = Unquantifiable	Uncertainty = Unknown Event	Uncertainty = Uncertain Event	Uncertainty = Risk & Opportunity	Uncertainty = Likelihood & Impact	Uncertainty = Lack of Knowledge
001	*Railway/Train operations*	H				√		√	
003	*Power-nuclear; Consultancy-construction*	D	M			√			√
004	*Capital investment-engineering & construction*	F	M		√				
005	*Railway/Train operations*	H							√
006	*Railway/Train operations*	H		√			√	√	
012	*Airport operations*	H	M				√	√	√
013	*Manufacturing- defence aircraft*	C	O						
014	*Manufacturing- defence aircraft*	C	O						√
018	*Manufacturing- defence aircraft*	C							√
020	*Manufacturing-defence submarine*	C	O	√		√			
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O				√		
	TOTAL			***2***	***1***	***3***	***3***	***3***	***5***

Table 5.9: Definitions of uncertainty by interviewees

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

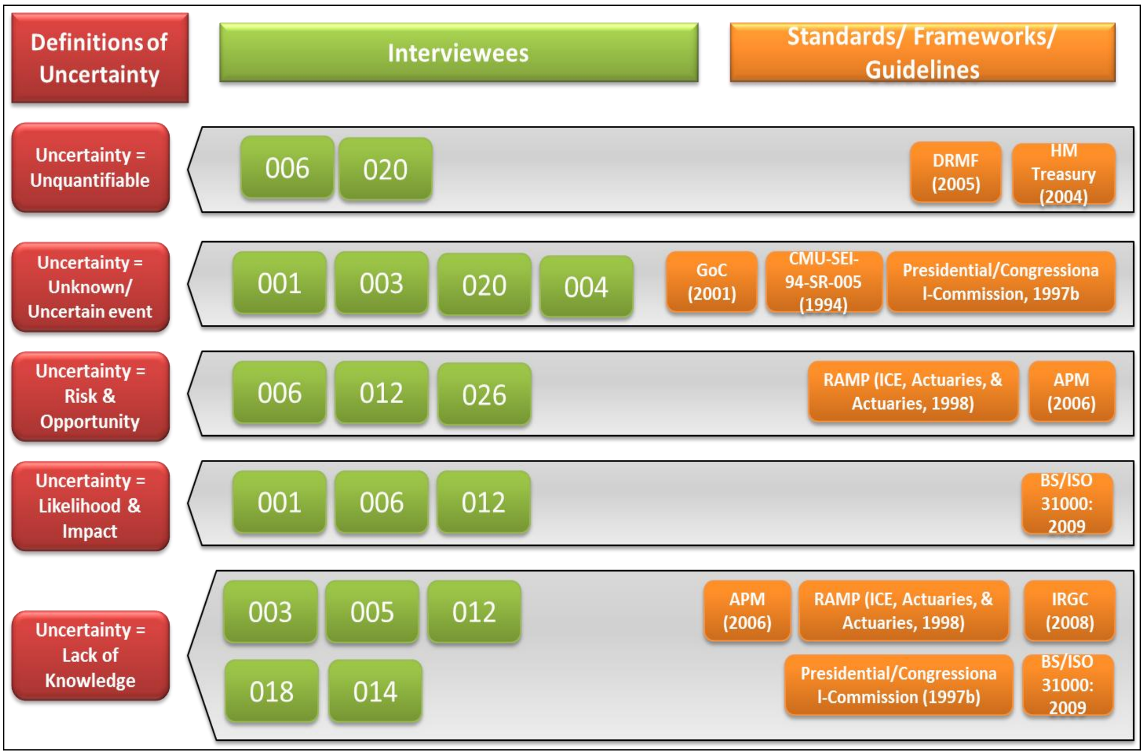


Figure 5.2: Definitions of uncertainty

5.3.3 Definitions of Opportunity

This research found that there are six categories of opportunities to emerge from the interviews; these are discussed below.

5.3.3.1 Opportunity is Positive Uncertainty

Opportunity is described as a *"positive uncertainty that could occur"* by Interviewee 001. Uncertainty is the total factor whilst risk is the downside, and opportunity is the upside. Similarly, COSO (2004) regards opportunity as a positive form of uncertainty.

5.3.3.2 Opportunity is a Means of Getting and Delivering a Project

Opportunity was viewed from the business perspective by interviewee 007 as *"getting work"*, which can be regarded as a mean of winning and delivering a project or business. However, this can only be achieved through a good understanding of the context and the nature of the opportunity that they are looking at.

5.3.3.3 Opportunity Provides Benefits

Opportunity was also viewed as something that can enhance the project and provide benefits to the organisation. The benefits are usually yielded by over-achieving the objectives, such as early project completion, better quality of products and expenditure savings. However, these benefits only materialise if the opportunities are exploited and capitalized because they are not visible. The following outlines the relevant definitions of opportunity provided by three interviewees:

> *"...similar to risks in that you can define things and you can see something that actually gives you a benefit and you can actually go forward on that..." (Interviewee 003)*
>
> *"...an event that can cause you to over achieve on your objective which might be benefits, it might be your time scale, it could be quality if you can manage" (Interviewee 011)*
>
> *"...reverse to risk and doing things a bit better, saving a little bit of operational expenditure and generally being more efficient" (Interviewee 024)*

5.3.3.4 *Opportunity is a Positive Risk*

Opportunity was also described as a positive risk or the converse of risk. Unlike risk, something needs to be capitalized upon to create an opportunity. This definition of opportunity can be authenticated with the UK government documents, which define risk as having a positive opportunity or negative threat. Similarly, the ICE's RAMP defined opportunity as something that can affect the objectives favourably.

Definitions of Risk	Example of Interviewee's Definitions	Similarity of Definitions
1) Opportunity is a positive risk	"Very much the same process as risk or threat, classed as positive risk" (001) "...opportunity is defined exactly the converse of risk..." (004) "...the upside of risk..." (010) "...something which will have a positive effect on the project..." (023)	➢ The Orange Book (HM Treasury, 2004) ➢ NAO (2000) ➢ Strategy Unit (2002) ➢ RAMP (ICE, 2002).

Table 5.10: Opportunity is a positive risk

5.3.3.5 *Opportunity is Always Taken but has no Specific Definition.*

Opportunity has been regarded as something that people usually do without having formal definitions. It is driven by the objectives, and, at some point people do realise that there are opportunities that need to be capitalized upon.

> *"...it is something we do a lot of but without having formal definitions" (007)*
> *"...there is no definition of opportunity..." (014)*

5.3.3.6 *Summary of the Definitions of Opportunity*

Utilising the above data, the definitions of opportunity can be summarised according to the sub-definitions as seen below:

Interviewee	Business Type	Industry		Definition of Opportunity: Opportunity = Positive Uncertainty	Opportunity = Getting/ Delivering Project	Opportunity = Provides Benefit	Opportunity = Positive Risk
001	*Railway/Train operations*	H		√			√
002	*Consultancy-construction, risk management*	F	M				
003	*Power-nuclear; Consultancy-construction*	D	M			√	
004	*Capital investment-engineering & construction*	F	M			√	√
007	*Consultancy-construction & engineering*	C	M		√		
010	*Mining-natural resources*	B					√
011	*Water supply & sewerage*	E				√	
015	*Services*	F	N				√
023	*Mining-petroleum E&P technology, refining*	B	C				√
024	*Water supply & sewerage*	E				√	
025	*Manufacturing- defence aircraft*	C	O				√
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O			√	
	TOTAL			**1**	**1**	**5**	**6**

Table 5.11: Definition of opportunity by interviewees

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

Figure 5.3: Definitions of opportunity

Based on Table 5.11, the research summarises opportunity as positive risk, and providing benefits. Figure 5.3 maps the definitions of opportunity by the interviewees, as well as those provided by the standards or guidelines. Similar to uncertainty, the data may not be sufficient enough to draw significant findings but the information provided by the interviewees is important and relevant in trying to achieve the third objective for this research: to develop the structure that explains the current understanding of risk, uncertainty and opportunity.

5.3 The Understanding of Risk, Uncertainty and Opportunity

During the interviews, the interviewees were asked as regards to their views on risk, uncertainty, and opportunity. From the data, the research found that there links existed between risk, uncertainty, and opportunity. The following are some excerpts from the interview data:

> *"...uncertainty is linked to both the risk and opportunity..." (Interviewee 004)*
>
> *"...there is a thin line between risks, issues, uncertainty" (Interviewee 006)*
>
> *"If it's all positive uncertainty---opportunity, if it's got the potential to be both upside and downside it's just a pure uncertainty..." (Interviewee 012)*
>
> *"...uncertainty is the total factor, risk is the negative side and opportunity is the positive side" (Interviewee 013)*
>
> *"...we sort of steer towards risk equals downside, opportunity equals upside-both driven by essentially uncertainty" (Interviewee 015)*
>
> *"I think there is an enormous link...we should always be looking at risks and uncertainty and opportunities together..." (Interviewee 020)*
>
> *"...uncertainty is either way; it could be uncertainty in terms of something positive can happen or something negative can happen" (Interviewee 026)*

From the data, seven interviewees mentioned that there were links between risk, uncertainty, and opportunity. Their views and ideas on the relationships are categorized into two, namely, the relationship between risk and uncertainty, and the relationship between risk and opportunity. Their ideas are discussed in depth in section 5.4.1.

5.3.1 Understanding the Risk-Uncertainty Relationship

There are different views of the relationship between risk and uncertainty. Uncertainty has been described as a potential source of risk. According to interviewee 007, *"uncertainty is obviously a potential source of risk"*, whilst interviewee 008 said that *"uncertainty may result in a risk"*. In addition, risk is seen has been seen as a negative side of uncertainty by interviewee 012. Meanwhile, interviewee 013 said that people risked their plan if they were uncertain about something. Interviewee 018 seemed to have a different view about this relationship. He pointed out that uncertainty arises only if the risk has not been clearly defined. Additionally, if people are uncertain about the issue, the risk may not occur now, but may occur when they have all the information. Below are other examples of interview data pertaining to this relationship.

> *"...the level of uncertainty is how little you know about the risk event, and that makes it more uncertain" (004)*
>
> *"...uncertainty for us is one level up which we also sometimes call risk area or some people call it hazard" (016)*
>
> *"We define risk as an uncertainty that threatens the achievement of any business objective…so there are uncertainties with negative consequences" (024)*

5.3.1.1 Risk and Uncertainty is Synonymous

From the data, this research found that nine interviewees have directly or indirectly mentioned that risk and uncertainty are similar. The terms 'risk' and 'uncertainty' have been used interchangeably and viewed as a form of each other. For example, interviewee 003 indicated that uncertainty was defined as risk, and interviewee 006 said that risk and uncertainty are a form of one another. Interviewee 012 and 021 mentioned that in the risk register, both terminologies are synonymous. Interviewee 001 pointed out that both are considered to have likelihood and impact should they occur. Other examples are as follows:

"...we don't specifically focus on uncertainty and I think if there was uncertainty we would see that as a risk...We don't actually discuss uncertainty as a topic..." (013)

"In our business we treat them the same..." (023)

"We define risk as an uncertainty that threatens achievement of any business objective... so there are uncertainties with negative consequences" (024)

5.3.1.2 Risk and Uncertainty are Different

Contrary to the above, there are views indicating that risk and uncertainty are not similar and should be viewed differently. The research found five interviewees who highlighted that both terminologies were not synonymous. Interviewee 005 said that risk may or may not happen, whilst uncertainty is when we know that something is going to happen but the level of impact is not fully understood. Meanwhile, interviewee 009 said that their organisation were very clear on the differences between risk and uncertainty. The same applied for interviewee 014 who mentioned that *"...uncertainty means you don't know so a risk is something that we recognise".* Interviewee 012 reported that they tended to disagree with the APM concepts of risk and uncertainty, which are reported to be similar. According to interviewee 012, this concept had been removed from the organisation. In addition, interviewee 019 highlighted that their organisation viewed and practiced risk and uncertainty differently; uncertainty being modelled 100% of the time but risk being modelled by the likelihood of occurrence.

5.3.1.3 Unclear Relationship

Although the risk-uncertainty was discussed at length by many interviewees, two interviewees reported that the relationships were, in fact, not clear- as seen below:

"The boundary line is very unclear" (003)

"...I am not convinced that there is a clear cut-off between, 'this is uncertainty, and this is risk'." (009)

5.3.2 Understanding of Risk-Opportunity Relationship

The risk-opportunity relationship is the second relationship discussed earlier; the details are described as follows:

5.3.2.1 Risk and Opportunity are Linked

Risk and opportunity have been associated in different ways. Interviewees 004 and 024 highlighted that there was a link between risk and opportunity.

> *"…risk and opportunity are intrinsically linked"* (Interviewee 004)
> *"…the opportunities are quite closely linked to the risks"* (Interviewee 024)

Meanwhile, interviewee 003 said that opportunity had been consulted as risk and interviewee 004 associated risks with the cost to be born, should the opportunity not materialize. Therefore, opportunity should be assessed against the risk prior to pursuing it.

> *"There might be a risk associated with every opportunity, because if you spend money and time and effort in the opportunity and it doesn't materialise, it means it will cost you more money…outweigh the opportunity against the risk and then pursue the opportunity"* (004)

Additionally, interviewee 021 mentioned that sometimes risk could be an opportunity, whereas interviewee 026 stated that people had a better understanding of risk management now, and opportunity was included as risk at a generic level.

5.3.2.2 Risk and Opportunity are Managed Together

This research found that opportunity is being managed similarly to risk, if not together- this was highlighted by interviewees 004, 008, 020, 022, 023 and 025. There are differing approaches to managing risk and opportunity together. For example, interviewee 025 added that risk and opportunity are managed through a matrix and discussed during monthly meetings. Meanwhile, interviewee 022 pointed out that risk and opportunity are managed through their web-based system. Opportunity is also managed within the risk management process, such as the inclusion of it in the risk register (019) the risk mitigation stage (016).

5.3.2.3 Risk and Opportunity are Managed Differently

Three interviewees were found to have a contrary viewpoint to that mentioned in the above discussion; they stated that risk and opportunity were managed differently. Interviewee 020 mentioned that they had decided that risk and opportunity were to be managed using different approaches. According to interviewee 020, risk was avoided, reduced, transferred and accepted, but opportunity exploited, transferred or basically kept, and assessed as to whether the situation was worth pursuing. Interviewee 026 had a similar understanding, saying that *“risk is you try to manage down; opportunity is you try to make it happen”.* Meanwhile, interviewee 023 said that opportunity was linked to profit plan and managed differently.

5.3.2.4 Opportunity is a Positive Risk

Four interviewees viewed opportunity as a positive side of risk.

> *“...what could impact negatively or positively on the projects…the threat is negative, the opportunity is positive...opportunity is classed as positive risk”* (001)
>
> *“...risks are seen as threats and also as opportunities...”* (019)
>
> *“The other side of the coin is what are the opportunities which should have a positive impact on the project, so we look at risk from a positive and a negative perspective…”* (022)
>
> *“...if you look at risk…which is positive and negative. So positive is the opportunity, negative is the risk itself”* (026)

5.3.2.5 Opportunity is the Opposite of Risk

In contrast to the previous section (5.3.2.4), opportunity was acknowledged as the other side of risk. This research found that different terminologies were used to express this definition, namely, converse (004); opposite (020 and 023); and reverse to risk (024).

"...opportunity is defined exactly the converse of risk..." (004)

"With opportunity we see that as exactly the opposite, it's an opportunity, it's something very positive" (020)

"...opportunity is the opposite..." (023)

"The opportunity is generally reverse to risk and doing things a bit better, saving a little bit of operational expenditure and generally being more efficient…" (024)

5.3.3 Summary of the Understanding of Risk, Uncertainty and Opportunity

Based upon the above discussion, Table 5.12 below provides a summary of the understanding of the relationships. The research found that the understanding of the relationships can be categorised into two: risk-uncertainty and risk-opportunity relationships.

a) Risk-uncertainty

Eight interviewees highlighted that the relationships between risk and uncertainty do exist, and nine interviewees said that risk and uncertainty were synonymous. Meanwhile, five interviewees expressed their understanding that risk and opportunity were different.

b) Risk-opportunity

Eight interviews stated that there are links between risk and opportunity and five interviewees pointed out that both concepts are managed together in their organisations. However, three interviewees highlighted that risk and opportunity are managed. Opportunity was also viewed as positive risk by six interviewees and as converse to risk by five interviewees.

To this regard, it can be summarised that the understanding of the relationships between risk, uncertainty, and opportunity varies.

Interviewee	Business Type	Industry		Risk, Uncertainty & Opportunity: There are relationships	Risk, Uncertainty & Opportunity: Unclear relationships	Risk-Uncertainty: General- Risk-uncertainty relationships	Risk-Uncertainty: Risk & uncertainty are synonymous	Risk-Uncertainty: Risk & uncertainty are different	Risk-Opportunity: Risk & opportunity are linked	Risk-Opportunity: Risk & opportunity are managed together	Risk-Opportunity: Risk & opportunity are managed differently	Risk-Opportunity: Opportunity is positive risk	Risk-Opportunity: Opportunity is the converse of risk
001	*Railway/Train operations*	H					√					√	
002	*Consultancy-construction, risk management*	F	M										
003	*Power-nuclear; Consultancy-construction*	D	M		√		√		√				
004	*Capital investment-engineering & construction*	F	M	√		√			√	√			√
005	*Railway/Train operations*	H						√				√	
006	*Railway/Train operations*	H		√			√						
007	*Consultancy-construction & engineering*	C	M			√							
008	*Railway/Train operations*	H				√							
009	*Manufacturing-defence aircraft*	C	O		√			√					
010	*Mining-natural resources*	B											
011	*Water supply & sewerage*	E											
012	*Airport operations*	H	M	√		√	√	√					
013	*Manufacturing- defence aircraft*	C	O	√		√	√						
014	*Manufacturing- defence aircraft*	C	O					√					
015	*Services*	F	N	√									√
016	*Mining-petroleum*	B				√				√			
017	*Construction*	F											
018	*Manufacturing- defence aircraft*	C				√				√			
019	*Manufacturing-defence submarine*	C	O					√		√		√	
020	*Manufacturing-defence submarine*	C	O	√						√	√		√
021	*Construction*	F					√		√				
022	*Power-transmission/distribution*	D								√		√	
023	*Mining-petroleum E&P technology, refining*	B	C				√			√	√		√
024	*Water supply & sewerage*	E				√	√		√				√
025	*Manufacturing- defence aircraft*	C	O				√			√		√	
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O	√			√		√		√	√	
				7	**2**	**8**	**10**	**5**	**5**	**8**	**3**	**6**	**5**

Table 5.12: The relationships between risk, uncertainty and opportunity

<u>NOTE:</u>

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

5.4 Discussion

From the above analysis, the research found that, at present, there are no streamlining of the definitions of risk, uncertainty and opportunity provided by the interviewees. The findings are similar to the earlier findings on literature discussed in Chapter 3- there is no streamlining in the definitions of risk and uncertainty. However, these definitions provide links or relationships with each other, and are discussed below.

5.4.1 Definitions of Risk, Uncertainty and Opportunity

The research attempts to develop diagrams, which summarise the definitions and understandings of risk, uncertainty and opportunity, derived from the analysis of interview data. Different colours are used to differentiate between risk, uncertainty and opportunity and their definitions. The solid-lines with arrows represent the definitions and understandings drawn from the data and the dashed-line with arrows represents the possible links or relationships with other concepts.

Figure 5.4 indicates that the definition of risk can be linked to uncertainty and opportunity. At the centre of this diagram is risk, presented in a solid rectangle-shape. From the data, the definitions of risk are found to have three domains, which are classified as uncertainty, opportunity (positive) and threat (negative). For example, risk is defined as opportunity or having a positive outcome and this is presented by having soft-edge boxes. Subsequently, risk is also found to be similar or related to opportunity- this is presented in the non-solid box. The definition of uncertainty is categorised into four domains, two of them linked uncertainty to risk and opportunity, as shown in Figure 5.5. Similarly, the definition of opportunity is categorised into four domains. One domain links opportunity with risk, indicating positive risk. The other links opportunity with uncertainty, which represents positive uncertainty. The research has therefore found that opportunity is also linked to risk and uncertainty, which is shown in Figure 5.6.

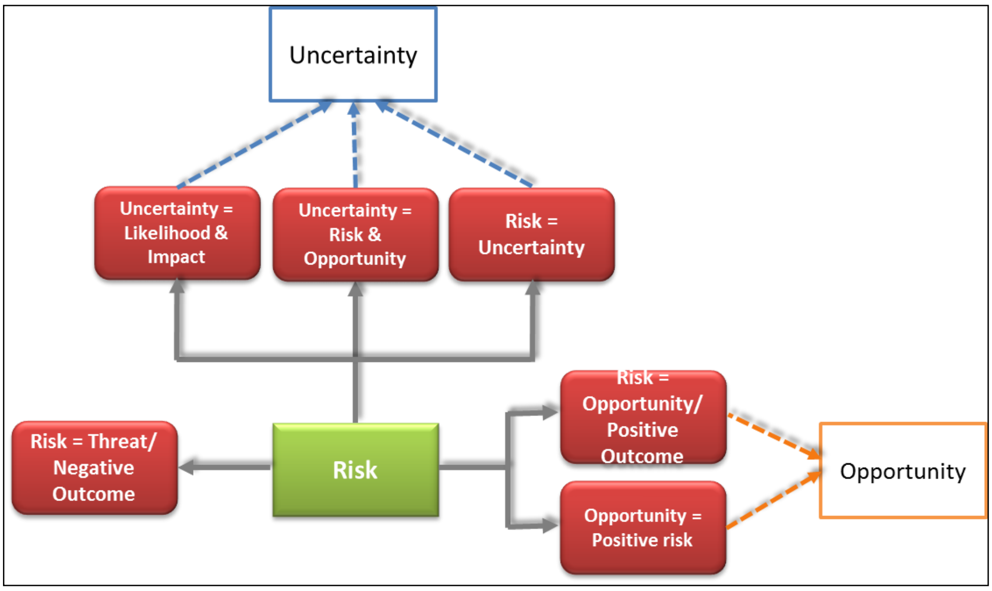


Figure 5.4: Definitions of risk and the relationship with uncertainty and opportunity

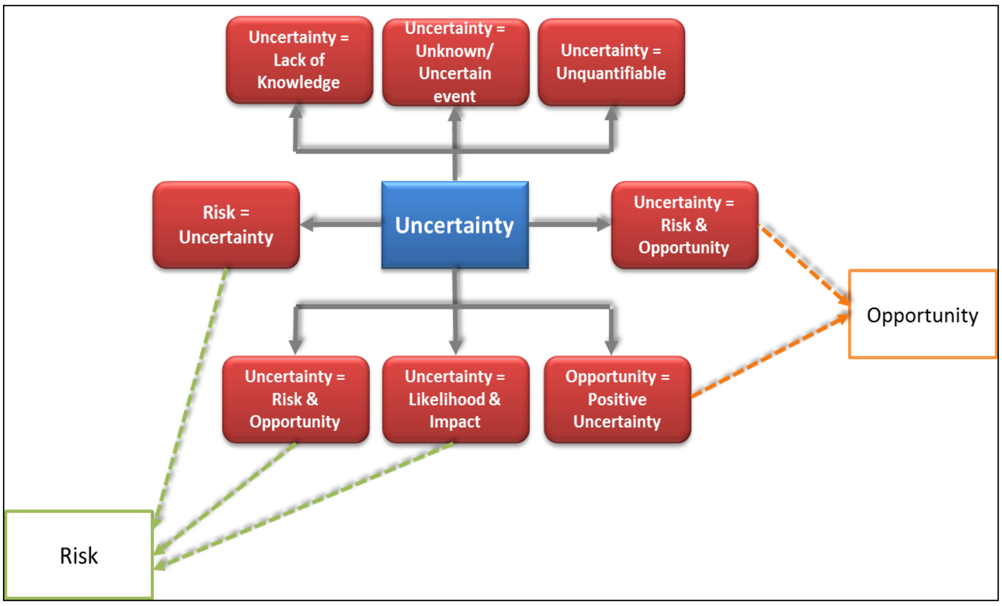


Figure 5.5: Definitions of uncertainty and the relationship with risk and opportunity

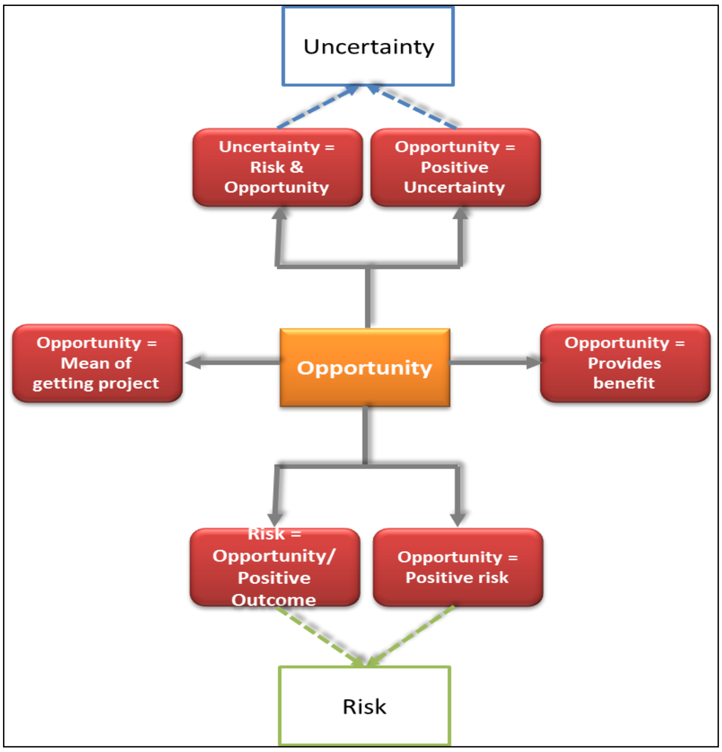


Figure 5.6: Definitions of opportunity and the relationships with risk and uncertainty

Based on the above diagrams (Figure 5.4 - Figure 5.6), the relationships between the definitions of risk, uncertainty and opportunity are summarized in Figure 5.7a and this is further refined in Figure 5.7b below:

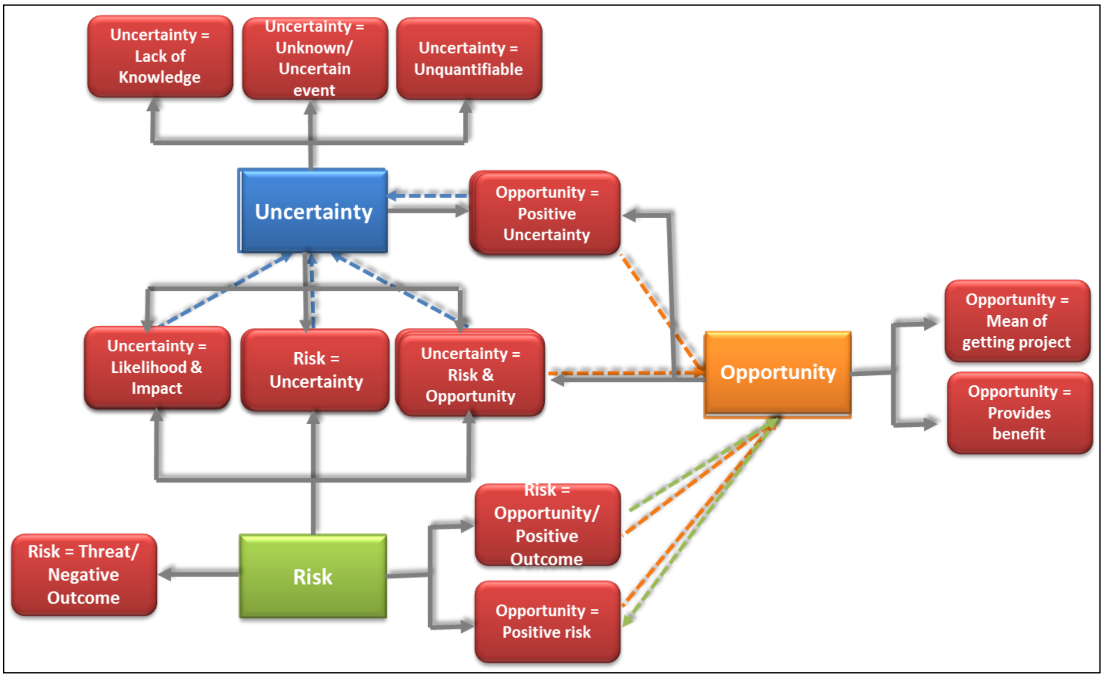


Figure 5.7(a): Relationships of the definitions of risk, uncertainty and opportunity – combined diagram

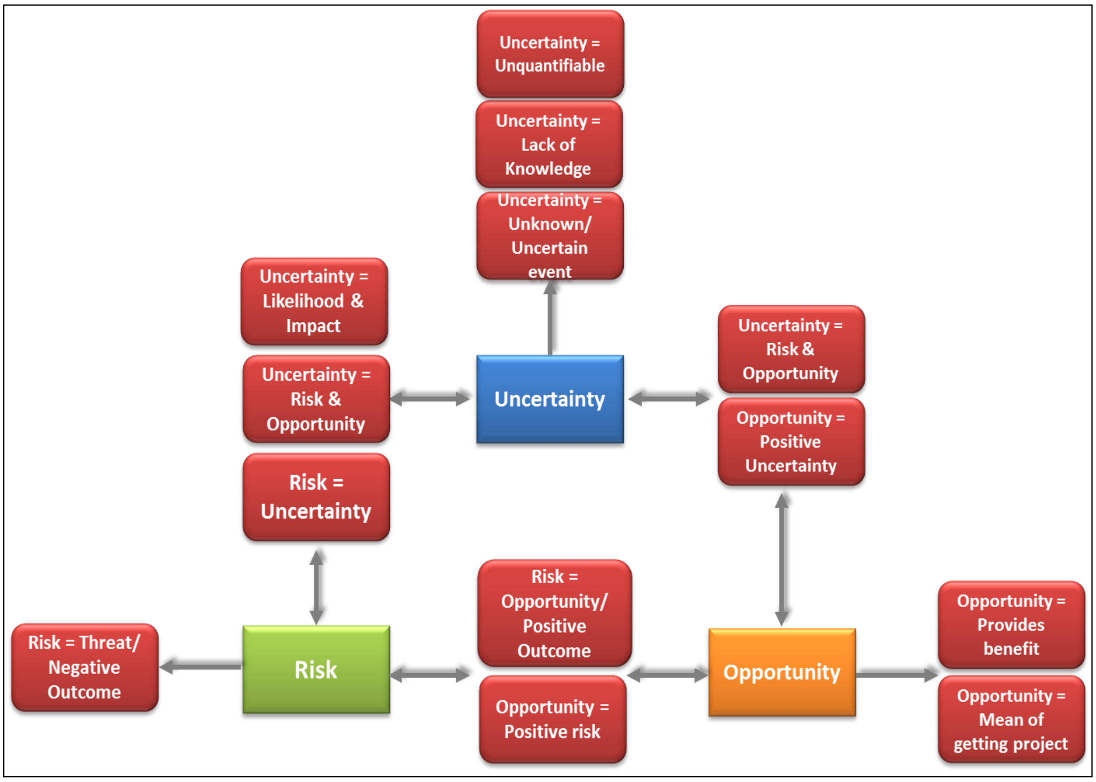


Figure 5.7(b): Relationships of the definitions of risk, uncertainty and opportunity – an improved diagram

The relationships between risk, uncertainty and opportunity which have been drawn from the research, and as seen in the improved diagram, are further discussed below:

a) Risk is a threat or opportunity and has a negative (downside) or positive (upside) impact.

   The data have shown that the majority of the interviewees viewed risk as a threat and as having a negative impact. Risk has its downside, which, should it occur, will impact the objectives negatively. Risk is also viewed as an opportunity, which does have a positive impact on the objectives set out by the organisation.

b) Risk can be measured.

   There is a chance that risk can occur. Risk is measured by the probability or likelihood of the occurrence, and the severity or impact of that particular event, should it materialise.

c) Risk is related to uncertainty

In contrast to the above description, some interviewees viewed risk as an uncertainty in achieving objectives. Risk and uncertainty are viewed as being interrelated, and they come about as an outcome of the other's occurrence.

Table 5.13 summarises the definitions of risk, uncertainty and opportunity described by the interviewees. Three (3) interviewees clearly differentiate between risk and uncertainty, thus corresponding to the K-K concept. Risk is defined as having both a negative and positive impact, uncertainty is defined as an unknown or uncertain event that occurs due to a lack of knowledge. Ten (10) interviewees understood that risk and uncertainty, essentially, have a similar meaning, thus disagreeing with the K-K concept. It is interesting to highlight that four (4) of these interviewees indicated that risk and opportunity were a sub-set of uncertainty, whereby risk was the negative outcome and opportunity was the positive outcome. Only six (6) interviewees related risk as having a negative outcome, whilst four (4) indicated that risk not only had a negative outcome, but a positive as well, known as opportunity. This research found that the industry categorisation has not significantly contributed to the general understanding of the concepts of risk and uncertainty.

Interviewee	Business Type	Industry		Definitions
				Risk ≠ uncertainty
003	*Power-nuclear; Consultancy-construction*	D	M	*Uncertainty = uncertain event, lack of knowledge; Risk=prob/impact; Opportunity is +ve outcome*
004	*Capital investment-engineering & construction*	F	M	*Uncertainty = unknown; Risk= -ve impact; Opportunity is +ve outcome*
005	*Railway/Train operations*	H		*Uncertainty = lack of knowledge; Risk is +ve and -ve*
				Risk = uncertainty
001	*Railway/Train operations*	H		***Uncertainty = risk & opportunity****; Risk is +ve and -ve; Opportunity is +ve risk and +ve uncertainty*
002	*Consultancy-construction, risk management*	F	M	*Uncertainty = Risk*
006	*Railway/Train operations*	H		***Uncertainty = risk & opportunity****, but uncertainty is unquantifiable; Risk = +ve and -ve*
007	*Consultancy-construction & engineering*	C	M	*Uncertainty = Risk; Opportunity is +ve outcome*
012	*Airport operations*	H	M	***Uncertainty = risk & opportunity****, unknown, lack of knowledge; Risk is -ve outcome*

015	*Services*	F	N	*Risk is +ve and -ve; Opportunity is +ve risk*
016	*Mining-petroleum*	B		*Uncertainty = Risk; Risk is -ve outcome*
024	*Water supply & sewerage*	E		*Uncertainty = Risk; Risk is -ve outcome; Opportunity is +ve outcome*
025	*Manufacturing- defence aircraft*	C	O	*Uncertainty = Risk; Risk is -ve outcome; Opportunity is +ve outcome*
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O	***Uncertainty = risk & opportunity**; Opportunity is +ve outcome*
				Risk = negative
008	*Railway/Train operations*	H		*Risk is -ve outcome*
009	*Manufacturing-defence aircraft*	C	O	*Risk is -ve outcome*
013	*Manufacturing- defence aircraft*	C	O	*Risk is -ve outcome*
019	*Manufacturing-defence submarine*	C	O	*Risk is -ve outcome*
021	*Construction*	F		*Risk is -ve outcome*
020	*Manufacturing-defence submarine*	C	O	*Uncertainty = unquantifiable, uncertain event; Risk is -ve outcome*
				Risk = negative & positive
010	*Mining-natural resources*	B		*Risk is +ve and -ve; Opportunity is +ve risk*
011	*Water supply & sewerage*	E		*Risk is +ve and -ve; Opportunity is +ve risk*
022	*Power-transmission/distribution*	D		*Risk is +ve and -ve*
023	*Mining-petroleum E&P technology, refining*	B	C	*Risk is -ve outcome; Opportunity is +ve risk*
				Uncertainty = lack of knowledge
014	*Manufacturing- defence aircraft*	C	O	*Uncertainty = lack of knowledge; Risk is -ve outcome; Opportunity is +ve risk*
018	*Manufacturing- defence aircraft*	C		*Uncertainty = lack of knowledge*

Table 5.13: Summary of definitions of risk, uncertainty and opportunity by interviewees

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

This research also found that the risk-uncertainty relationship and the risk-opportunity relationship do exist. Risk and opportunity are said to be uncertain, inasmuch as the risk will not always occur, and neither can one be certain that the opportunities will materialise. Therefore, if there is a certainty, one would not have risk and opportunity. This relationship can be translated into a structure that contains three separate levels, as shown in Figure 5.8a. This figure has been developed based on the interviewees' views and understanding, and is supported by the definitions provided in the standards and guidelines.

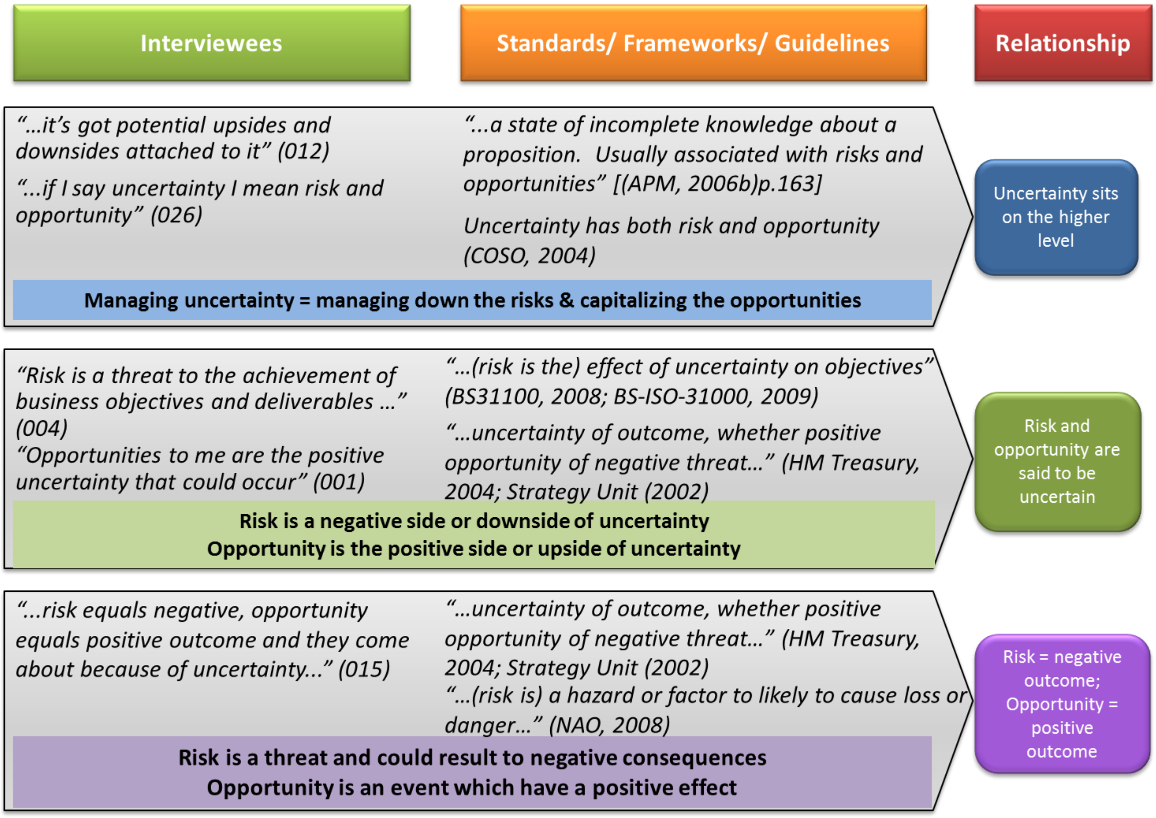


Figure 5.8(a): Understanding and definitions of risk and uncertainty: risk = uncertainty

Figure 5.8(b): Relationships of uncertainty, risk and opportunity: The two sides of uncertainty

Figure 5.8b simplifies the structure of the relationship discussed above. Based on this structure, uncertainty is positioned at the higher level, and risk and opportunity lie beneath. Risk is a negative side or downside of uncertainty, whilst an opportunity is the positive-side or upside of uncertainty. Thus, managing uncertainty can be described as managing down the risks and capitalizing the opportunities. Uncertainty is also considered as a potential source of risk, and may result in risk- which means that if we are uncertain about something, there is risk in our plan. Conversely, an ill-defined risk is a source of uncertainty. The level of understanding and information about a risk event is vital in managing uncertainty effectively.

Meanwhile, figures 5.9a and 5.9b summarize the other understanding of risk: risk as having two sides – threat and opportunity – whereby seeing risk as a threat means that it is recognized as the downside and can negatively impact upon the project or the business. In contrast, opportunity is known as the upside of risk and can have a positive impact.

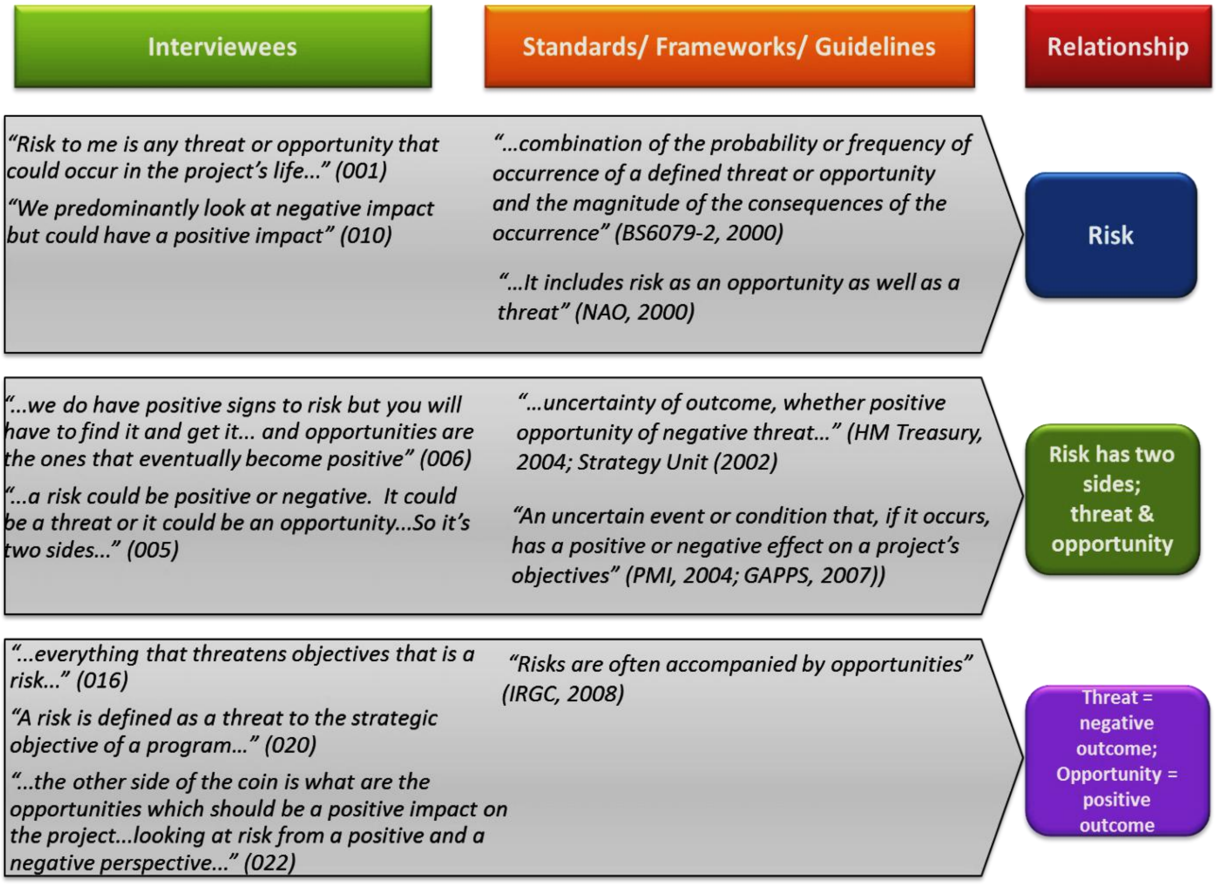


Figure 5.9(a): The two sides of risk

Figure 5.9(b): The relationships of risk and opportunity: The two sides of risk

On the other hand, risk and uncertainty were also viewed to be dissimilar. There are several reasons that could lead to such differences. First, risk is an event that can be recognized and measured, whereas uncertainty is an immeasurable event of which we have no clear understanding or information. Second, risk is said to be reflected in the allowance or contingencies from the risk register and thus can be modelled by the likelihood of occurrence. However, uncertainty is only reflected in the base cost and is modelled solely by time.

There were varying views concerning the existence of such a relationship, and whether or not they were synonymous. This research identified the viewpoints of those who said that no real relationship existed between risk and uncertainty. There is a need for this view to be explored further, as no additional information was provided by the interviewees.

Besides the risk-uncertainty relationship, there is also the risk-opportunity relationship, which does exist, and this was highlighted by the interviewees. Opportunity does not emerge by itself but has to be exploited and capitalized. However, should it does not materialise, and then there will be risk associated with it. This means that risk is being used as a basis to pursue an opportunity. The general understanding of risk implies that every time people talk about risk, they would include an opportunity as well.

It is widely held by the interviewees that risk and opportunity are both managed together either formally or informally in a systematic process. They may be managed in a specific process defined and developed by the organisation, and may be called risk and opportunity management. Opportunity might be managed as early as the bid stage where risk is being looked at, and, at some point, it might also be managed during the evaluation and mitigation stages of the risk management process. At these stages, there are registers for risks and opportunities, which are managed and evaluated at the same time. In terms of monitoring and control, opportunity is reviewed regularly together with risk during monthly meetings. In contrast, there are views and practices that isolate opportunity from risk. This is due to their differing nature – risk is the major concern to the organisation, and people tend to observe it as negative or a threat more so than opportunity. Furthermore, considerable effort needs to be taken when exploiting an opportunity to make sure that it is worth pursuing.

The next chapter will discuss the second part of the research findings, which is the practice of risk management.

CHAPTER 6

FINDINGS ON ANALYSIS:

PART II: MANAGING RISK IN PRACTICE

6.1 Introduction

This chapter presents the findings based on data collected from the interviews with regards to the current practice of risk management. It supports the research aim: evaluating the current understanding and practice of risk management with the main objective being to investigate the process adopted by differing industries. This chapter will discuss the current practices of risk management, including the risk management function and risk management issues. Besides, this chapter seeks to provide a clearer picture of the current practices of risk management which will assist in formulating a generic framework for project risk management.

6.2 Risk Management in Practice

This section discusses the findings on the current practices of risk management. Based on the interview data, the information related to risk management application can be divided into:

a) Knowledge and understanding
b) Practices of risk management
c) Process, steps and stages
d) Software, tools and techniques
e) Results of risk management
f) Surprises from risk management
g) Practices to be improved

6.2.1 Knowledge and Understanding

Risk management involves the process of identifying, analysing, responding and monitoring continuously. The essence of successful management of risk lies beyond the knowledge and understanding through the process. The issue of understanding in respect of the concept of risk and uncertainty were briefly discussed and analysed in Chapter 5. Thus, this section further examines the current state with the understanding of risk and its management. From the interview data, the knowledge and understanding of risk management are divided into ten categories: understanding the risks, the project, the processes, the objective; risk and issues; education and training; culture; cost control; budget and contingency; and awareness.

6.2.1.1 Understand What are the Risks

The key to successful management of risk is the understanding of risk itself. Attention is also drawn to the understanding on the differences between risk and issue due to the lack of knowledge to distinguish them. Risk has been identified in the risk register as cause, task and issue. For example, delay to construction is not a risk but an effect and the contractor will be charged accordingly. When such misunderstanding happens, a quick action is needed; moderated by normalizing the process to elaborate further what is the risk. This can be achieved through the following approaches:

a) Understand and explore the risks on projects.

b) Questioning whether or not there is a risk.

c) If there is a risk, understand what it does and how important it is to the project.

d) Focus on the cause of the risk; it does not happen by itself and there has to be something before it.

e) Address this carefully prior to raising any risk to avoid spending unnecessary time managing cause or issues and not risk.

"...people tend to make lots of management issues as risk which makes it difficult; people tend to put in the risk register sometimes what I would call management issues and sometimes they will put in risks which are really not risks, which are just concerns that they have..." (004)

"...differentiate between risks and issues…; They think they know where the risk is and when they tell me what the risk is, I said no that's not the risk, that's the cause…you know that's going to happen, you know that's the problem, what is the risk, but by normalizing that process, by having that understanding you actually capture in the end" (019)

"There is a big difference between risk and issue; you identify risk, not issues, lot of people sometimes don't understand the differences

6.2.1.2 Understand the Project and its Objectives

This research found that it is also important to understand the project and properly address its objectives. This is achieved through the following approaches:

a) Understand the scope of what needs to be delivered.
b) Understand the value of the project.
c) Understand the business.
d) Understand the interrelationship between project risk and business risk, and how risk flows from the project to the business.
e) Understand how risk management can help in the delivery of project time, cost, and quality.

"...before you can actually describe the risk you have got to understand your objectives..." (004)

"So first thing is about understanding the scope of what needs to be delivered…it's about understanding the value of the project…when we understand the scope then we will understand the risks better" (005)

"...you need to understand what your goals or objectives are, because if you can't define what your goals are you have no risks..." (015)

6.2.1.3 Understand the Process

One of the essences of understanding risk is through understanding the process. This was discussed in depth by twelve (12) interviewees. Based on the data, the maturity exists when people understand the process and know what they must do rather than being told or enforced by a system. The process has to be presented in a structured yet easy to understand. This will avoid people from doing it for the wrong reasons. Risk management should be part of the delivery system and according to interviewee 006; it is a process that involve all level, from the grassroots up to the CEO, being the owner of the risks or the one who may be affected by the risk. However, the ownership of the risk may be delegated to the project level.

> *"If they fully understand the scope of work that needs to be delivered in this stage, then they will be much more confident about managing the risks within that stage..."* (005)
>
> *"…people did not understand the fact that risk management is actually a discipline...it is actually a process that is part of the whole organisation, all across all levels all from the CEOs down to the lowest person...it needs to be embedded across all levels…people's understanding of the application of the process, the application is very important"* (006)
>
> *"...when you're trying to put project risk management in an organisation you've got to make it simple…how we identify, how we prioritize, how we are doing something about the risk…"* (007)

6.2.1.4 Risk Management Culture

Culture is part of the issues on understanding risk management highlighted by the interviewees. As discussed in Chapter 4, the perceptions and understanding are reflects the culture (Reisinger, 2009, Samovar et al., 1981). Therefore, it is not easy to implement risk management because it requires a change in thinking by the management, and it consumes time. Besides facing with reluctance, risk management was also understood as another way of getting more funds. For example, risk register is used to demonstrate what the risks cost them, escalating something during the identification phase, and putting the risk management process and documentation for tendering and for legislation compliance with no intention of practicing it. Interviewee 012 introduces behavioural level into the process as an alternative solution to manage this issue. This will ensure that people participate actively and being rewarded for doing it.

> *"...biggest issue in successful risk management is engaging with the people involved, and making sure that people involved understand how risk management can help them deliver their project time, cost, and quality"* (013)
>
> *"So it's not easy to implement the framework because you should change management mind setting and that takes time. It takes three, four, five years sometimes"* (016)
>
> *"...there was a big reluctance, it's not perfect or is it developing and that's why people are more risk aware than before…"* (020)

6.2.1.5 Understanding of Risk: Risk is related to Cost Controls and Contingencies.

Risk management was also being understood as a cost-control exercise, an accounting technique or a box ticking procedure, and also an allocation of contingency provision, which is normally being practiced in project management.

> *"...it was defined in the traditional way that you got the project costs and then you add 30% to it...so it was basically...a cost control exercise as well"* (003)
>
> *"…people within the organisation did not have a clue what risk management was about. They thought it was just an accounting technique or an accounting activity that needed to be done so that they can tick the box"* (006)
>
> *"Where I have seen risk management used and where it is successful is for example, when you have risk provision, like a project management contingency"* (026)

6.2.1.6 Awareness, Education and Training

However, the awareness is still lacking, and this will require continuous improvement to raise the awareness such as developing policies, appointing personnel to take charge, providing training, and reducing bureaucracies. Education and training are found to be a fundamental solution for risk management understanding, which was highlighted by eleven (11) interviewees. Trainings can be conducted internally to guide people through the thought process rather than going on courses conducted externally just to learn risk management. Additionally, the person who is facilitating risk management should also have a general knowledge of what can happen in his area. Nevertheless, the process of educating people should also include a risk management champion and not only the workforce.

> *"...risk awareness is still very much lacking...what needs to improve is the awareness"* (006)
>
> *"I need to continue to raise their awareness and remind teams, individuals why we do things and how to do things; the way we are trying to work is to put policies in place where they need to be in place, apart from that we have people and points of contact"* (007)
>
> *"…some people think it's just bureaucracy and we have a lot of people who we call problem-solving heroes"* (016)
>
> *"...people now---understand a little bit more about risk management…just because anybody goes on the training does not mean that they understood everything…"* (Interviewee 026)

6.2.2 The Practices of Risk Management

Although there are standards and guidelines, which lay down how risk can be managed, the practice of risk management varies between organisations. This may be due to the different nature of the business, the industry that they belong to and the products that they deliver. The following sub-sections will discuss the processes and current practices of risk management.

6.2.2.1 The Practices

Managing risks for project or for business requires the organisation to have a systematic and structured process. Organisations may opt to look for any available standards and guidelines or perhaps develop their own process. They may also have a generic guideline at the top level, but the process is defined separately in different parts of the organisation or towards each project. A good example can be taken from interviewee 013 whereby their organisation has a project to programme risk management and also other functional elements of risk management within the business. Within the process itself, there are defined stages, gates or check points, known as 'toll gates', which is like an auditing process, to go through for each risk.

These ‘toll gate’ systems geared towards the government’s guidelines, which have also been used for project governance. Interviewee 022 said that their process is called maturity in project management (MPM), which defines the level of maturity of the business or project. The details on guidelines are discussed in section 6.4. The risk management process starts off when a business or a project starts, from creating and reviewing the risk register, conducting risk workshops and managing those risks, which are discussed below.

a) Project life cycle

The risk management process is adopted anywhere within the project life cycle, and the approach may vary from one to another. For example, interviewee 025 said that risk management was part of the planning process while interviewee 014 stated that risks should be considered when there is a project, looking at different aspects of risk, such as regulatory compliance, external related risks and internal business processing risks. Additionally, interviewee 023 indicated that risk management starts with the bid stage, conducted right the way through to delivery. Once the project is completed, all risks should be reviewed and monitored at different levels of the organisation.

b) Risk register

The risk register is a live document which reports the status of existing risks and identifies new risks that occur as a result of the previous risk process. According to interviewee 010, every new project has to have a risk register. As the project develops, there may be a new influence that can cause the project to deviate, and therefore, it needs to be reviewed and assessed. Individuals within those business units are responsible for the creation of a risk register based on their experience and knowledge. However, interviewee 015 has different views about the risk register. He pointed out that it is a direct management responsibility or part of the insurance function to maintain and update the register, not only for risk but for opportunity as well. Risk register also helps to formulate the contract through the view of how things are going to be managed (Interviewee 002).

c) Workshop

Workshops – also known as meetings or brainstorming sessions – are regular yet not mandatory method of conducting risk management. Interviewee 009 argued that workshops can and do happen but risk management is more of an ongoing process. Organisations may conduct the workshop internally involving their own people for each project. However, interviewee 007 said that they might also get the client or other stakeholders to be involved as a combined group. Details regarding workshop will be discussed further in section 6.2.3.3.

6.2.3 Processes, Steps and Stages

6.2.3.1 Stages and Steps

This section discusses the stages and steps of the risk management process, responding to the research question indicated in Chapter 1, that is, '*How do organisations manage risk and uncertainty for their projects?*' Largely, the risk management literature offered a generic process involving the process of identifying, analysing, responding and monitoring risk. However, the process is being used and adopted differently to suit the organisation's business and environment. The process has been categorized into six: define, identify, analyse, evaluate, response, and monitor and review, as shown in Figure 6.1. Meanwhile, Table 6.1 provides the stages for risk management process in practice as indicated by the interviewees. This section will discuss the detail of the stages and steps of the processes.

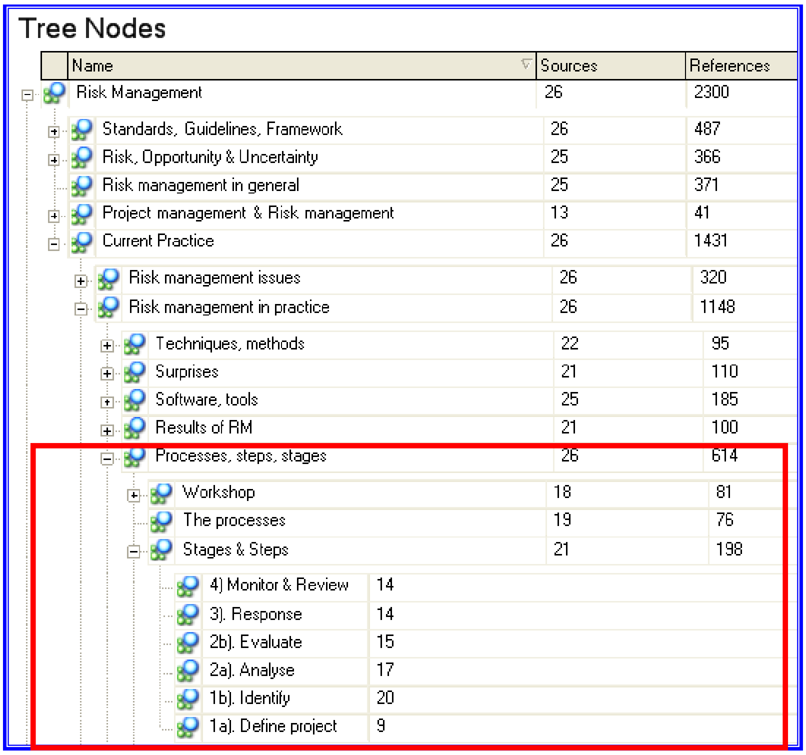


Figure 6.1: NVivo Tree Nodes – stages and steps in managing risks

				RM in Practice - Stages					
Interviewee	Business Type	Industry		Start with Define Project	Identify	Analyse	Evaluate	Response	Monitor & Review
001	*Consultancy-construction, RM*	H		√	√	√	√	√	√
003	*Capital investment-eng & const*	D	M		√	√			
004	*Railway/Train operations*	F	M		√	√			√
005	*Railway/Train operations*	H		√	√		√	√	
006	*Consultancy-eng & const*	H			√	√	√	√	√
007	*Railway/Train operations*	C	M		√	√			
008	*Manufacturing-defence aircraft*	H		√	√	√	√	√	
009	*Mining-natural resources*	C	O	√	√	√	√	√	√
011	*Airport operations*	E		√	√	√	√	√	√
013	*Mining-petroleum*	C	O		√		√	√	
014	*Services*	B		√	√	√	√	√	√
015	*Manufacturing- defence aircraft*	F	N	√	√	√			
016	*Construction*	C	O		√	√	√	√	
017	*Manufacturing- defence aircraft*	F			√	√	√	√	√

019	*Manufacturing-defence submarine*	C	O	√	√				√
020	*Construction*	C	O		√	√	√	√	√
021	*Power-transmission/distribution*	F			√	√	√	√	√
022	*Mining-petroleum E&P technology, refining*	D			√		√	√	√
023	*Water supply & sewerage*	B	C		√	√			√
025	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O			√	√	√	√
026	*Consultancy-construction, RM*	C	O	√	√	√	√	√	√
	TOTAL			***9***	***20***	***17***	***15***	***15***	***14***

Table 6.1: Stages in the risk management process

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

a) Define the context

Nine interviewees mentioned that the process should start with defining the context with activities like meetings, discussions and planning. In other words, it is crucial to have a clear and defined understanding of the project goals and objectives. Additionally, there is a need to appreciate the concerns of the project manager prior to proceeding with the risk management plan.

> *"…we need to understand what needs to be delivered, what activities to be done and what is the value of the project that we are undertaking." (005)*

b) Identification

It was discussed earlier in section 6.2.1 that the understanding of risk is the essence of successful risk management. Identifying risks also demands a clear understanding, which can be achieved through various means. Based on the data, interviewees 005, 006 and 026 pointed out that identification is the first stage in the risk process, albeit the definition stage as discussed earlier. The function of the identification stage is to get people to identify and define risks that may affect the business or project objectives. The activities involved are as follows:

- Risks are defined in a generalized way, without any cost data (Interviewee 003).
- The process focuses on high-quality descriptions and only key risks would be identified (Interviewee 016 and 021)
- The process is made compulsory and risks are identified and reviewed at least every month (Interviewee 020).
- Risks can be identified by asking questions and also by having a meeting (Interviewee 020).
- Risks are identified before and during workshop sessions or brainstorming sessions and risk owners are assigned (Interviewee 001, 005, 008, 009, 015).
- Identified risks are captured and documented in a register (Interviewee 004, 019).
- Identified risks should include their cause and effect (Interviewee 001, 009).
- Risks can be identified through lessons learnt from previous projects (Interviewee 009).
- Risks are also identified based on specific discussions around the critical path and sub-critical path schedule meeting developed during one-to-one interviews; usually conducted before any risk workshop (Interviewee 009).
- Different types of risk are identified - external related risk, internal business processing risk, risk to regulatory compliance, risk to the evolving part of the project itself and also risk from the timing perspective (Interviewee 014).

c) Analysis or Assessment

From the interview data, the research found that the organisations use the similar technique to analyse the identified risks. The techniques are discussed below.

Analysing likelihood or probability of occurrence and impact

Fourteen interviewees clearly mentioned that they analyse risks using the probability-impact scoring matrix.

- The probabilities of occurrence are tabulated and weighted using a matrix scoring system, which represents a band from low to high.
- Results from the matrix are listed down, and the risk is ranked in terms of their probability of occurring and their impact.

- Risks are prioritised, essentially from the top of the rank list, and tied to the document concerning what they are going to do about the risks to reduce their probability and what they might do to reduce the impact.
- The impact of risks could be related to projects, such as financial, schedule, quality, environment and reputation.

Other techniques

- *Assumption analysis* - used to look at the assumptions made on projects: the robustness, stability and sensitivity of the project to that assumption (Interviewee 001)
- *Balanced scorecard* - used to ensure that everybody is scoring on the same basis (Interviewee 004)
- *Standard set of questions* - requires people to respond with regards to the risks. The responses can be in terms of a scale, and 'yes' or 'no'. This technique supports the standard scoring system, which produces the probability-impact matrix (Interviewee 014).
- *Root-cause analysis* - focuses on the root of the risk. This technique will produce a very high-quality description of risk. It does not require analysis tools and only needs prioritisation and simple impact analysis. It is also best suited for the identification stage (Interviewee 016).

Two interviewees highlighted their concern over the word 'analyses' or 'assessment' as the terminology of this stage. According to interviewee 001, the 'analyse' and 'evaluate' stages often tied together in terms of how likely they occur – evaluating the impact and at the same time looking at the risk treatment. In another situation, interviewee 006 mentioned that they would put risk assessment jointly with risk analysis. Additionally, the interviewee agreed on the idea of getting away from risk assessment but maintaining the risk analysis, risk evaluation and risk management, which is what the AS/NZS 4360, BS6079-3, BS/IEC 62198 and BS/ISO 31000 are doing. He added that from an outside view, we could say everything that we are doing is analysing, assessing, evaluating or managing those risks. The risk evaluation stage will be discussed next.

d) Evaluation

As discussed earlier, there is concern over an overlapping between the analysis, assessment and evaluation processes. For this research, evaluation is separated from analysis, with the intention of observing differing views and issues discussed by the interviewees. The followings are activities involved at this stage.

- Risks are brought to the controllable level through the evaluation process (Interviewee 008)
- Risks are evaluated in terms of financial impact, which is one way of understanding what the risks mean to the project (Interviewee 025)
- Risks are evaluated and filtered appropriately to eradicate non risk items such as management roles and management duties, which are mistakenly identified as risk (Interviewee 006).
- Risk evaluation falls into two – prioritisation and signification. Risk prioritisation is a process of prioritising risk according to the importance while risk significance is a process multiplying the weight of that risk with the probability of it happening, which provides a score or measurement of the risk. (Interviewee 006).
- Major risks are observed.

e) Response or Treatment

The next stage is responding or treating the risks which have been analysed and evaluated earlier. Interviewees 009 and 011 indicate that, at this stage, people need to respond to the risks followed by allocating an action plan to deal with the risks. From the data, seven out of twelve interviewees who provided information on risk response refer to it as *mitigation*. The activities involved during this stage are discussed below:

- Response or treatment should be included in the risk register (Interviewee 022)
- Mitigation actions are required to reduce or eliminate the risk (Interviewee 013)
- The process is related to controlling risks (Interviewee 022)

- There are different ways of treatment: risk can be mitigated, accepted, transferred or insured (Interviewee 026).
- Risk appetite is where people would want to remove all risks.
- Risk responses are also translated into detailed actions throughout the project by getting the involvement of others, such as passing down the risk by awarding contracts to a sub-contractor to deliver the work.
- The responses could be in the form of sign-off and control, determining someone to look after the actions, and continuously follow up on the performance of the risks so they can be closed out (Interviewee 014, 016).

Similar to the evaluation stage, the research also found overlapping between the response and treatment stage with other stages, such as with analysis and evaluation.

"…the 'analyse' and 'evaluate' are often tied together in terms of how likely they occur, but you also evaluate the impact and look at the risk treatment" (001).

Risk treatment also consists of prioritisation and signification. According to interviewee 006, it can be managed through effective resources' planning, procurement process, assurance process and also quality process. Risk response is therefore considered as an output treatment and strategy of managing risk.

f) Monitoring and Reviewing

Once the response and treatment planned are laid down to be managed for each risk, they have to be monitored and reviewed constantly.

- Risk review is conducted after the full risk session to see whether the risks are closed out and whether there are other risks, which are still relevant or new risks emerged as a consequence of the action taken (Interviewee 001).
- New risks will be addressed through the same process and, therefore, the process is continuous.

Governance process

- Monitoring and reviewing is a governing process - a medium for which there is accountability and responsibility (Interviewee 006).
- It is also used to drive the audit process in the organisation to control and communicate the risks, ensuring that the actions identified earlier are managed and implemented accordingly (Interviewee 014, 026).
- Seven interviewees indicated that risk reporting forms part of the project review, which is conducted periodically and usually presented periodically to higher management for further action.

6.2.3.2 Summary of Stages and Steps

From the interviews, the research found that the process of managing risk involves several stages, namely, identify, analyse, assess, evaluate, response, and monitor and review. These are found to be consistent with the literature. Figure 6.3 depicts the summary of the stages and steps in managing risks which has been developed based on the interviews. The risk management is presented as a continuous process, from defining the context to monitor and review and back to defining the context. New risks emerged at the monitoring and review will have to go through the same process. This diagram includes the possible techniques that can be used for each step, and supported by quotes from the interviewees on how the steps can be conducted. Figure 6.4 provides a simplified version of the summary, indicating the stage numbering for easy reference.

Stage 1 – (a) Defining the context and, (b) Risk Identification

The process should start with defining the context and not by looking at identifying the risks straight away. This supports the idea that the degree of complexity is important to any project because complex project requires more effort to understand and deliver the objectives. Meetings and discussions are very important to prepare the project implementation, to understand the delivery system and to pave the way for the project that they will undertake. Risks are identified through workshops, interviews and lesson learnt.

Stage 2 – (a) Risk Analysis/ Assessment and, (b) Risk Evaluation

Risks are analysed and assessed in terms of their likelihood and impact of the risks should they occur. They are also evaluated on various aspects including financial, quality and schedule.

Stage 3 - Risk response/ Treatment

At this stage, mitigation actions for each risk are put in place to reduce, eliminate, transfer or accept. The main objective is to try to control the risk to an acceptable level.

Stage 4 - Risk Monitoring/ Review

The objective of this stage is to determine whether the risks can be closed out, are still relevant, or new risks have emerged. All new risks that emerge during the process must be managed the same way by going through the risk management process. However, it was found that new risks may emerge at any stage or step, and, therefore, they must be managed immediately upon first appearance. Stage 4 is also a means for governance, which involves accountability and responsibility. Additionally, monitoring should be conducted periodically, and must be communicated to all relevant parties.

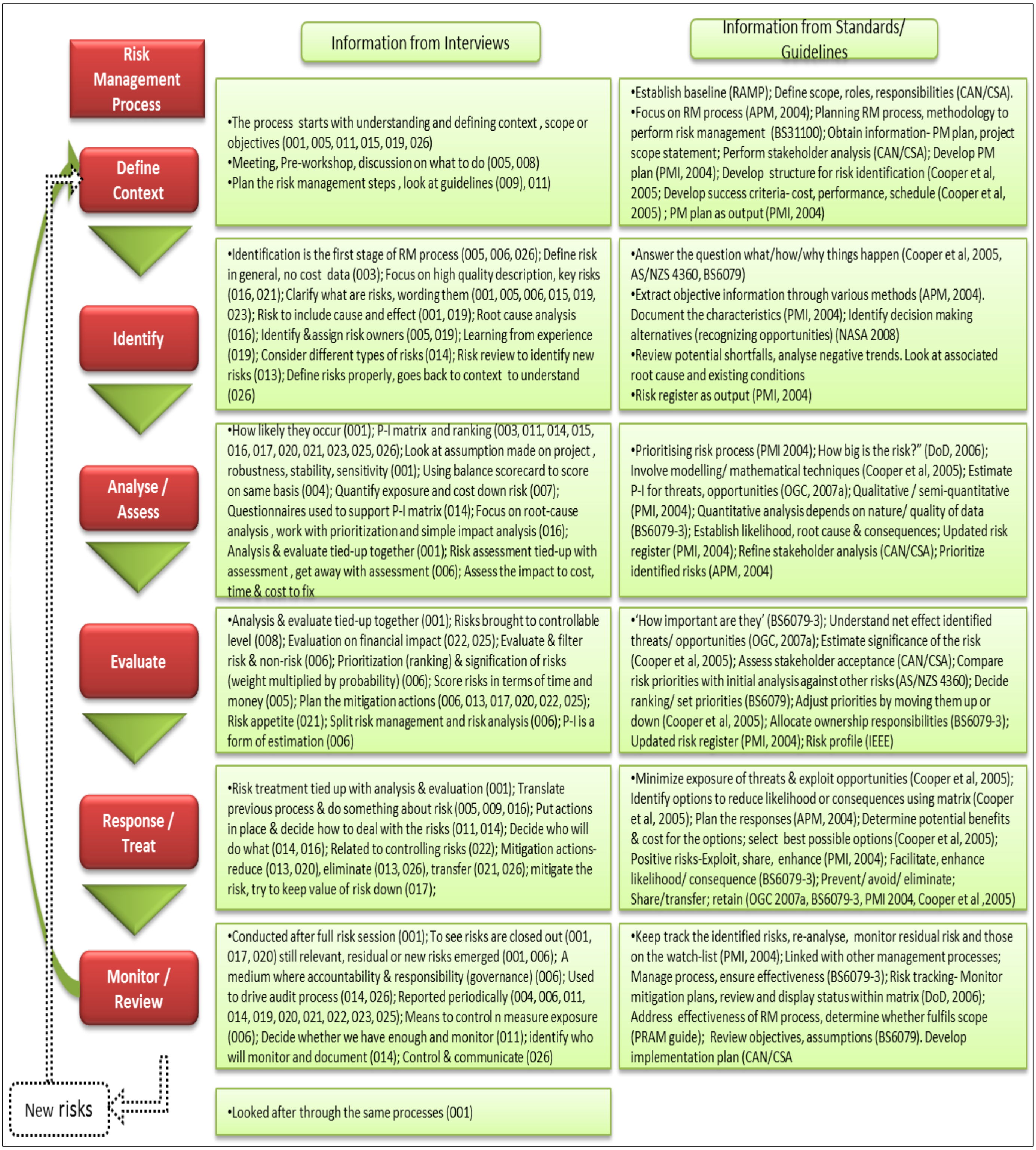


Figure 6.2: Summary of the stages and steps of risk management process from interviews compared with standards/ guidelines

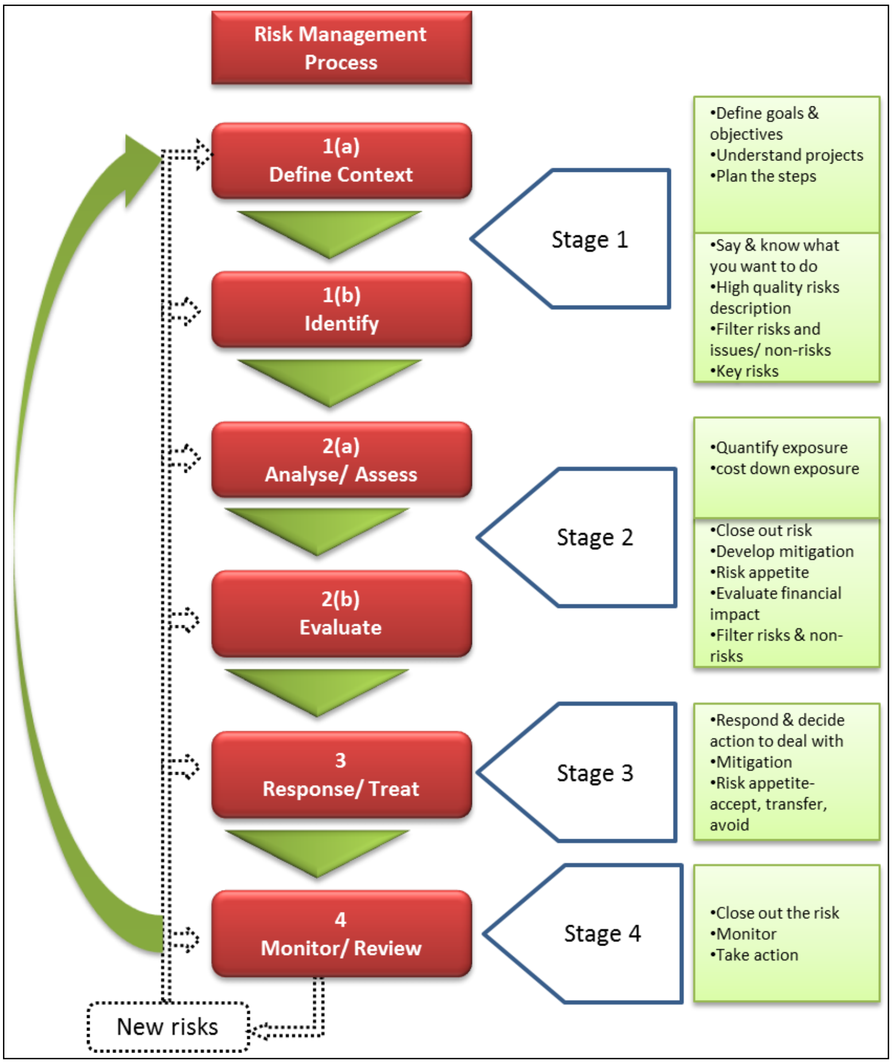


Figure 6.3: Findings from analysis – summary of risk management process from interviews

6.2.3.3 Risk Management Workshop

The activities relating to risk management workshop are presented in Figure 6.5 and are discussed below:

a) Pre-workshop

A pre-workshop is an activity held before the actual workshop to get to know some basic information regarding the project before the actual workshop. It is also known as general discussion or pre-discussion, mainly to understand the scope of the project and the related risks and to prepare the risk manager or the facilitator for the workshop. Risk may also be identified during pre-workshop.

b) The workshop

According to the interview data, workshops are carried out to identify the risks, to assign ownership for each of them, to analyse and evaluate the likelihood and impact if they occur, and to propose mitigation actions. Interviewee 013 stated that it is conducted to review the current situation on all the topics, presenting the status of the information and looking for the final agreement from management that they are happy with what is reported. There can be a series of workshops conducted or some of them may be conducted separately as sub-workshops in different work streams. For example, interviewee 004 mentioned that there will be functional workshops during the bidding process, technical workshop during the construction and an operational workshop, especially for PFI projects. Workshop requires the right set of expertise and the knowledge of the subjects.

c) Duration

Based on the data, the duration of the workshops varied between organisations, depending on the complexity of the project. An effective and productive workshop should not go beyond four to five hours.

d) Facilitation

Fifteen interviewees mentioned that they conducted the risk workshops internally; facilitated by the risk manager, risk champion, any other company expert or external consultants especially in cases where they do not have sufficient knowledge concerning certain areas.

e) Output

From the data, five interviewees provided information concerning the output or outcome from the risk management workshop. The risk register is found to be the outcome, as indicated by interviewees 005, 007 and 017. In addition, interviewee 014 pointed out that the risks are presented to the leadership in a report form while interviewee 001 mentioned that ownership of the risks is the output.

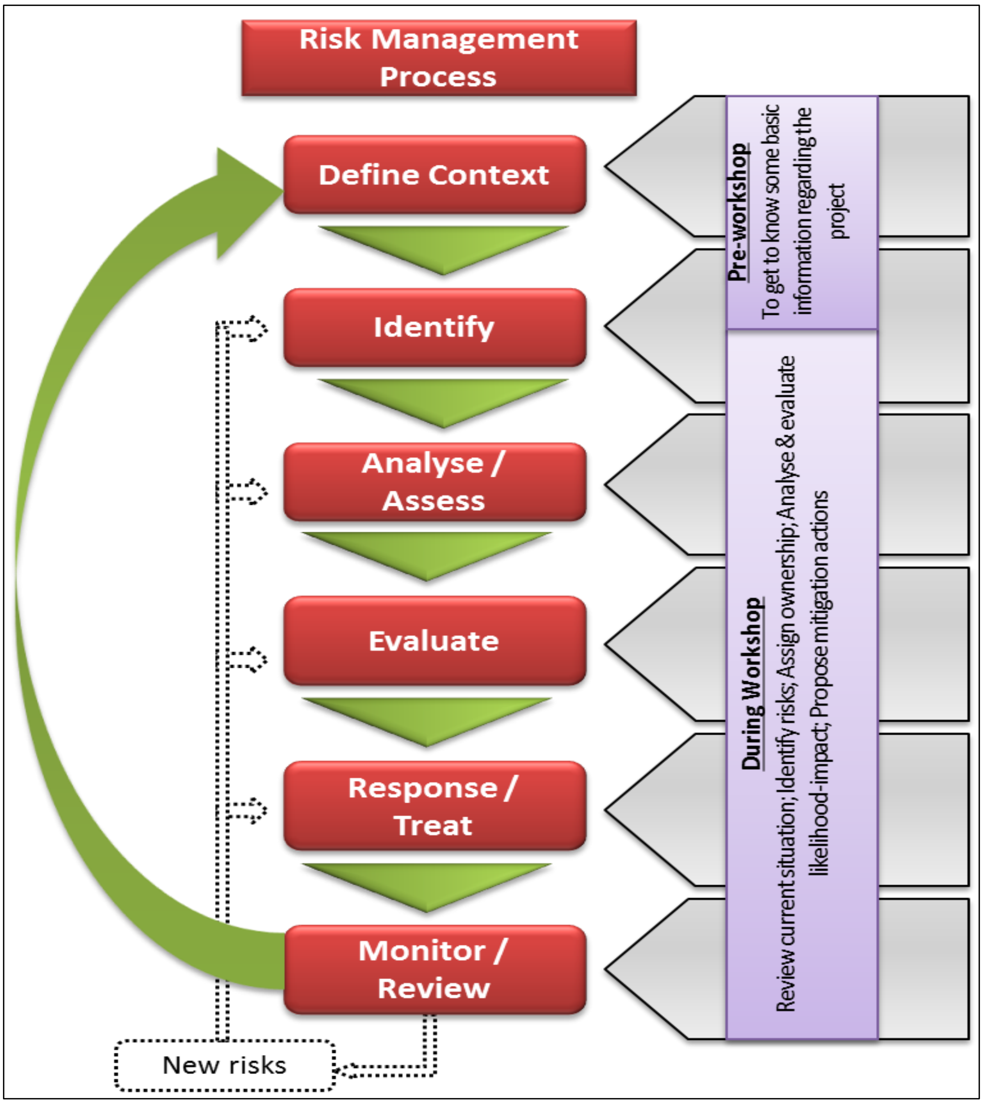


Figure 6.4: Findings from analysis – Workshop activities for risk management from interviews

6.2.3.4 Issues and Problems of the Risk Management Process

Interviewees 003 and 004 mentioned that they had problems in defining the risks. It is difficult to make sure that the right things are defined confidently. According to interviewee 002, they do not find it easy to have a standard routine process because the most important thing concerning the action of risk management is to affect the contract, which favours the customer, and needed to be agreed by the parties involved. Interviewee 015 mentioned that the problem is that people tend to forget that there is a process, particularly when there are demands for getting the job done and when other risks are identified at the beginning of the project. The challenge is doing it and closing up the actions, and linking with the audit process.

6.2.3.5 Summary on Risk Management Workshop and Issues Relating to the Risk Management Process

From the data, the information concerning risk management workshops can be summarized as follows:

a) The duration to conduct the risk management workshop varies from one organisation to another. It depends on the complexity of the projects that the organisations are managing.

b) Majority of the organisations conducted their risk management workshop internally, facilitated by their company expert, except for special cases or topics that need to be conducted by external experts.

c) Risk register is the outcome from the workshop, presented to the management level for monitoring purposes.

Meanwhile, this research also found two main issues relating to the risk management process, as follows:

a) It is difficult to define risk correctly due to the lack of understanding of the concept of risk as well as the difficulties in communication due to confidentiality of information.

b) It is also difficult to make sure that the whole process of managing risks is conducted and followed systematically due to insufficient administration as well as the demand to deliver the project or programme accordingly.

6.2.4 Techniques, Software and Tools

One of the secondary research questions set for this research is related to the significance of tools in risk management, which was highlighted by Hogarth (1980) that tools may not capture the essence of many important problems. The interviewees were asked questions relating to the software, tools, techniques and methods used to manage risk. This section investigates the extent of the use of tools and techniques for risk management.

6.2.4.1 Techniques

The research found that workshop, risk register, lessons learnt, and brainstorming are the most commonly used. Table 6.2 summarizes the techniques used by the organisations.

		RM Practice - Techniques & Methods									
Inter-viewee	Business Type	Industry		Brainstorm	Estimate	Experience & Lesson Learnt	Interview	Risk Register	Scheduled Meetings	Tornado Chart	Workshop
001	*Railway/Train operations*	H		√	√	√	√	√		√	√
002	*Consultancy-construction, RM*	F	M					√			
003	*Power-nuclear; Consultancy-construction*	D	M								√
004	*Capital investment-eng & const*	F	M					√			√
005	*Railway/Train operations*	H						√			√
006	*Railway/Train operations*	H		√				√			√
007	*Consultancy-construction & engineering*	C	M	√		√					√
008	*Railway/Train operations*	H									√
009	*Manufacturing-defence aircraft*	C	O	√		√	√				√
011	*Water supply & sewerage*	E		√		√		√			
012	*Airport operations*	H	M			√		√			√
013	*Manufacturing- defence aircraft*	C	O								
014	*Mining-petroleum*	B						√			√
015	*Services*	F	N	√		√					
016	*Manufacturing- defence aircraft*	C	O		√	√					√
017	*Construction*	F				√					
019	*Manufacturing-defence submarine*	C	O		√	√		√		√	
020	*Manufacturing-defence submarine*	C	O	√		√					
021	*Construction*	F						√			
022	*Power-transmission/distribution*	D						√	√		
023	*Mining-petroleum E&P technology, refining*	B	C	√		√					√
024	*Water supply & sewerage*	E									
025	*Manufacturing- defence aircraft*	C	O	√				√			√
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O	√		√		√	√		
	TOTAL			*10*	*3*	*12*	*2*	*13*	*2*	*2*	*13*

Table 6.2: Techniques and methods used in risk management

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

6.2.4.2 Software and Tools

The interviewees were also asked about the type of software and tools that they normally used for risk management in their organisation. The researcher found that fourteen different types of software or tools have been adopted, which includes own-developed programme and other miscellaneous programmes. Table 6.3 provides a summary of the type of software and tools used by the organisations.

From the data, fourteen interviewees stated that Microsoft Excel was used as a tool for risk management. Monte Carlo simulation is the next popular software, which is used by eight organisations. Active Risk Management (ARM), @Risk, and Pert master are other types of software that are adopted by most organisations whereas Predict and Primavera were found to be the least popular software in this research. Meanwhile, seven interviewees indicated that they currently use other types of computer program that were developed in-house.

				RM Practice - Software & Tools							
Interviewee	Business Type	Industry		@Risk	Active RM	Monte Carlo Simulation	MS Excel	Pert master	Predict	Primavera	Other Software
001	*Railway/Train operations*	H		√	√		√	√	√		
002	*Consultancy-construction, RM*	F	M	√		√	√				
003	*Power-nuclear; Consultancy-construction*	D	M			√	√				
004	*Capital investment-eng & const*	F	M								√
005	*Railway/Train operations*	H		√	√	√					
006	*Railway/Train operations*	H		√	√	√					√
007	*Consultancy-construction & engineering*	C	M					√		√	
009	*Manufacturing-defence aircraft*	C	O		√	√		√	√		
010	*Mining-natural resources*	B					√				√
011	*Water supply & sewerage*	E					√				
012	*Airport operations*	H	M			√	√				
013	*Manufacturing- defence aircraft*	C	O								√
014	*Mining-petroleum*	B					√				
015	*Services*	F	N	√		√					
016	*Manufacturing- defence aircraft*	C	O								√
018	*Manufacturing- defence aircraft*	C					√		√		

019	*Manufacturing-defence submarine*	C	O					√		√	
020	*Manufacturing-defence submarine*	C	O		√			√			
021	*Construction*	F					√				√
022	*Power-transmission/distribution*	D					√				
023	*Mining-petroleum E&P technology, refining*	B	C				√				
024	*Water supply & sewerage*	E				√	√				
025	*Manufacturing- defence aircraft*	C	O				√				√
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O		√		√				
	TOTAL			***5***	***6***	***8***	***14***	***5***	***3***	***2***	***7***

Table 6.3: Software and tools used for risk management

NOTE:

B - Mining & quarrying C - Manufacturing D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities F - Construction
H - Transportation &storage M - Professional, scientific & technical activities
N - Administrative & support service activities O - Public administration & defence; compulsory social security

6.2.4.3 Functions of Software and Tools

The interview data have been categorized to reflect the function of software and tools, which provides information concerning the "dos and don'ts". From the analysis, the functions can be summarised as follows:

a) A database to create a risk register
b) A reporting tool
c) A means for project planning
d) A means for programme risk analysis
e) A means for verifying risk budgets
f) Financial modelling
g) Project budgeting and forecasting

Some drawbacks were also highlighted during the interviews. Based on the experience in developing a mitigation process, interviewee 013 criticized the use of software as it does not do anything to help the process. Meanwhile, interviewee 004 also voiced his criticism concerning their software, which is not very intuitive like Microsoft Project, whereas interviewee 016 mentioned that they had stopped using analysis software because it was not part of risk philosophy and does not add value for them. Generally, software and tools are reported to be a mean or an aid for information processing and decision making. For example, interviewee 001 mentioned that it was just a mean to get the results while interviewee 005 said that it was used to provide consistency and transparency of the information. Interviewee 013 also related the usage as an enabler for integrating information across the company in a structured form.

6.2.4.4 Issues Concerning the use of Software and Tools

The interviewees have highlighted the issues of dependencies on tools and reliance on numbers by practitioners. The issues on dependencies towards tools and techniques have been discussed earlier in Chapter 1. People should not rely on the number or the tool but the application of the results and how one decides based on that. It is the understanding of risks and their exposure that is more important and one should not let the software and tools drive the process.

Interviewees 010, 016, 018 and 026 pointed out that having wonderful software is useless if we do not capture and prioritise the important risks by the right people who understand the objectives and are able to review and manage the risks. This issue was highlighted by Hogarth (1980). There are also other shortfalls of the use of software and tools. For example, there is no software that can reflect the complexity of the organisation. Interviewee 016 voiced his criticism of everyone who is focusing on the sophistication of risk analysis and running Monte Carlo simulation, which he found to be a totally different philosophy because they are only playing around with figures and therefore losing contact with reality. Nevertheless, it is useful to have software and tools, as long as there is sufficient understanding concerning how risk works. Hence, interviewee 026 advocated that the process is the key thing, and that the tool is second.

The findings conform to the concerns of Hogarth (1980), Del Cano & De la Cruz (2000), and Seyedhoseini & Hatefi (2009) that tools are lacking on the flexibility to capture the essence of many important problems. Additionally, the decision to opt for any methods or software must be made carefully to ensure that suitable risk management is performed.

"...that software is not user-friendly, it's got other issues related and hardly report those risks...it's not used as a management tool...very few people actually know how to use software and they are only there because they just have to input the data and then produce registers..." (004)

"Most of the project managers, if we talk to them about Monte Carlo they don't understand it" (005)

"…the software to them is a bit of a burden because they have to enter information into it and they don't see any value in it themselves...the software is not the most user-friendly or intuitive piece of software that we have seen many times" (013)

"I don't think anybody could do anything these days without software, even if you were only using Excel spreadsheets, which is what we have done in the past at the local level, you need software to manage risk because you are dealing with lots of information...we have the software with all the risk information in it. It's a bit more sophisticated than a register..." (013)

6.2.4.5 Summary of the Use of Software and Tools

Based on the data, the research found that there are various techniques, methods, software, and tools used in risk management.

a) Techniques and methods

There are four commonly used techniques and methods:

i) Risk register (13 interviewees)

ii) Workshop (13 interviewees)

iii) Experience and lessons learnt (12 interviewees)

iv) Brainstorming (10 interviewees)

In addition, four other techniques were mentioned by the interviewees, namely, estimate, interview, scheduled meetings, and tornado chart.

b) Software and tools

The data shows that five common types of software or tools are adopted by the organisations for risk management:

i) Microsoft excel (14 interviewees)

ii) Monte Carlo simulation (8 interviewees)

iii) Active Risk Management or ARM (6 interviewees)

iv) @Risk (5 interviewees)

v) Pert master (5 interviewees)

Meanwhile, Predict, Primavera, Microsoft access, Delphi, and Balanced scorecard are among other choices of software and tools used by the organisations. Apart from adopting available software or tools, seven interviewees pointed out that their organisations have adopted their own-developed software or programme for risk management. The research also found that software and tools act as an aid for information processing and decision making. The functions can be summarised as follows:

i) A database to create risk register

ii) A reporting tool

iii) A means for project planning

iv) A means for programme risk analysis

v) A means for verifying risk budgets

vi) Financial modelling

vii) Project budgeting and forecasting

Figure 6.6 depicts the risk management steps and the possible tools and techniques that can be used. It also includes brief idea of the function of the tools as in order to minimise or avoid the dependencies as discussed earlier.

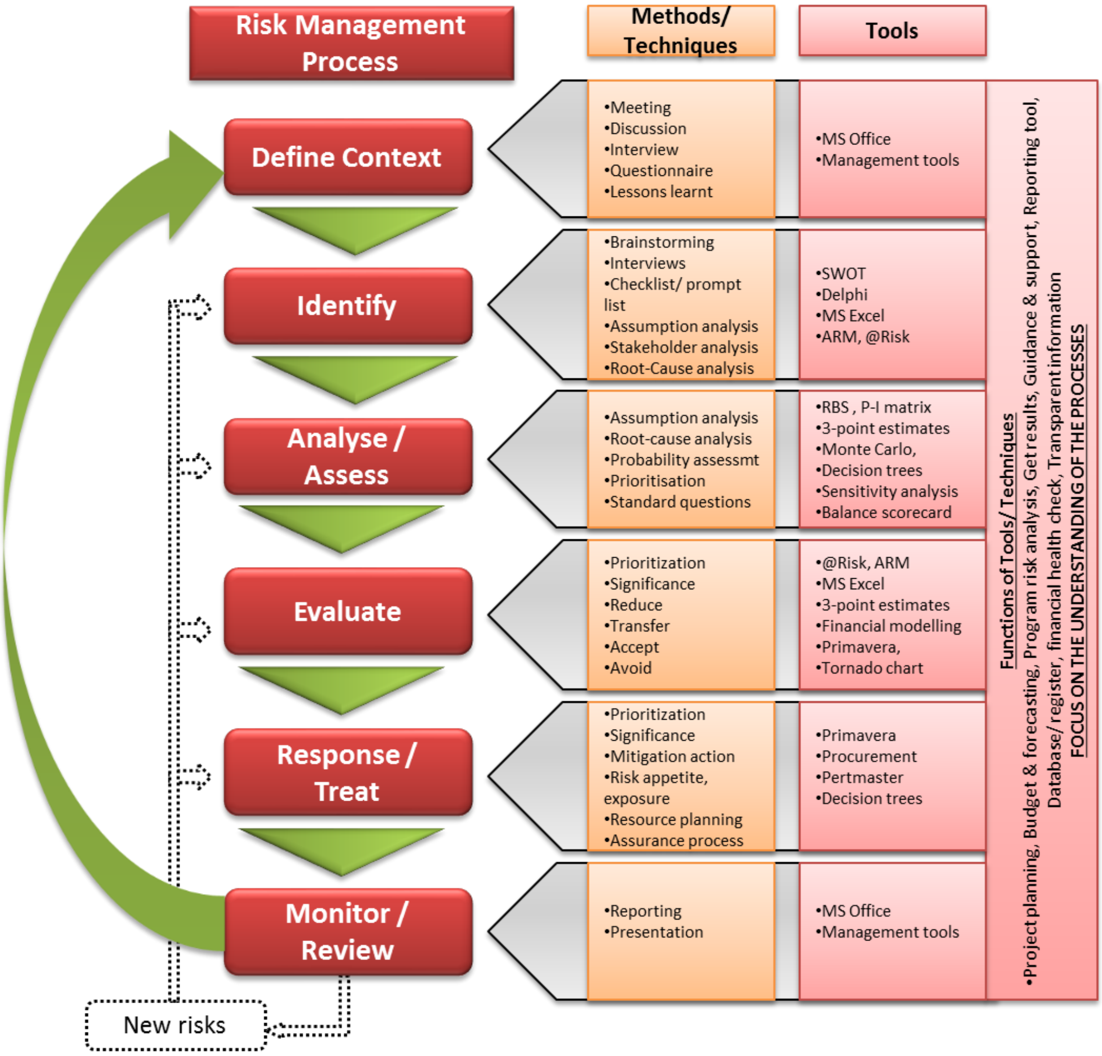


Figure 6.5: Findings from analysis – Tools and techniques for risk management from interviews

6.2.5 Results of Risk Management

The interviewees were asked to describe the results from risk management practices in their organisation, as discussed below.

6.2.5.1 Results are Good

The results can be categorized as follows:

a) Cost and time savings

The practice of risk management has resulted into savings in terms of cost and time. It avoids unnecessary problem-solving and over spending. Additionally, it also supports the goal of delivering the project on time and on budget by providing an early warning of potential issues.

> *"We have really managed to develop a very simple process and method and it has been implemented and accepted in the whole organisation… we are saving hundreds of millions every year…"* (016)
>
> *"The risk management supports the final outcome of the project; it supports the goal of delivering a project on time and to budget and it highlights an early warning of potential issues"* (023)
>
> *"it's a very important way of working to avoid over spending because if we don't do it then you guarantee your over spending more or less"* (025)

b) Performance improvement

The risk management process helps to improve management performance and delivers accountabilities better. It also promotes better communication through good risk identification and gives confidence to the customer. Additionally, it also helps organisations to have strong forecasting and understand their financial performance. Risk management also helps the delivery of a project by carefully looking at the objectives and things that might prevent them from delivering.

> *"...results are usually useful...help management in catching the feel of their performance of how well they are doing...helping the management to deliver on their accountabilities"* (014)
>
> *"...it promotes risk identification, early warning and the communication we find that we are managing all the risks…The outputs that we have are the S Curve and the histogram...We use it to give confidence to our customers, our stakeholders. We can deliver projects on time...we use the outputs to agree a contract...We use it for setting production targets; we use it through the project to monitor our conflicts completely on time against cost...We have 90% confidence, 90% of the risks, that we identified don't turn into issues, they are managed as risks"* (019)
>
> *"...It helps the delivery of that...It does work, we have seen it because it means that people are looking at the objectives, looking at the things that might prevent them from delivering those objectives in terms of risks, and then, therefore, they manage those risks so that those objectives are still possible; it is a control mechanism in the sense that what you are trying to do happens"* (026)

c) Better understanding about the process

The risk management process helps to understand and identifies uncertainties and risks. It improves the working and process efficiency on product deliveries and also gives confidence to everyone on risk management.

> *"We have really identified uncertainties, risks areas; involving the right people...it's much more about working efficiency and process efficiency and such things"* (016)
>
> *"...It gives confidence not just to the guys working it but up to senior management as well...due diligence on risk management, they understand the risks and the cost associated with those risks…it just gives more confidence to those who manage this sort of programme and also to the customers as well..."* (018)

6.2.5.2 Results are Difficult to Justify

Five interviewees relate the results of risk management are difficult to highlight. Not all risk management system works perfectly and achieves the objectives completely due to the following reasons:

- A lot of time spent on scoring the risk before and after mitigation.
- Risk management process is tedious; they have to identify existing controls and unique controls and create a risk register.
- There are arguments concerning whether it is useful or not because a lot of money spent to bring people in and to conduct the process, but the amount of savings achieved is questionable.

6.2.5.3 Results Depend on the Project Team and Experience

The results of risk management also depend on the experience of the organisation to deliver projects as well as the composition of the project team. People learnt from experience by having good project planning. Therefore, the results from risk management practice may prevent them from bidding for projects that will not contribute to profit based on their experience.

6.2.5.4 Results are related to Culture.

Culture has been linked to the results of risk management. Culture is very important because risk management will only be effective if people are willing to adopt the philosophy. A good environment and the need to identify risk are the driving force to the results of risk management.

6.2.5.5 Summary of the Results of Risk Management Practices

Based on the analysis, the research found various results from the practices of risk management, which can be summarized as follows:

a) Positive results

- i) Cost and time savings
- ii) Performance improvement
- iii) Better understanding of the process

b) Negative results

- i) No risk management system works perfectly and achieves the objectives completely
- ii) Time spent on scoring the risk before and after mitigation
- iii) Money spent to conduct the process but the amount of savings achieved is questionable.

c) Others

- i) Depending on the experience from past projects and lessons learnt.
- ii) Depending on culture towards risk management. It will only be effective if they are willing to adopt the thinking.

6.2.6 Surprises from Risk Management

The interviewees were also asked about the surprises encountered from the risk management exercise. The information is categorized as follows:

6.2.6.1 Unforeseen Events

Ten interviewees shared their common surprises encountered in their projects where unforeseen events emerged during or upon completion of the project. These events appeared to be new things coming out from the risk workshop, which interviewee 004 termed as 'new risks' that they have not foreseen before. Interviewee 005 mentioned that this happened when they found that the project is more complex and costs more, not according to plan. The recent credit crunch and bad weather, which hit Britain, are examples of the surprises that people had not considered, but they happened and had a negative impact on project performance.

6.2.6.2 Lack of Experience

Surprises also happen due to the lack of experience in a project. This happens when people understated the cost of achieving their requirements, and the fundamental risk was not identified and not assessed as critical, and it actually turned out to be critical.

6.2.6.3 Lack of Information

Lack of information also contributed to the surprises in a project. For example, Interviewee 005 mentioned that it is difficult to get accurate information when dealing with old assets and, therefore, issues relating to planning and surveying are unavoidable. Interviewee 010 argued although assessment exercise has been conducted, the cost might still increase a few months' time due to unforeseen event. The wording and contract clauses also contributed to the surprise. Thus, the contracts awarded are grey, and it is difficult to forecast or to identify risk.

6.2.6.4 Inaccurate Register and the Risk Itself is the Surprise.

Inaccurate risk register was found to contribute to the surprise. Ideally, all risks should have been recorded in the register. Nonetheless, risk, which is not captured anywhere, might suddenly emerge. Meanwhile, risk itself has been identified as the surprise. Interviewee 004 mentioned that this was because people could not foresee all potential risks, and, therefore, these are also considered as a surprise.

6.2.6.5 Issues on Surprises - Culture

There are culture issues, which can be part of the cause of the surprise. Interviewee 016 pointed out that people are afraid for what they will find out, and the worse scenario is that they are the root cause themselves.

6.2.6.6 Actions on Surprises

There are different approaches taken to manage such surprises. According to interviewees 004, 005, 013 and 022, good decision making is very important to manage the surprises. Interviewee 004 added that they had to make sure that those surprises are captured into a risk register for future use. Interviewee 023 mentioned that they would manage the surprises the same way as risk. Reviewing and feedback are other approaches to manage surprises. Interviewees 006, 022 and 023 pointed out that they would review the surprises and compare the forecast with what actually happens and feed the information back into the system through the lessons learnt. This will ensure that they are documented for future use.

6.2.6.7 No Surprise

Two interviewees have clearly mentioned that there are no surprises. According to interviewee 018, they have not experienced such surprises but will manage them similar to the current risk management processes should they occur. Meanwhile, interviewee 019 also said that they had not had any surprises but only risks, which are predominantly known unknowns.

6.2.7 Summary of Surprises from Risk Management

The various surprises reported from the practice of risk management are summarized as follows:

a) Unforeseen events, such as new risks that have not been foreseen.

b) Lack of experience in a project has made people understate the probability of an event happening.

c) Lack of information has contributed to the surprises in a project.

d) Inaccurate risk register was found to contribute to the surprise because people could not foresee all potential risks.

e) Culture issues. People tend to hide the risk information because they are afraid that they are the root cause themselves.

According to the analysis, these surprises can be managed through the following actions:

a) Good decision making
b) Capturing all surprises into a risk register
c) Reviewing and feeding back into the system
d) Documenting all lessons learnt

The above summary indicates that surprises are largely people issues. This is consistent with Arrow (1951) that people tend overestimate the amount of information available. In fact, their knowledge was limited because people sometimes have insufficient information to arrive at a judgement (Bernstein, 1998). Therefore, surprises from risk management are found to be directly related to uncertainty. A good decision making is vital because decisions always deal with uncertain situations (Knight, 1921).

6.2.8 Practices to be Improved

The interviewees were asked regarding the improvements they would suggest for the practice of risk management and are categorised accordingly.

6.2.8.1 Risk Management Process

From the data, there are suggestions that the stages in the risk management process could be better. Improvements are needed in the analysis and assessment stage, identification stage as well as monitoring stage. The details are discussed below.

a) Analysis and assessment

Three interviewees (004, 020, and 023) suggested that the analysis and assessment stages need to be improved. For example, the scoring sheets and the analysis software have to be improved and be more user-friendly. Improvement is also needed to mitigate the risks, and the impact of risks should be focused on the schedule rather than on the financial aspects.

b) Identification

Four interviewees indicated that they need to improve on the identification stage. Interviewees 001 and 019 highlighted the importance of identifying risk, making sure that people can describe risks appropriately and are able to differentiate between risks and issues. Meanwhile, interviewees 012 and 021 mentioned that the risk register is fairly complicated and that they need to start using software for a database.

c) Monitoring

Monitoring also needs to be improved to better manage the risks. Interviewee 005 highlights the importance of performance monitoring, especially concerning the monetary issues, by which people can have a better visual understanding about the project. Interviewee 015 indicates the need to improve on the way people present risk to the management.

d) The steps

Interviewee 026 went to the extent of reducing the steps that they currently have in order to improve the whole process.

6.2.8.2 Budgeting

Forecasting the amount of money to be spent on the project is a crucial activity and has to be improved. Interviewees 002 and 022 said that they would need to improve on the way they forecasted the cost to manage risks and contingency allowances.

6.2.8.3 Culture

Improving the culture is one of the approaches highlighted by the interviewees. The most important issue is to get people to change their attitude and thinking towards appreciating risk management and how it works, which is a challenge. The following are the improvements suggested by the interviewees.

a) Introducing behavioural component - Interviewee 012 indicates the need to introduce a behavioural component in risk management, getting into the psychology side of it. People would be rewarded for good risk management, and penalised for ineffective risk management. As such, this is seen as a good move to monitor the individual performance and to keep the maturity level up.

b) Appreciate and be transparent - There is a need to start appreciating true risk management and to be more open and transparent as to what people mean by risk and who is best to manage it. Interviewee 012 highlighted the need to move away from contractual risk management, which usually holds someone responsible if risk occurs because this creates the issue of over pricing the risks.

c) Improve the functions - Interviewee 013 said that people needed to understand the benefits from risk management, and they have to be convinced on that. Meanwhile, interviewee 015 mentioned that people need to be reminded that the material exists and that there is a process. Governance also needs to be made clear, identifying different levels of ownership, such as risk sponsor, risk oversight owner and the risk owner himself.

6.2.8.4 Education and Training

From the interviews, sharing the experiences through education and training courses are found to be a good exercise in order to have better understanding and awareness. Interviewee 018 suggested that people from the industry should be involved in sharing the experience what is being done. Meanwhile, interviewees 019 and 021 would like to improve on training the subcontractor and on staff induction, respectively. This will help them to start thinking about risk and learning from experience, which is a more effective way of sharing risk management practices.

6.2.8.5 Experience

Improvement could also come from observing and learning what other businesses do and select those that are applicable to improve the project or business. Besides that, a collective experience is useful to improve procedure in risk management process. These have been highlighted by interviewee 023 and 025.

6.2.8.6 Opportunity Management

Interviewee 009 and 020 pointed out that the management of opportunity also needs to be improved. Managing opportunity is important because it is about making products more profitable by bringing them on time with more focus, and therefore, we need to seek for opportunities to improve tasks that can save money.

6.2.8.7 Risk and Audit

Based on the data, the research found that there is a need to improve the links between risk and audit. Interviewee 015 indicated that it is about linking risk controls, particularly those related to governance, and the internal audit programme to give assurance that the risk could be managed effectively.

6.2.8.8 Understanding

There are issues of the lack of understanding that need to be improved. Interviewee 004 said that people need to be educated to understand and identify risk while interviewee 019 mentioned that it was the way of thinking that needed to be improved. This is because risk is still seen as part of project management and not as something different as risk management. Clarity about ownership of risk also needs to be improved. According to interviewee 015, the role and responsibility of risk owners at different levels need greater clarification and understanding so that there will be an owner for different types of risk. Besides this, business needs also require improvement. According to interviewee 022, if a business does not see the need for risk management, then they will not use it, and, therefore, a commercial need has to be highlighted in the project delivery.

6.2.8.9 **Summary of Practices to be Improved**

From the analysis, the following are a list of improvements suggested relating to the practices of risk management.

a) Risk Identification

- To make sure that people can describe risks appropriately.
- To differentiate between risks and issues.
- To use appropriate software or database system for risk register.

b) Risk Analysis and Assessment

- To improve on the scoring sheets and the analysis software to be more user-friendly.
- To focus on the impact of risks on the schedule rather than financial.

c) Risk Monitoring

- To monitor monetary issues so that people can have a better visual understanding about the project.
- To improve on the way people present risk to the management.

d) Overall process of risk management

- To reduce the current steps in order to improve the whole process.

e) Budgeting

- To improve the way they forecast the cost to manage risks and contingency allowances.

f) Culture

- To change people's attitude and thinking towards appreciating risk management and how it works.
- To introduce the behavioural component in risk management by monitoring individual performance in order to keep the maturity level up.
- To increase the appreciation of true risk management and to be more open and transparent as to what people mean by risk and who is best to manage it.
- To improve the understanding and to convince people of the benefits from risk management
- To remind people that the material exists and that there is a process.
- To improve on risk governance, identifying different levels of ownership, such as risk sponsor, risk oversight owner and the risk owner himself
- To ensure that experienced individuals lead the process rather than only focusing on the management to decide.

g) Education and training

- To get the people from the industry to be involved in the education and training courses, sharing the experience and knowledge of what is being done.

h) Experience

- To improve on the observation and lessons learnt through collective experience.

i) Opportunity management

- To improve on the management of opportunity because it is about making products more profitable by bringing them on time with more focus.
- To try to find the opportunities concerning a task that can save money.

j) Audit

- To improve the links between risk and audit through linking governance and the internal audit programme for effective risk management.

k) Overall understanding

- To improve on education, especially for risk identification
- To improve the understanding that risk is to be seen as risk management and not part of project management.
- To be clear about ownership of risks so that there will be an owner for different types of risk.
- To improve on the business needs of risk management in the project delivery.

6.3 Risk Management Function

During the interview session, the interviewees were asked to describe their risk management function in the organisation and based on the data; the information can be divided into four groups. The first group mentioned that they had a risk management function, which sits within the project management office while the second group said that they also had it, and that it sits within the programme management office. Another group indicated that risk management belongs to the business and finance function whereas the last group did not have any risk management function in their organisation. Table 6.4 tabulates the groupings according to the list of interviewees. From the data, the research found that the majority of the interviewees indicated that they have a risk management function set up in their organisations and that only two of the organisations did not have any. Fourteen interviewees said that their risk management function sits within the project management office. This is directly related to the scope and limitations set for this research, which covers on PRM and the chosen informants for the interview, which are the managers which are directly involved in managing the projects in each organisations. Eight interviewees mentioned that risk management was a function set up in the programme management office and five said that it sits within the business and finance office. Not a single interviewee mentioned that the risk management is a standalone function.

Based on the above analysis, the research found that risk management is formed as part of other functions. Primarily, it sits in the project management office. Besides this, the risk management function was also found to be within the programme management office and business office, as shown in Figure 6.7.

Interviewee	Business Type	Industry		RM Function			
				No RM Function	Within Business & Finance Office	Within Programme Mgmt Office	Within Project Mgmt Office
001	Railway/Train operations	H				√	
002	Consultancy-construction, RM	F	M				√
003	Power-nuclear; Consultancy-construction	D	M				
004	Capital investment-eng & const	F	M			√	√
005	Railway/Train operations	H			√		
006	Railway/Train operations	H					√
007	Consultancy-eng & const	C	M	√		√	√
008	Railway/Train operations	H		√			√
009	Manufacturing-defence aircraft	C	O			√	
010	Mining-natural resources	B			√		
011	Water supply & sewerage	E					√
012	Airport operations	H	M		√		
013	Manufacturing- defence aircraft	C	O			√	
014	Mining-petroleum	B			√		
015	Services	F	N			√	
016	Manufacturing- defence aircraft	C	O				√
017	Construction	F					√
018	Manufacturing- defence aircraft	C				√	
019	Manufacturing-defence submarine	C	O				√
020	Manufacturing-defence submarine	C	O		√		√
021	Construction	F					√
022	Power-transmission/distribution	D					√
023	Mining-petroleum E&P technology, refining	B	C				√
024	Water supply & sewerage	E					
025	Manufacturing- defence aircraft	C	O				√
026	Manufacturing- defence aircraft, Turbines; Power-nuclear	C	O			√	
	TOTAL			*2*	*5*	*8*	*14*

Table 6.4: The interviewee's information- Risk management function

NOTE:

B - Mining & quarrying; C - Manufacturing; D - Electricity, gas, steam & air conditioning supply
E - Water supply; sewerage, waste management & remediation activities; F - Construction
H - Transportation &storage; M - Professional, scientific & technical activities
N - Administrative & support service activities; O - Public administration & defence; compulsory social security

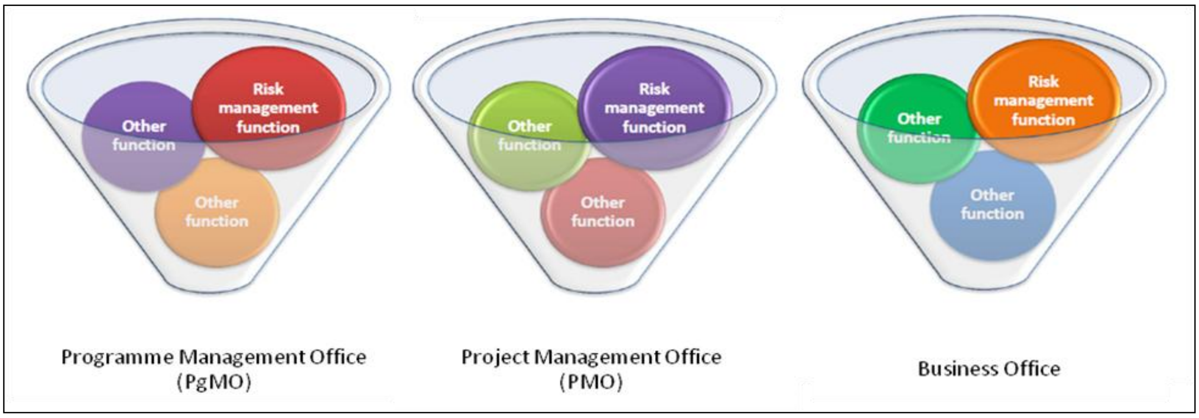


Figure 6.6: Risk management function *(developed by author)*

6.4 Risk Management Standards and Guidelines

One of the research problems indicated in Chapter 1 is that organisations may adopt differing approaches to manage risk, and that they may or may not be using off-the-shelf standards and guidelines that are common. This section explores the current knowledge and application of the risk management standards and guidelines.

6.4.1 Standards and Guidelines Used.

The interviewees were asked to describe the use of current standards and guidelines in their organisations. The findings are discussed below:

6.4.1.1 Identified Standards and Guidelines

During the interview, the interviewees provided information concerning the current standards that they may or may not actually adopt in the organisation. The followings are the standards and guidelines identified during the course of the interviews.

Name of available standards & guidelines mentioned.	Interviewee	Comments / Information discussed
ALARM or IRM (IRM-AIRMIC-ALARM, 2002)	006, 011, 026	ALARM is similar to IRM; they basically have risk assessment, risk analysis. IRM is very high level, having only 7-10 pages.

APM or PRAM (APM, 2006a)	006, 011, 012, 019, 020	APM terminology is adopted within the organisation. APM is criticized for not aligned with British Standards and the Australian/New Zealand Standards PRAM is a bit old hat, trying to report risk as uncertainty.
Australian/New Zealand Standards (AS/NZS-4360, 1999)	012, 015, 026	Produced in 1994, this standard is mentioned during the interview.
British Standards (BS-31100, 2008a)	012, 015, 026	This standard has just come out.
ISACA	014	The organisation has adopted the ISACA guidelines, a risk management concept and guidance on risk management and that can be used in the IT. ISACA adopts ISO 27000 for information security.
COSO	005, 014	COSO was identified one of the guidelines that they refer to but no further information was provided
HM Treasury Orange Book (HM-Treasury, 2004a)	015	This guideline talks about transfer, tolerate, terminate, and it takes the opportunity as a response to risk
ICE-RAMP (ICE et al., 1998)	012	This standard is mentioned during the interview.
ISO (BS-31100, 2008a)	005, 007, 012, 014, 015, 016, 018, 020, 026	This standard is less than two years old; uses five pages to describe the framework and how to implement and eight pages to describe the management of risk. It sees risk as positive and negative, which health and safety people refuses as they only feel negative impact.
OGC-MoR (OGC, 2007b)	005, 009, 011, 012, 015, 026	It has only been in existence for probably about 6-7 years; was developed for delivering the IT projects and programmes. It is about delivering public sector projects and that it is the way the public deliver projects of benefit. That there was a major update of it in 2007; it is a little bit more detail compared to other documents
PMI (PMI, 2004)	011, 020, 023, 025	Although the words might be different, the risk management activity within PMI, APM and PRINCE2 is exactly the same.
PRINCE2	011, 020	PRINCE2 is adopted in practice; it is not only for IT. The management of risk from OGC is integrated into PRINCE2. PRINCE is actually for all public companies.

Table 6.5: List of identified guidelines during the interviews

6.4.1.2 Functions of Standards and Guidelines

The interviewees shared their mixed understandings about the current standards and guidelines. Interviewees 003 and 014 stated that the standards and guidelines were a control framework while interviewees 004, 016, 019 and 020 said that they are a form of advisory document that provides guidance concerning how risk management can be done. Meanwhile, according to interviewees 006 and 019, the standards and guidelines are best practices that can be adopted into an organisation. Interviewee 006 and 015 added that these documents talked about analysis and assessment of risk, and, in principle, how risk can be managed.

Meanwhile, interviewees 004, 017 and 026 argued that these standards and guidelines do not actually tell how to manage the process and how it fits into the organisation. They also do not provide specific tools to manage, such as balanced scorecard and earn value as seen by interviewees 004 and 009. Interviewee 007 found that standards are difficult for an organisation that works around the world while interviewee 012 mentioned that it is difficult for support services, which are driven by time scales.

6.4.1.3 Summary of Identified Standards and Guidelines and Their Functions

From the analysis, the research found that twelve existing risk management related standards and guidelines were mentioned by the interviewees. However, this does not mean that the list is exhaustive as they were not asked to name any specific documents. The main idea was to get the interviewee's understanding concerning what standards and guidelines mean and how they function. Figure 6.8 summarises the scope or functions of and standards and guidelines including their limitations.

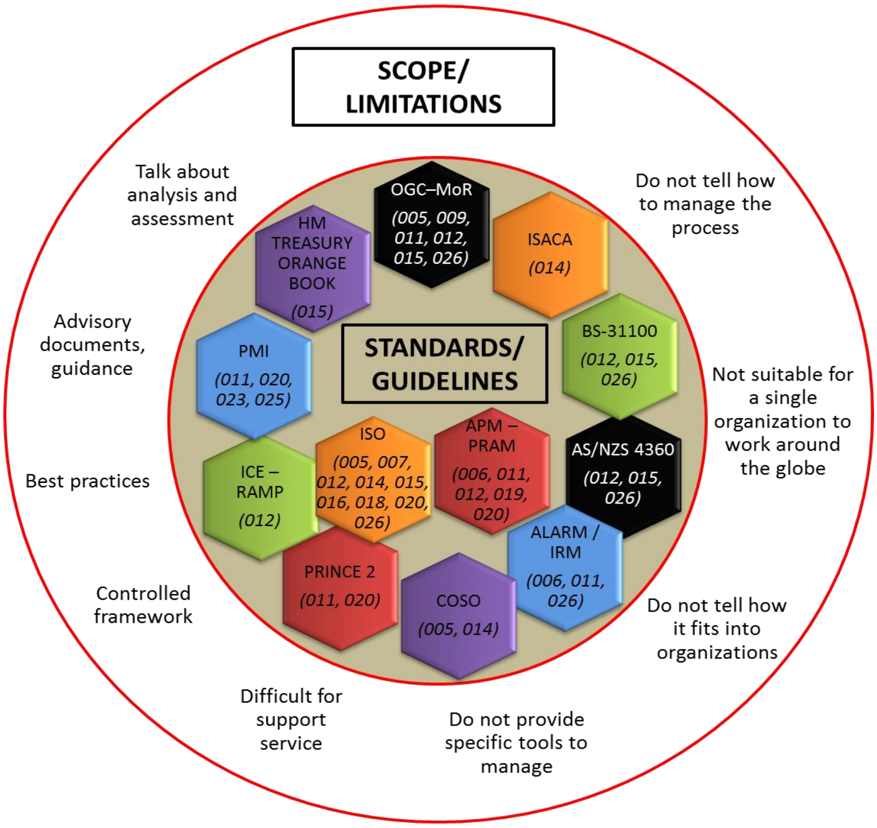


Figure 6.7: Various standards and guidelines mentioned by the interviewees and their scope and limitations *(developed by author)*

6.4.1.4 Standards and Guidelines in Current Practice

Chapter 3 of this research discusses the various approaches to risk management, which have been developed and improved over the years. Thus, the knowledge and practice of risk management by organisations may vary. Organisations may select the standards and guidelines and use them straight away or rephrase them to suit their business and environment. Interviewee 005 stated that the generic documents are rephrased to make sure that they fit the business. Similarly, interviewees 007, 012 and 020 mentioned that the standards and guidelines were manipulated and tailored to meet the needs of their organisations.

The usage of these documents also depends on the knowledge of individuals and the training given, as seen by interviewees 005 and 011. Different businesses and industries require different approaches for their management process. This is supported by interviewee 005 who indicated that the requirements are very different from industry to industry and from the public to the private sector. Therefore, what fits the respective business and industry is very important. In managing risk, organisations have options to take and adopt any standards or best practices for their process. However, according to the data, people need to ensure that what is taken fits into the environment. Interviewee 012 mentioned that the organisation extracted and expanded the basis to make sure it works for the projects. Additionally, interviewees 015, 018, 020 and 026 shared the same fundamental principles. They do not ignore the standards, and, in fact, have documented and developed their own process using them as a base. Interviewee 013 expressed that in the past the standards did not particularly fit the way the organisation works. The following are examples of information from the interviews relating to the current usage of standards and guidelines.

6.4.1.5 Issues with Standards and Guidelines

The interviewees have expressed their concerns with the use of the current standards and guidelines. Ten interviewees argued that the standards are very generic, and the differences are insignificant. For example, interviewee 011 mentioned that although the words are different, the activity within the words is similar. The guidance on the implementation is very important. Interviewees 012 and 026 criticise that these documents are produced by differing organisations that looked into risk as an opportunity to express their interpretation of what risk management is about. Historically, most of the guidance was prepared based on the project risk in the manufacturing industry and was later introduced and developed to suit the needs of different environments. It is more or less a generic processes or at least integrating or streamlining the current processes and telling the users what they already expected to know.

Meanwhile, seven interviewees argued that the standards have their disadvantages and differences. They are found to be of similar and to some extent, conflicting with each other as well. The standards and guidelines were criticised for reducing the level of thought (Interviewee 003) and, bureaucratic and very statistical which requires lots of information to a tool set (Interviewee 013). Additionally, it is difficult to have off-the-shelf risk management tools and processes and this may ends up with some software packages being marketed alongside. Interviewee 012 disagrees with APM, which defined risk as uncertainty, which is completely flawed. Additionally, he also disagrees with ICE's risk assessment stage, which is actually identification and analysis whereas another guideline identifies analysis as two separate stages. Interviewee 015 disagrees with the HM Treasury's Orange Book concept of mitigation that promotes opportunity as a response to risk.

6.4.2 Standards and Guidelines Adopted in the Organisations.

This section is a continuation of the previous and will discuss on current standards and guidelines adopted in the organisation. The interview data were categorised into three, namely, using available standards and guidelines, using own guidelines, or not using any particular guidelines.

6.4.2.1 Using Available Standards and Guidelines

From the data, six interviewees mentioned that their organisations are using the current standards and guidelines, which are available in the market. Details of the information are discussed below.

a) Name of standards and guidelines

The names of the standards and guidelines used are tabulated in Table 6.6. From this information, the research found that six types of standards and guidelines were adopted by the organisations. However, some of them mentioned that the guidelines were only used as a basis for the setting up of their own framework.

Name of available standards & guidelines used	Interviewee	Comments / Information discussed
APM PRAM (APM, 2006a)	006, 011, 020	The APM's terminology is used, either directly or indirectly.
British Standards (BS-31100, 2008a)	012	The use of BS 31100 is mentioned but no further details were provided.
ISACA	014	The organisation is adopting ISACA guidelines.
COSO	005, 014	COSO is mentioned as one of the guidelines that they referred to but no further information was provided.
ISO 27000	014	ISO 27000 was used for information security, which was said to be used by ISACA.
PRINCE2	011	The organisation adopts PRINCE2 in their practice and argues that it is not only for IT. OGC's management of risk is integrated into PRINCE2.

Table 6.6: The interviewees' information: Name of standards and guidelines used

b) Motivation to use the standards and guidelines

According to interviewee 011, the organisation's vision was to have its own standard of risk management. However, this was not possible because the way construction projects and other projects like IT operate in the organisation are different. Moreover, the vision was difficult to implement as it kept on changing and being challenged. It was hard to benchmark against others and also not understood by the external auditors, and, therefore, this idea was scrapped. Similar difficulties were shared by interviewee 014. According to him, from an external point of view, there are expectations and if the organisation falls short of these, people would start having discussions and arguments. Meanwhile, interviewee 006 stated that the reason for the organisation to choose APM is not known.

6.4.2.2 Using own guidelines or framework

Twenty interviewees identified that they are using their own guidelines that had been developed to suit their business.

a) Name of own guidelines or framework

The majority of the guidelines are given an appropriate name to reflect the process framework and the organisation's business except for four. These guidelines have been used between one year to at least twenty-five years or since the formation of the organisation and this is shown in Table 6.7.

Interviewee	Business Type	Industry		Name of guideline	Year / Duration Used	Basis of guideline
001	Railway/Train operations	H		Guide for Railway Investment Projects (GRIP), Investment Regulations	6-8 years	ISO, BS, AS/NZS
004	Capital investment-engineering & construction	F	M	Group Framework for Opportunity & Risk Management (GFORM)	2005	NA
005	Railway/Train operations	H		Gateways (similar to OGC)	12-18 months	ISo, OGC-MoR
007	Consultancy-construction & engineering	C	M	CMS Systems	5 years	Best practices
009	Manufacturing-defence aircraft	C	O	Life Cycle Management Guides	N/A	NA
010	Mining-natural resources	B		N/A	7-8 years	NA
012	Airport operations	H	M	N/A	2006	APM-PRAM

013	Manufacturing- defence aircraft	C	O	(Company name) Risk Management	N/A	NA
014	Mining-petroleum	B		Statement of Risk Management	N/A	NA
015	Services	F	N	Risk Manual, Risk Management Handbook	>10 years	OGC-MoR
016	Manufacturing- defence aircraft	C	O	Risk-Six	2002	NA
017	Construction	F		Risk Strategy Plan	13 years	External Standards
018	Manufacturing- defence aircraft	C		N/A	10-15 years	NA
020	Manufacturing-defence submarine	C	O	Risk & Opportunity Management	15 years	APM-PRAM
021	Construction	F		Management Systems	N/A	NA
022	Power-transmission/distribution	D		Project Management @ (Company name), Project Management Model	>10 years	NA
023	Mining-petroleum E&P technology, refining	B	C	Risk Management Procedure	10 years	NA
024	Water supply & sewerage	E		N/A	2 years	OGC-MoR
025	Manufacturing- defence aircraft	C	O	(Company name) Project Risk Management Method	>25 years	External Standards
026	Manufacturing- defence aircraft, Turbines; Power-nuclear	C	O	Group Quality Procedure (GQP), Local Operating Procedure	>15 years	NA

Table 6.7: The interviewees' information: Own guidelines or framework used

b) Basis of own guidelines or framework

Ten interviewees highlighted that their guidelines, which were developed internally, were actually based on the generic standards and guidelines. According to interviewee 003, during 1990, there was no standard to refer to and the process of risk management in his organisation was developed based on the general principles. The process has been improved as they are complimentary. It is important for the research to investigate the proximity of the organisations' approaches to the published documents. However, due to confidentiality factors, most of the interviewees were reluctant to provide copies of their own risk management processes. Thus, the research has to rely mainly on the information given during the interview sessions. Table 6.8 provides example of the similarities of own guidelines with published standards and guidelines. It was found that there are close similarities between their own guidelines and the published standards and guidelines. From the data, ISO 31000, BS 31100, BS6079-3, AS/NZS 4360, OGC-MoR, APM and IRM are among the popular guidelines and are used as the basis to formulate their own guidelines.

Interviewee	Own Guideline	Similarity to Published Standards/ Guidelines
001	GRIP: 1) Define objectives; 2) Identify; 3) Analyze; 4) Evaluate; 5) Treat; 6) Monitor & Communicate	Claimed by interviewee to be similar to ISO 31000, BS 6079-3:2000 and AS/NZS 4360: 1) Establish context; 2) Identification; 3) Analysis; 4) Evaluation 5) Treatment 6) Monitor & review 7) Communicate & consult
004	GFORM: 1) Baseline information 2) (Opportunity & Risk) Identification 3) (Opportunity & Risk) Analysis 4) (Opportunity & Risk) Management 5) Planned outcome 6) Feedback	Claimed by interviewee to be similar to external standards/ guidelines
005	Not specified	Claimed by interviewee to be similar to ISO and OGC-MoR
006	Not specified	Claimed by interviewee to be similar to IRM and ALARM
012	Not specified	Claimed by interviewee to be similar to APM
015	RM Handbook 1) Establish risk infrastructure 2) Define/ review goals 3) Identify 4) Assess 5) Plan 6) Monitor 7) Capture experience	Claimed by interviewee to be similar to OGC-MoR 1) Identify context & identify risk 2) Assess 3) Plan 4) Implement
016	Risk 6 1) Identification 2) Analysis & determine root cause 3) Assessment 4) Mitigation 5) Action plan 6) Follow up & evaluation	Claimed by interviewee to be similar to external standards/ guidelines
017	Risk Strategy Plan 1) Identify risk 2) Assessment & impact of risk 3) Manage & reporting process 4) Review & update regularly	Claimed by interviewee to be similar to external standards/ guidelines
020	Risk & Opportunity Management 1) Identify 2) Analyse (Qualitative) 3) Evaluate (Quantitative) 4) Mitigate (Pre-emptive & feedback) 5) Report	Claimed by interviewee to be similar to APM Claimed by interviewee to be similar to BS 6079:2000 1) Context 2) Identification 3) Analysis 4) Evaluation 5) Treatment 6) Maintain, communicate, monitor, review Claimed by interviewee to be similar to BS 31100:2008

		1) Identify 2) Assess 3) Respond 4) Report 5) Review
024	Not specified	Claimed by interviewee to be similar to OGC-MoR

Table 6.8: Comparisons of own guidelines and their similarities to published standards/ guidelines

c) Reviews, updates and regulatory checks

The guidelines are being updated and reviewed regularly to make sure that they are consistent with the latest development and changes in the industry. Interviewee 005 highlighted that the guideline might change slightly when a new standard comes along, and that it is also updated depending on the most-recent development of the standard being used. Additionally, the guidelines need to be aligned with any necessary regulatory and industry requirement. Interviewee 015 confirmed that they have to meet the industry set requirements where they operate and interviewee 006 said that the guidelines complied with the current popular standards.

d) Motivation to develop own guidelines

Data collected on the motivation to develop their own guidelines can be further categorised into five.

No guidelines available previously

There were no guidelines available prior to the one they have and not many people were thought about risk as a formal process. According to interviewee 012, prior to 1994, there was no risk management process existed.

Existing standards are not suitable

The second category is because the existing standards are unsuitable for their businesses. This was a concern of interviewees 005, 006, 007, 009 and 013. Various reasons were found to cause the need to develop a new process in a new environment such as the merger of separate entities and current frameworks are geared to a different sector.

Difficult to use existing standards

The difficulties to use and to understand the existing standards motivate them to have their guidelines. Interviewee 009 indicates that the terminology was confusing and difficult to understand.

Fulfilling business needs

The fourth category is related to their business needs; a mechanism for governance and control; that have to be fulfilled. According to interviewees 004 and 010, a risk management guideline ensures that risks are being managed systematically.

Awareness

They are aware that it is a good practice to have such a guideline, of which they are not under pressure to comply with international standards. Interviewee 016 highlighted that they never added the guidelines because it looks nice but because risk owners and risk coordinators want it.

e) Importance and benefits of guidelines

A risk guideline provides guidance concerning how risks are managed, from the use of the register, identifying, analysing, evaluating to reporting the risks. According to interviewee 001, it is about how things are actually going to be managed and delivered within the company and interviewee 004 mentioned that it stipulated how risks are scored; the likelihood of the risk occurring, and the associated score. It is a process that meets and delivers the project objectives and stakeholders' requirements.

According to interviewee 001, the guideline clearly defines how they are going to run a company and to monitor what has been done is in accordance to the procedures. It also provides a framework or a template that everybody in the organisation to use.

f) Issues and problems of using own guidelines

The interviewees were asked about issues and difficulties they have encountered in using their guidelines. Interviewee 003 mentioned that they came across the difficulties as early as when developing the process. There was not much literature to be referred to, and, therefore, the thinking process was hard. For interviewee 004, the framework that they are using does not necessarily suit his organisation but may suit another business in the same group like construction and civil engineering. His organisation has projects that last for twenty-five years, which make it difficult to use the equivalent framework and scoring systems. Additionally, the framework may not be suitable for small projects because it is time consuming. Another issue is about the awareness. Interviewee 016 mentioned that the biggest problem was the implementation of the framework because people may not want to have it.

6.4.2.3 Not Using any Particular Standards, Guidelines or Framework

Based on the data, there were organisations that do not use any particular guidelines or standards in managing risk. The details are discussed below.

a) Reasons for not using any particular guidelines

Three interviewees confirmed that they are not using any particular guidelines due to certain reasons. Interviewee 002, 007 and 008 pointed out that the guidelines did not provide much of the full process around it, and, therefore, they opted not to have a single framework for risk management. Besides that, the standard framework was not able to guide them to the right way of doing risk management because everything they did was embedded into the system.

b) The way risks are managed.

The interviewees provided information concerning how risks are being managed despite not using any guidelines. According to interviewee 002, there will be short document about risk management during the early stage of the process. At the approval stage, a comprehensive risk document will prepared, which will provide details regarding the type of risks and how they are being addressed. Interviewee 007 has a different approach of managing risk in his organisation. They adopt best practices from different standards and guidelines; examining the information and only implementing the relevant process. Similarly, interviewees 008 and 019 mentioned that they also adopt relevant processes from some of the guidelines introduced by other organisations, and not everything, and have been practices and revived continually.

6.4.2.4 Possibility of own developed guidelines to be used by others

The interviewees provided their ideas regarding the possibility of expanding and using their own guidelines into other organisations. Generally, they agreed with the proposition, with some of them suggesting certain conditions. Their mixed reactions are discussed below.

a) Generally possible to be used by others

Thirteen out of twenty interviewees who identified that they are using their own guidelines confirmed the possibility of expanding their guidelines into other organisations. Their guidelines are said to be comparable to some other standards, contain fewer pages and are transferable. Technically, interviewees 005, 013, 024 and 026 emphasised that only top level or corporate level guidelines would be of use for other organisations as these processes are very generic. By implication, this means that the detail and technical processes are unsuitable as these are intended to suit to their own business.

b) Possible to be used within a similar type of industry or business

There were mixed reactions, whether the guideline could be adopted by others within the similar type of industry in general or for specific projects. Interviewee 003 suggested that the structure of the general guidelines is suitable for particular projects and could also be used for a variability of projects in the industry. Interviewee 024 indicated that although his organisation is in the water industry, the guidelines are project specific, which means they are only appropriate for engineering and construction projects. Meanwhile, interviewees 005 and 026 have suggested that their guidelines are only suitable for those who are in a similar type of business. This is because the requirements differ between industries and between the private and public sectors.

c) It is possible but with conditions.

Although the idea of expanding their guidelines into other organisations is generally accepted and has been discussed earlier, there is one fundamental condition that needs to be observed. Prior to adopting any guideline, it is important to make sure that it is tailored to suit to the environment. For example, interviewees 003, 010, 020 and 022 mentioned that the structure needs to be moulded accordingly to suit the particular project or industry requirements.

d) It has been used by others.

The research found three own-developed guidelines which have been used by other organisations. Interviewee 001 has seen others adopting and almost following what they are doing, whereas, interviewees 010 and 016 indicate that their guidelines, which are developed for specific businesses, have been used by other business entities within the same group. This is possible because the guidelines are formulated to be simple and yet practical.

e) It is not possible

Two interviewees disagreed with the possibility of using their guidelines by other organisations. Interviewee 023 mentioned that they operate in a distinct industry with differing liabilities and processes, and therefore, it not possible for other entities to adopt the same guideline. Meanwhile, although it was mentioned earlier by interviewee 026 that their general procedure could be used by others, their local operating procedure was at the lower level and very specific, thus it may be difficult to be used by others.

6.4.2.5 Possibility to Have Future Standards and Guidelines for the Industry

In this section, the interviewees were asked about their views of the possibility to have standards and guidelines specific for their industry. Similar to the previous section, the responses are mixed and are discussed below.

a) It is possible to have standards and guidelines for the industry.

Based on the data, nine interviewees generally support the proposition of having standards and guidelines for the industry. Nine interviewees thought that there could be a generic guideline for each industry.

b) Conditions in having standards and guidelines for the industry

The research found that a future industry standard is possible provided that the following conditions are fulfilled:

i) The standard has to be robust and relevant to the specific industry.

ii) The standard has to be generic so that every company can take and use it to suit a specific environment. Each company can lay down their own details for implementation.

iii) The standard has to be mandated by the client.

c) It is impossible to have standards and guidelines for the industry.

Based on the data, nine interviewees disagreed with the proposition of having standards and guidelines for the industry, thus will maintain with the use of their generic framework due to the following reasons:

- Standards need to be applied across industries and not for a specific industry.
- It is about tailoring to suit the organisation, understanding of what they are doing and why they are doing it, and not changing the process.
- It will be difficult to get everyone to agree and support with one standard as it is not regulated.
- It may remove the element of thought, which will weaken the process.

d) Concerns about the idea of having standards and guidelines for the industry

The interviewees expressed their concern about the possibility of having standards and guidelines for their industry. The followings are a list of concerns of the interviewees.

- It will become more generic, amalgamation of other standards.
- It will be interpreted differently by various organisations.
- It will only be a guide and not mandatory.
- It needs consent from industry.

- It needs a regulatory body to govern the standard.
- It needs clear benefits to the organisations.
- Organisations may practice risk management differently.

6.4.3 Summary

Based on the above discussions, the use of standards and guidelines in managing risks are summarised as follows.

6.4.3.1 Functions of Standards and Guidelines

From the data, it can be summarised that standards and guidelines are:

a) A control framework which governs the overall process but does not provide specific tools to be used along with it;

b) A set of best practices to work for but is not necessarily easy for certain environments and scope of services;

c) A set of guidelines which tells how risk can be managed but does not explain how to manage it;

d) Produced for both the public and private sectors but does not explain how it fits into the organisation.

6.4.3.2 Standards and Guidelines in Practice – How do they Work and Fit into the Business and industry.

The research found that the generic standards and guidelines are used as a basis of their practice and may not necessarily be fully implemented. They are rephrased to suit their business and environment and are used as a basis in developing their own processes. Based on their experiences, the generic guidelines or standards would not normally fit the way their organisation works and their usage is dependent on the individual's knowledge and training. The management approaches vary within and between industries as well as from the public to the private sector, and it is very important to adopt the best practices that fit their requirements.

6.4.3.3 Issues with the Available Guidelines and Standards

There are also issues relating to the use of generic standards and guidelines. Historically, the generic guidelines or standards are developed based on risk management practices in the manufacturing industry, which have been streamlined to the current situation. They are produced by different organisations, reflecting the different ways of interpreting risk management. There are different views and understandings concerning the generic guidelines or standards. They are said to be different and conflicting with each other. However, they are also said to be very similar and the differences are insignificant. Besides that, these documents are very bureaucratic and the direct usage of these documents reduces the level of thought and understanding of risk, uncertainty and opportunity.

				Standards & Guidelines								
Interviewee	Business Type	Industry		Using Standard	Not Using Any Standard or Guideline	Using Own Guideline	Guideline to be used by others	Guideline to be used by similar industry	Guideline is used by others	Guideline can't be used by others	Guideline for the Industry? And with condition?	Guideline for the Industry is not possible
001	*Railway/Train operations*	H				√	√		√		√	
002	*Consultancy-construction, RM*	F	M		√							
003	*Power-nuclear; Consultancy-construction*	D	M					√			√	√
004	*Capital investment-eng & const*	F	M			√	√				√	
005	*Railway/Train operations*	H				√	√				√	
006	*Railway/Train operations*	H					√					√
007	*Consultancy- eng & const*	C	M		√	√						
008	*Railway/Train operations*	H			√							
009	*Manufacturing-defence aircraft*	C	O			√					√	
010	*Mining-natural resources*	B				√			√		√	
011	*Water supply & sewerage*	E		√								
012	*Airport operations*	H	M			√	√					
013	*Manufacturing- defence aircraft*	C	O			√	√				√	
014	*Mining-petroleum*	B		√		√					√	
015	*Services*	F	N			√	√				√	
016	*Manufacturing- defence aircraft*	C	O			√			√		√	√
017	*Construction*	F				√						
018	*Manufacturing- defence aircraft*	C				√	√				√	
019	*Manufacturing-defence submarine*	C	O		√							√

020	*Manufacturing-defence submarine*	C	O			√	√				√	
021	*Construction*	F				√	√				√	√
022	*Power-transmission/distribution*	D				√					√	√
023	*Mining-petroleum E&P technology, refining*	B	C			√				√		√
024	*Water supply & sewerage*	E				√	√	√			√	√
025	*Manufacturing- defence aircraft*	C	O			√	√				√	
026	*Manufacturing- defence aircraft, Turbines; Power-nuclear*	C	O			√	√			√		√
	TOTAL			***2***	***4***	***20***	***13***	***2***	***3***	***2***	***16***	***9***

Table 6.9: The interviewees' information: the use of standards and guidelines

CHAPTER 7

FINDINGS ON ANALYSIS:

PART III: GOVERNING THE PROCESS OF PROJECT RISK MANAGEMENT

7.1 Introduction

This chapter discusses the views and information provided by the interviewees relating to the project management and governance in their organisation. It supports the research objective via evaluating the current practices of managing project risk through governance process. It discusses elements and mechanisms of governance adopted by the organisations to manage project risks and achieve project objectives.

7.2 Elements of Project Governance

The research found that the elements of project governance are divided into responsibility and accountability, which relates to the process of controlling and monitoring the processes.

7.2.1 Responsibility and Accountability

There were various reasons relating to the achievement of objectives. According to interviewee 004, it remained in their best interest to ensure that people were managing properly as they were investing in the project. Everyone was responsible towards achieving and meeting the objectives. Procedures were in place to help the team achieve the goals (026), and they had to meet the full list of requirements, and the objectives set out earlier prior to proceeding with any project (019). This research found several techniques were employed by organisations to ensure responsibility and accountability. RACI technique (Responsible, Accountable, Consulted, and Informed) is used by interviewee 001 whereby it is the job holders' responsibility towards the delivery of the tasks and their role is ultimately to be accountable, ensuring that the responsible person does it; that they should be consulted and informed. Another technique adopted is SQEP: ‘suitably qualified and experienced personnel’, used by interviewee 019 and interviewee 020. It requires the personnel’s ability to control and manage, prior to the involvement in any project. This ensures that they are the right person for the specific purpose: they will be able to deliver the tasks given. It was found that experience is one important factor in allowing for a person to be made responsible for a particular position.

The task of project management was found to be the responsibility of different people. For example, in a bid process, the bid manager or bid director is made responsible for project management. At a higher level, it becomes the project sponsor’s responsibility in terms of developing the initial ideas and business case for review and approval by the executive committee. In each project, there will be somebody who is responsible for risks; this research found varying views within the data, some highlighting that the function of managing risks was not necessarily the responsibility of a risk manager. Risk management could be the responsibility of several departments within the organisation, such as the finance and the programme office. Meanwhile, a project manager is also responsible for managing the risks and running risk reviews for the areas for which he is accountable. Besides that, managers at every level are responsible for delivering the objectives, and, therefore, they must be responsible for managing risks.

7.2.1.1 Project Management Office (PMO)

There were three types of management functions which were discussed in the interviews: Portfolio Management Office (PfMO), Programme Management (PgMO) and Project Management Office (PMO). Based on the data, the research found that nineteen interviewees discussed or at least mentioned their PMO; six interviewees provided information relating to PgMO; and one interviewee mentioned PfMO.

a) Portfolio Management Office (PfMO)

Interviewee 011 did mention PfMO when asked to discuss risk management function. It was found out that the use and understanding of portfolio management is very immature and the portfolio office was adopting the role of a PMO, thus making it insignificant. This will hence not be discussed further.

b) Programme Management (PgMO)

Meanwhile, this research found five dedicated positions within the programme management office, namely, programme manager; risk management manager; value management manager; project management manager; and development manager. Three of the six organisations that have a programme management office were from manufacturing (defence aircraft) (012, 018, 026); two organisations from the railway or train operations (001, 005), while the other was from airport operations (012).

An example of a PgMO was found to be in the organisation which interviewee 011 belongs to. The PgMO was set up for big programmes, with various projects under them as well as stand-alone project. One of the objectives of PgMO is to ensure that the risk management process is available for people and project use. A PgMO has also been called a programme management counsel (018), providing governance to ensure that the programmes are well organised in delivering programme management and risk management. The use of PgMO was found to be beneficial for an organisation serving various sectors such as civil aerospace, defence, energy, marine and nuclear. There are specific teams for each sector and these programmes are led by a programme manager of a specific area, who will develop and improve the process for the type of work that they have (026). Additionally, a programme management director provides governance for the people and ensures that they are working consistently in a standardized form.

> *"...all working on individual projects within their portfolio...fully managing projects in the company...early project management of it is actually done by somebody called the development managers...we have dedicated people who deliver some of the programmes such as Thames Link and historically West Coast...project managers in assets delivering projects, report to the programme manager; project management section and the programme management section also reported to the infrastructure investment..."* (001)

> *"...we have five programmes...I have a group of people that sit on each of the programmes who actually facilitate the issues, risk and opportunity management process...they're directly responsible to the project leads..."* (012)

> *"We have a programme management counsel. That counsel provides the governance that the programmes need to set up a programme organisation to deliver programme management and risk management...we don't have such an organisation that sits there and does programme management and risk management...I do work outside of the programmes, to look at the overall governance...using matrix organisation...so people are mainly assigned to work in progress, which means they work in direct tasks against their programme"* (018)

> *"...a specific team that will only look at certain sectors...There won't be any overlapping; Civil aerospace have got their own programme management office, defence, energy, marine and nuclear all have their own separate programme management office...We have a programme management manager, who will lead that area and he will try and develop processes, make the processes work better based on the type of projects that we have and based on the type of the organisation structure that we have...the internal work is different, so, therefore, the programme management office has to support the way that the business is set up...People understand what the responsibilities and what the objectives are...The person in the project, who sits in the project who is looking after risk, will report to his own programme manager; programme manager will then report to the project director"* (026)

c) Project Management Office (PMO)

The functions of PMO are to provide advice and guidance to projects and to make sure that projects are consistent with the organisation's project management framework and manual. Additionally, PMO also provides guidance and help to the project management community to drive the project. PMO controls the majority of the practices, processes and methods, including looking after the tools and results. The idea is to standardize the way project management is performed and to increase efficiency across the organisation. Also, PMO has to work efficiently and effectively for the projects.

There were some overlapping tasks and duties reported by the interviewees. For example, according to interviewee 005, the PMO person is meant to provide leadership to the risk managers, but the risk managers do not report to that person. Meanwhile, project managers are found to be the risk managers on all projects whether they know it or not, although not all project managers have knowledge concerning how to manage the risks (007, 009 and 020).

The head of PMO has accountability for developing the tools and processes to be used across the business. Additionally, he is responsible for reviewing the performance of his project managers in managing each of their projects, in terms of risk, budget, milestones and plans.

This research found ten positions that relate to the PMO. They are the project director, project manager, bid director, bid manager, commercial or contracts manager, risk manager, design team, installation team, commissioning team, and project team. From the data, only interviewee 002 indicates that they do not have a PMO for their project. The project manager is the most common position, followed by the project team, project director, commercial or contracts manager and design team. Interviewee 007 highlighted the importance of the project manager and stated that *"...there are a few thousands project managers who work on a day to day level managing projects, they are the main points of focus on those projects; project managers are largely the most important people in this organisation; they are the ones who actually deliver projects and produce profit...."* Meanwhile, interviewee 008 said that their organisation had a dedicated team for managing projects led by a project manager. Interviewee 009 said that project management was a function, its responsibility to make sure that project managers are deployed in various businesses and projects.

"...what we do is actually to provide a framework that says, this is how we define risk, this is how we fund risk and…this is what they need to do or this is the criteria that they need to meet in order to get their funding and also in order to make sure that what they are doing is in line with company policy…" (005)

"they (the project managers) will be the one who is the point of contact and if they don't know something they will find out; they will seek advice; the way we are trying to work is to put policies in place where they need to be in place, apart from that we have people and points of contact..." (007)

"...project management as a function exists and the project management function is responsible for making sure the project managers are deployed into the various businesses, into the various projects making sure those people receive the appropriate training and making sure that they do receive the appropriate guidance concerning how to apply things like risk management and project management..." (009)

"...we have a project management office...central functional home for the PMO kind of controls the majority of the practices and processes and methods; there is also a section that looks after tools and sections thereof, it looks after the PMO results...the idea is to increase efficiency by everybody using the same tools and methods and processes...there is a head of the PMO who has the accountability for developing the tools and processes so that they are universally used across the business..." (013)

"...project management is a function, but the function sits within the projects predominantly; risk, although in the project, they sit together...in a number of the industries the project manager is also the risk manager, so they not only manage projects but also try and manage the risks..." (020)

"A project management office was a set up for each of the sectors...to provide guidance and help and any necessary sort of tool or template that the project management community need to drive the project...the project management office is really there to provide the governance, to provide the tools and templates, to provide the assistance, and to provide the framework for the project management within each of the sectors but also at the company level to try to work in the same way or similar way in terms of using the process..." (026)

7.2.1.2 Project team

Project teams are seen to be very important and interviewee 005 reported that the majority of people who manage project or risk management actually are part of the project teams, providing an update on their performance to the PMO. He added that their organisation had two different PMOs; central PMO and project PMO; advising and reviewing projects independently. The central PMO, which sits in finance, provides confidence or assurance to the business that each investment will provide the right benefits. Based on the interviews, the project teams are formed and governed in different ways, due to the different environment and nature of business.

a) Project team is formed based on tasks

The teams could be divided into assets and programmes of work, and headed by different people.

b) Project team is formed based on values

The teams can be formed around values, which are categorized into different groups or steering committees, such as risk management steering group and planning, monitoring and control working group. However, the steering committees could only be formed for large-scale projects. Interviewee 005 mentioned that a project had its sponsor that developed the initial ideas and concepts of what they want to do, develop a business case that goes through the executive committee for review and approval. According to interviewee 025, the process owner (or sponsor) appoints a steering committee to write the proposal or business case for committee approval.

c) Project team is formed based on function

The third type is the common type of governance whereby the project sponsor appoints the project director and the latter will then appoint the project manager to carry out the task of managing the project. The appointed project director is the bearer of all project risks and he is the one who directs the project. Additionally, the type of project team has standard functional teams, which will provide assurance that the project is being delivered.

> *"...sponsor would appoint a project manager, who will now carry that project forward...that project manager could choose to either appoint staff to work on the project or they could actually put that project out to the market for say design consultancy services...By the time the project is in detailed design we expect to see a risk register that fully represents the profile of that project"* (005)
>
> *"...We have a break down structure to manage all the work, management tasks...the requirements that we have to monitor the project, require greater length of detail..."* (019)

The research found that the existence of a risk manager depends on the organisation. Risk managers may or may not report to the project manager. However, although project management exists, there is no assurance that there will be a specific leader for risk. When a project is secured, the next stage is to bring in the resources. These people will carry out the work and have their own risk register and project management programme (004). Interviewee 014 stated that their project delivery process was in accordance with the standard framework; a stage-by-stage process; which was used to drive all projects. Meanwhile, interviewee 023 said that their practices were based on the manufacturing process, whereby the project manager releases the sales order to allow the procurement to happen, which gives the sourcing organisation authority to govern the purchase order.

> *"Once we have won the project, the whole task then is moved on to the construction people…and they would have their own risk register, and they will have their own project management programme...we subcontract all that to construction or external designers, so design will have to be carried out and all those things have been carried on as we go along..."* (004)
>
> *"That project charter is then used to drive all the other activities that relate to this opportunity...That then flows into the standard project delivery framework within this company...The delivery framework is a stage by stage process, from stage one to stage five some goes to stage six for a difference in the nature of the project"* (014)
>
> *"...We have a break down structure to manage all the work, management tasks...the requirements that we have to monitor the project, require greater length of detail..."* (019)
>
> *"...project manager releases the sales order line to allow procurement to happen, that creates procurement demand…so that gives our sourcing organisation authorization to govern or place a purchase order that the signing off authority for the purchase order is separate for the project organisation which a governance point there and that sits within sourcing"* (023)

7.2.2 Controlling and Monitoring

The main concern in managing projects are identifying and achieving project objectives, which are set out at the early stage. These concerns have to be made clear to everyone throughout the duration of the project. Therefore, controlling and monitoring are vital to ensure that the project concerns are achieved. Meetings are conducted regularly to monitor and review the projects. Interviewee 005 explained that they had four-weekly cycle meetings to provide project updates to the PMO, whereas interviewee 008 said they reviewed the budget every month, and any variations are referred to the board for approval.

Interviewee 014 indicates that before the start of any project or before an investment proposal is developed, there should be an opportunity to identify the need of having the project in the first place. Interviewee 015 shared similar views concerning this, pointing out that there would be a key risk if the definition of deliverables and functionality performance of the proposed project was not made clear.

7.2.2.1 The Perspectives of Controlling and Monitoring

From the interview data, the research found the element of 'control and monitor' was related to financial and time management. Four interviewees (006, 008, 020, and 021) associate the objective achievement with cost or budget and time, from various perspectives. Projects are typically driven by the capacity to complete in time and within budget, but there are instances whereby some projects are delivery-focused and need to be delivered at any cost (006).

7.2.2.2 Mechanisms of Controlling and Monitoring

There are various techniques adapted to control and monitor projects, such as organisational framework, milestone and stage gates, steering group, and audit process.

a) Organisational framework process

The organisational framework provides guidelines on how risk is defined and funded, and the criteria needed to apply for funding. For example, life cycle management is a procedure and practice adopted by two organisations, 009 and 020. The governance for project management is contained in the operational assurance statement and life cycle management guides which provide guidance consistently across the organisation. Various terminologies have been used that reflect the framework process by the organisations, such as programme control (001); project delivery framework or PDF (014); group framework for opportunity and risk management or GFORM (014); quality procedure (026). Others used different words such as operational framework (009); control framework (014 and 022); project policy (025);

and control mechanism (010). Albeit the different terminology, the control framework lays down a set of procedures or guidelines of managing risks, overseeing tendering processes, ensuring accountability and ensuring that the management systems are similar regardless of business location, defining responsibility, as well as providing generic procedures and allowing the possibility of adding other details.

b) Milestones and stage gates

Interviewees 008 and 016 narrated that dedicated milestones are used to monitor the project performance against the work programme. Besides that, stage-gate procedure is also used as a mechanism of control and monitor. From the data, the research found that six interviewees (001, 002, 004, 005, 007, and 010) specified that their organisations used stage gates as their procedure to manage projects. The various stages or gates are ultimately an approval process, to be followed by each project. Interviewee 007 highlighted that every project is like a gateway process and risk is embedded in that process, whereas approval is based on the understanding of the risks. These layers of procedures also denote the different levels of reviewing and approving. Interviewee 014 pointed out that sign-off steps are adopted for complex projects. A small project may have multiple sign-offs in one step, for example, stage gate one to gate three can be completed in one sign-off because of the simple solutions.

Meanwhile, according to interviewee 007, a good proposal is enlisted into a system for budget approval and risk allocation. Additionally, interviewees 007 and 014 alluded that the decision to approve any project or business case is based on understanding the associated risks, and tangible and non-tangible benefits through a sign-off process. Receiving approval for the bid, particularly the risk of winning the bid, is considered as a standardized process; interviewee 002 emphasised the need to be fair to both sides, place responsibilities and come to an agreement. Meanwhile, interviewee 004 said that they had a bid management process, normally pre-qualification, that they have to go through before the preferred bidding stage. Tendering will only start when the management committee or the board has approved funding for that project

Interviewees 008 and 010 advocate the inclusion of feasibility studies within this sign-off process. It is deemed to be a lengthy process by interviewee 016 because it is not only producing documents, but also increasing the maturity of everything. As mentioned earlier, projects have to demonstrate benefits prior to being granted funding to deliver and interviewee 005 stated that the estimated amount is based on information, including some contingencies. The pre-study phase may take half a year or a year (interviewees 016 and 019) and once approved, the project will be assigned to the budget and other resources to start. Interviewee 025 said that to be able to reach its goals, projects may not attain a good balance between what is expected and the circumstances given to the project.

> *"...getting approval for the bid, particularly the risk of winning the bid. There will be several layers of approval processes"* (002)
>
> *"...approval is based on understanding the commission risk to our group and the project risk as well...we use a system to get approval from various line managers and regional directors to proceed with the net gateways...So every project is very much like the gateway process..."* (007)
>
> *"That investment proposal goes to the governing body within that business or function and a decision is made to proceed or not, based on a very clear assessment of what the business benefits are, what the risks are of actually doing that and all the relevant things like environmental, all the criteria, what are the non-tangible benefits...Some complex projects must be signed off step-by-step. Some simple projects you can have multiple sign-up's done in one goal so you can have your stage gate one to three done in one sign off..."* (014)
>
> *"There is what we call gates, similar to the government gates..."* (015)
>
> *"...delegate authority...seeks approval to submit the pre-qualification and then when it is often got through, then there's approval to submit tender..."* (021)

c) Steering group

Another form of controlling and monitoring is to establish steering groups such as the risk management steering group and the planning, monitoring and control working group. These groups are formed to provide guidance on projects, ensuring the projects comply with all the rules set by the board, as reiterated by interviewee 009. Interviewee 014 asserts that the steering group or steering board only applies to large-scale projects, and the sign-off procedure depends on the scale of a project, whereas a small-scale project may consist of the customer, project manager, finance, and controls personnel. Interviewee 016 mentioned that steering group meetings are conducted to analyse test reports or compliance reports and check on the status of risk.

d) Audit

Five interviewees (014, 015, 019, 020, and 022) provided information relating to assurance and audit. The audit processes ensure that projects conform to the guidelines and deliver the targeted values. According to interviewee 015, the risk audit programme is a part of the corporate governance controls. The audit process is seen to be similar to the gateways, whereby according to interviewee 020, they cannot get past from one gate to another without being checked and audited.

> *"...this project assurance team do selected reviews of projects to confirm that they are compliant with the rules...then have an assurance process called a value assurance review, which look at the project to ensure that the project delivers the value so it confirms that its compliant with the process and also that the benefits desired have been realized from the project so it is some sort of audit process that is done in some case half way through the project..."* (014)
>
> *"...link between risk management and internal audit, particularly at the more corporate levels...having identified the risks, what are the audit processes in place to confirm that those risks are being managed effectively..."* (015)
>
> *"...before we can start the work we have audits and we have to demonstrate prior to starting any work that we meet the requirements...In order for our process to go ahead, again we have a full list of requirements that we need to meet...It has to go through a series of interviews, assurances, and then demonstrations"* (019)
>
> *"...from a commercial contractual perspective and so we have auditing processes that ensure through that, change that we can comply with the processes..."* (022)

7.2.3 Reviewing and Reporting

The third element of governance is the reviewing and reporting processes. These processes could be performed in many ways and at different stages of a project. Interviewee 016 highlighted that the reviewing and reporting processes are part of the management activities and has become systemised. Risks have to be frequently reviewed and reported as the projects are developed. This has been agreed upon by interviewees 004, 011, 014, 015, 016, 020 and 022 as part of the governance requirements. Meanwhile, interviewee 005 pointed out that reporting is the task of a PMO person who also provides leadership to the risk managers. Interviewee 020 asserted that as a business, they had to report to the corporate office through which they are monitored closely at a higher level.

> *"...we have to report our risk to the group because it's part of their requirement, because it's a registered governance requirement and we have to report it...we have to report every six months our risk registers and identify any significant risks we have"* (004)
>
> *"...we feed our report back to the different sections within the project, as well as the senior management"* (006)
>
> *"...there are all sorts of other controls, as you would expect, so there are operational reporting, there is HR reporting, the finance community report all reporting, variances and status and issues and risks..."* (015)
>
> *"...on every steering group meeting and executive management meeting, it is nowadays a fixed item called top risk status report...then we have monthly reporting which is quite common..."* (016)
>
> *"...we, as a business, have to report to corporate...and they as a business have to report to a higher level...we are continuously being monitored..."* (020)

Budgeting needs to be reviewed, and, according to interviewee 008, the review process is conducted every month as part of the project management activities. The project manager then reports to the management weekly (005 and 022), monthly (009 and 016) or half-yearly (004, 022 and 023). According to interviewees 022 and 023, the project manager is the person who is responsible for the delivery of a project, to set the parameters, and he is accountable for the profit and loss of the project.

> *"...what we have is that on the four-weekly cycle projects provide update...project teams provide update on their performance to the project PMO"* (005)
>
> *"...every month we have a review of the budget...Any variations means we refer back to the board and get it approved..."* (008)
>
> *"...they have to respond or they have to produce a contract status report every month...standard reports that need to be produced in order to get consistency"* (009)
>
> *"From a review perspective, we do quite straight forward monthly project reviews"* (023)

7.2.3.1 Performance Criteria, Improvement, Measurement

Besides objectives; performance criteria, performance improvement and performance measurement need to be reviewed and reported. The tasks to be performed can be further categorized as follows:

a) Project performance criteria - in terms of value planned (005), money spent (005), and risk (005, 007, 020);

b) Measurement, concerning the amount of funding asked against what has been delivered, which will be the basis of funding on the next stage (005); assurance process to reconfirm that investment of the business case is right (012); evaluation process for all suppliers to make sure that they are doing everything expected (012); 'pain-share gain-share' for any cost from management reserve (020);

c) Improvement, on the understanding of how the sponsor is going to realise the benefits that they proposed in their business case (005); raise a chart and revise the way that says the process and procedures can do the task faster (018); effective forecasting (021)

7.3 Standardized Project Management Process

The project management process was found to be a tool for management control to ensure that the objectives were met. The process helps the management to place a clear and standardised approach, and validates what has been delivered according to the requirements (014) and what was perceived to be good practice to deliver projects (012). By having a standard process, it is easier for the team to deliver the tasks to the project expectations. Meanwhile, an overall or generic project management process was found to best suit an organisation which ran different types of projects. The usage of these processes is driven by various reasons and may vary between organisations. One of the reasons in using a standardized project management process is due to the difficulty in managing projects in the past. For example, according to interviewee 009, in 2000, the company ran into real crisis points, which were well-known in the press due to the lack of project management effort emphasized within the organisation. Recognition is another reason found to be the driving force. Interviewee 012 accentuated that being in a regulated industry, it was important for them to point out that the process was benchmarked against external accreditation, thus, there was no need to explain in detail. This process may be developed internally or adopted from best practices, and are discussed next.

The research found various standardised methods used to govern the project management processes, and this can be divided into fourteen categories. Table 7.5 illustrates the different standardised project management processes identified by the interviewees. The project management manual was found to be the most common method used by the organisations. APM project management methodology and other management systems were also highly recognized and used by the organisations; these were identified by six interviewees, respectively. PMI, OGC, and PRINCE2 are among the other related methodologies identified and used by the organisations. Additionally, there are also other gateway processes and methodologies identified by the interviewees relating to project management.

7.3.1 Project Management Documents, Tools and Techniques

The interviewees were asked concerning the usage of project management documents, guidelines, manuals or systems within their organisation. From the data, the project management related standardized documents used can be divided into two: using available guidelines, standards or frameworks; alternatively, using own developed documents. However, some interviewees, such as 001, 007, 009, 020 and 026, reported that their organisation adopted more than one type of project management document. Table 7.7 outlines further details of this, according to the information accumulated from the interviewees.

				PM Standards Used				Own PM Guidelines				
Interviewee	Business Type	Industry		APM	PMI	PRINCE2	Six Sigma	Life Cycle Management	Management Systems	PM Manual/ Systems	Quality Document / Plan	Others
001	*Railway/Train operations*	H								√		√
004	*Capital investment-eng & const*	F	M									√
005	*Railway/Train operations*	H								√		
006	*Railway/Train operations*	H		√								
007	*Consultancy-eng & const*	C	M						√		√	
009	*Mfg - defence aircraft*	C	O	√	√			√		√		
011	*Water supply & sewerage*	E		√		√				√		
015	*Services*	F	N			√						
018	*Mfg - defence aircraft*	C					√					

020	*Mfg -defence submarine*	C	O			√		√				
021	*Construction*	F							√			
022	*Power-transmission/dist*	D								√		
023	*Mining-petroleum E&P technology, refining*	B	C		√				√			
025	*Mfg - defence aircraft*	C	O		√							
026	*Mfg - defence aircraft, Turbines; Power-nuclear*	C	O	√					√			
	TOTAL			***4***	***3***	***3***	***1***	***2***	***4***	***5***	***1***	***2***

Table 7.1: The interviewee's information – project management standards and guidelines adopted

Additionally, there are various tools and techniques used by the organisations in managing projects, namely, balanced scorecard, project management system, management system or corporate policy, quality document, Pert master, Primavera, Microsoft Project, project portal, PRINCE2, life cycle management, OGC, work breakdown structure, and other tools and techniques. Table 7.8 illustrates the details concerning the tools and techniques in managing the projects. The details on project management document, tools and techniques have been discussed earlier in Chapter 6.

Interviewee	Industry		Balanced Scorecard	PM Framework/ Manual / Systems	APM	Management Systems / Corporate Policy	Quality Document	Pert master	Primavera	MS Project	Project Portal	PRINCE2	Life Cycle Management	Other Database	OGC	WBS	Others
004	F	M	√														
005	H			√													
006	H				√												
007	C	M				√	√	√	√	√	√						
008	H					√				√							
009	C	O			√							√	√	√			
012	H	M			√										√		
015	F	N										√					
016	C	O		√													
018	C					√			√							√	√
021	F					√											
022	D			√					√	√						√	√
023	B	C				√											
025	C	O		√													
			1	***4***	***3***	***5***	***1***	***1***	***3***	***3***	***1***	***2***	***1***	***1***	***1***	***2***	***2***

Table 7.2: The interviewee's information – tools and techniques adopted in managing projects

7.4 Barriers to Project Governance

The interviewees also provided their views on the issues and problems relating to project management. These views are discussed below:

a) Attitude.

One issue in project management is personal attitude. It is related to the superiority complex, whereby a project manager may have difficulties in controlling the risk manager. Such an issue was experienced by interviewee 005, by which the project manager could not instruct the risk manager, who was not reporting directly to him.

b) Enforcement of rules

Failing to enforce rules may impact projects especially upon the total cost. This is also due to weak governance (011). It was found that there were cases whereby projects need to be delivered on time and according to the specifications, but not as budgeted. According to interviewee 006, their project was very delivery-focused and therefore, they might have spent more than the budgeted amount.

c) Capability

According to interviewee 009, lacking the required capability and focus in project management had nearly brought them to bankruptcy in 2000. Efficient project managers are needed and they must be trained to implement the project management processes (015, 022).

> *"...around 2000, the company got into some real difficulties, which are well known in the press...A number of projects nearly brought the company to bankruptcy...the company realized that project management capability was not as it should be...they assumed that we were good at project management, when in fact, we were not. We didn't have enough project managers on the ground and the problems of integration, that's a key issue...We didn't manage the requirements group...we did have something, but it was inconsistent and it wasn't very comprehensive"* (009)

d) Dynamic environment

Due to the dynamic environment, interviewee 012 highlighted that they had proven the efficiency of their periodical forecasting, delivering projects suited to the value of the client's constant changing demands and continuously evolving requirements. These had introduced some subtleties around their proven mechanics, and therefore, they had to manipulate the project delivery to fit the operating demands, which inevitably, created additional cost.

e) Administrative load

The inherent problem with big organisations was that they gathered a lot of administrative load and bureaucracy around them. According to interviewee 012, some of the low-probability events may become more likely on such a massive portfolio, which forces them to have greater management across the portfolio, thus bringing more administration and functional accountability. Interviewee 012 criticized this and pointed out that they had to over-react to such problems, which does not create added value, but only manages the politics of the projects.

f) Complicated contracts

Contracts are complicated and usually spelled out using jargon words. Interviewee 021 highlighted that people do not really understand the risk of large and complicated contracts, including PFI, compared to traditional contracts, which are fairly well embedded.

7.5 Summary

The emergence of the concept of governance in the 1990s has influenced the development of various corporate governance codes and also project governance practices to improve control, responsibility and accountability. This has been discussed earlier in Chapter 3. The theory of governance offers a standpoint for better understanding project governance and risk management. (Guo et al., 2013). Additionally, Guo et al (2013) advocated that project governance seeks to provide a structure that conveys the project objectives and also a means of performance monitoring. Based on the discussions, the concept of governance is vital to project risk management, and this has been highlighted by the interviewees. Governance is either being practiced concurrently or embedded within the task of managing project risk by the organisations.

7.5.1 Elements of Project Governance

The research found three main elements of project governance which were discussed by the interviewees, namely, responsibility and accountability; controlling and monitoring; and reviewing and reporting.

a) Accountability and responsibility

Projects are governed according to the extent of responsibility given to the managers who are responsible in managing the project and its risks, as well as the level of the managers' accountability in managing projects' capital and funding. There are three types of management departments responsible in governing the risk management processes: Portfolio Management Office (PfMO), Programme Management Office (PgMO), and Project Management Office (PMO). However, PfMO was discarded due to insufficient information from the interviewees. Meanwhile, a programme may exist individually, or within a number of projects and sub-projects; the PgMO is responsible in managing the programmes, led by a programme director. A PMO, however, will provide guidance to projects, consistent with the organisation's project management framework. The head of the PMO is accountable for the processes and holds responsibility towards the performance of the project and the project team, which are formed and governed in varying ways.

b) Controlling and monitoring

Projects are also governed through controlling and monitoring activities. The controlling of activities applies to all processes and procedures, including tender or bid management, financial management, and time management. Projects are monitored through the use of a framework, milestone and stage gates, steering group, and also assurance and audit. The framework process provides guidance through a set of procedures, by which the projects are obliged to observe. The stage gates mechanism is used to control and monitor project performance. Approvals are required at each stage prior to moving onto another stage. Meanwhile, steering groups are usually formed for large-scale projects and provides a similar task of ensuring compliance to the requirement by performing the sign-off procedures. Audit is the fourth control mechanism discussed by the interviewees. It provides assurance that projects conform to the guidelines and deliver the objectives successfully.

c) Reviewing and reporting

Reporting to a higher authority is one element of project governance and can be conducted in various ways, usually periodically. Among the areas of reviewing or reporting, are risk report, budget, profit and loss, as well as project progress. The processes are performed in many ways and are part of the management activities.

7.5.2 Standardised Project Management Processes.

Projects are governed through the establishment of various procedures. These are either internally developed procedures or processes, or adopted from best practices. The processes involve steps and stages, which are very much like stage gates or gateways, with layers of procedures and levels of reviewing and approving by authorised persons. As a management tool, the project management process helps put in place a standardized approach for delivering projects, according to the requirements set by the organisations. The process may vary between organisations, and may be developed internally or adopted from best practices. The current standardized processes adopted by the organisations are ranked as follows:

i) (1) Own project management manual

ii) (=2) Own management systems

iii) (=2) APM

iv) (=3) PMI

v) (=3) OGC’s general processes

vi) (=3) PRINCE 2

vii) (=3) Other gateway processes

viii) (4) Life cycle management

ix) (=5) 6-sigma

x) (=5) Lean 21

xi) (=5) Own quality plan

xii) (=5) GRIP

xiii) (=5) Balanced-scorecard

a) Project management standards and guidelines

There are two main types of project management standards and guidelines adopted by the organisations, namely, existing or available guidelines and own-developed guidelines.

i) Existing/ available standards and guidelines

- APM
- PMI
- PRINCE 2
- 6-Sigma

ii) Own-developed guidelines

- Life cycle management
- Management systems
- Project management manual
- Quality document/plan

7.5.3 Issues in Governing Project Management and Risk

The research found seven (7) major issues in project governance which need to be addressed; these can be categorized into human, technical, and environment.

a) Human

Individual attitudes and reaction towards instruction and project environment need to be improved. Additionally, the number of capable project managers on the ground is insufficient to match the work load.

b) Technical

Projects are found to be lacking in reporting consistently and enforcing rules due to a lack of governance. Complicated contracts, such as PFI, also become an issue in managing projects, as they are grey and thus difficult to understand.

c) Project environment

Administrative load and bureaucracy are inherent problems to big projects, creating additional and unnecessary tasks of managing the politics of projects which do not add any value to the project. The dynamic environment of a project has led to the manipulation of project delivery to suit the operating demand, which inevitably inflates the overall cost of the project.

CHAPTER 8

DISCUSSION ON FINDINGS

8.1 Introduction

The process of managing risk for projects started in the 1950s and its application has been developed and adopted in the management of projects. Standards, frameworks and guidelines have been introduced to assist the process of managing risks. The establishment of various approaches to risk management was as a result from the introduction of governance concept into corporate risk management. Various governance codes such as the Cadbury Report (1992), the Greenbury Report (1995), the Hampel Report (1998), the Turnbull Report (1999), OECD Principles of Corporate Governance (1999), EASD Principles and Recommendations (2000) and the Sarbanes-Oxley Act (2002) were developed to improve control and enhance accountability and responsibility. In the area of project management, the development and application of risk methodology have seen a broader expansion due to the growing importance of projects and the increase in complexity. The establishment of various processes to risk management started since 1990s with the introduction of Project Uncertainty Management (PUMA), the Multi-Party Risk Management Process (MRMP), the Shape, Harness and Manage Project Uncertainty (SHAMPU), the Two Pillar Risk Management (TPRM), the Project Risk Analysis and Management (PRAM), the Risk Analysis and Management for Projects (RAMP) and the Active Threat and Opportunity Management (ATOM). However, the adoption of these documents reduces the understanding of the fundamentals of risk and uncertainty. The research was designed to evaluate the current understandings and practices of project risk management processes by project organisations in the aerospace and aviation industry, the oil, gas, and petrochemical industry, power, telecommunication as well as the construction industry. There are four objectives set to support this aim and are achieved through the main findings, which are presented and discussed next. This chapter discusses the overall findings of this research of which some of them can be presented diagrammatically for better understanding.

8.2 Findings on the Existing Risk Management Processes

Objective 1: To evaluate existing risk management processes from standards, frameworks, and guidelines.

The first objective was achieved with the empirical evidence extracted from the literature, largely from the standards, framework, and guidelines relating to risk management processes published worldwide. A total of forty-eight (48) documents were reviewed, which are categorized accordingly into international or national standards (14 documents), national statute or governmental documents (17 documents), professional bodies' documents (12 documents), and other organisational documents (5 documents). These documents presented their own risk management process. Based on the evaluation, the research developed a theoretical framework of risk management process which is useful to be used as reference. With the comprehensive information structured within the framework, it helps to enhance the knowledge and understanding of the procedures in implementing risk management. The details are discussed next.

8.2.1 Project Risk Management and its Process

Project risk management or PRM has been acknowledged as the main element of project management. The process of managing risk for projects has become a comprehensive management approach and is becoming an integral part of project management BoKs. The APM (2004) and Cooper et al. (2005) emphasise that the use of risk management minimize the risk of not achieving objectives as it provides insight, knowledge and confidence in making decisions through a structured framework. Furthermore, the use of a consistent framework helps to promote transparency and effective communication within project organisations. In the UK, the concept of PRM started in the defence industry in 1985 and became widely acknowledged as a main element in project management. Since then, it has been addressed by various government agencies as well as by project management associations. The fundamental of PRM is that there is a real project plan to work on and the purpose of PRM is to produce the best project deliverables. Chapter 3 of this research has provided a comprehensive review of fifteen approaches to risk management; either PRM is related or indirectly related and used for project, namely, the PRM Guidelines, AS/NZS 4360, APM PRAM Guide, PMI PMBOK, RAMP, UK's MoR, BS6079-3:2000, BS/IEC-62198, BS/ISO-31000, BS-31100, ISO/IEC-16085, CAN/CSA-Q850, USA's DoD, and NASA's NPR 8000.4A. Based on the reviews, PRM has been collectively defined as follows:

> *"A structured process of understanding and managing project risk successfully through the minimisation of threats and maximisation of opportunities"*

Generally, a typical mainstream risk management process consists of four conceptual management steps, which are known as risk identification; risk assessment; risk response, and risk review and monitoring (see Figure 8.1). The naming of the steps may vary, and may not necessarily be generic as mentioned above. For example, the INSEAD's PRM process [see (Loch et al., 2006, Pich et al., 2002, De Meyer et al., 2002)] has four conceptual steps with similar terminologies except that it uses the term 'documentation and learning' instead of risk review and monitoring. It includes the historical and current project databases and post-project assessment. On the other hand, Cooper et al. (2005) propose a three-staged process known as key processes for effective management of risks. This three-staged process was found to be a simplified one, combining the activities of identifying, analysing, assessing, and developing plans into one process; followed by responsibility assigning and costing. Although graphically uncomplicated, one still has to go through the complete process of managing risks, which is similar to the generic process discussed earlier. Based on the reviews, the generic processes can be described as follows:

a) Risk identification is a process of documenting the risk characteristics; determining what, how, and why it happens.

b) Risk analysis is a process of determining the magnitude and consequences of the risk, involving a numerical analysis or mathematical modelling.

c) Risk evaluation is a process of determining the tolerable level of the risks and their suitable responses.

d) Risk treatment is where the method of responding to the threat is developed according to priority.

e) Risk monitoring and control is a process where the risks are tracked and monitored throughout the project. Any residual risks are treated the same, and managed accordingly as new risks.

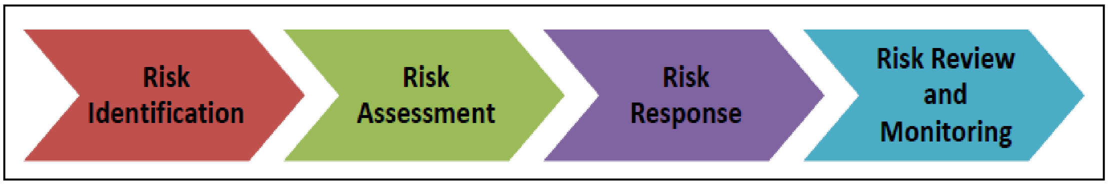


Figure 8.1: The mainstream or conceptual steps of the PRM process

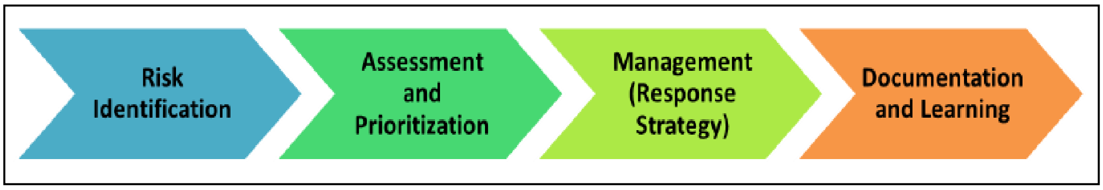


Figure 8.2: INSEAD's conceptual steps of the PRM process
Source: Loch et al. (2006:p13)

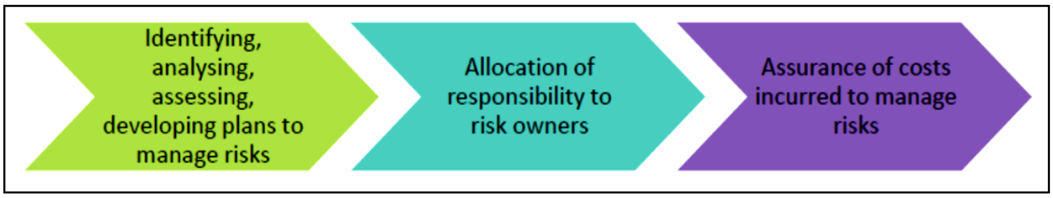


Figure 8.3: Three key processes for effective management of risks
Source: Cooper et al. (2005:p3)

Upon reviewing fifteen approaches used to manage risks for projects, this research found out that a comprehensive and well explained risk management process can have up to eight clear stages, with varying names given to each step which may represent the same process or meaning. These are tabulated in Table 8.1(a) and Table 8.1(b) below. Table 8.1(a) indicates that none of the documents reviewed actually presented an eight-steps process diagrammatically. However, it was only upon investigating the detail steps that the research then developed the propose eight-step process framework. This is shown in Table 8.1(b). The detail comparisons are discussed earlier in Chapter 3.

Document	No. of steps or stages	Steps or stages
DoD (US) 2006	4	(1)Identify→ (2)Analyse→ (3)Response & Treat→ (4)Monitor & Review
PMBOKBOK® (PMI, 2004)	5	(1)Establish context → (2)Identify → (3)Analyse → (4)Response & Treat → (5)Monitor & Review
MoR (OGC, 2007a)	5	(1)Establish context → (2)Identify → (3)Assess → (4)Response & Treat → (5)Monitor & Review
PRAM Guide (APM, 2004)	5	(1)Establish context → (2)Identify → (3)Assess → (4)Response & Treat → (5)Manage process
RAMP (ICE et al., 2002)	5	(1)Establish context → (2)Identify → (3)Assess → (4)Response & Treat → (5)Monitor/Review
CAN/CSA-Q850-97	5	(1)Establish context → (2)Analyse → (3)Evaluate → (4)Monitor/Review → (5)Communicate/Consult
AS/NZS 4360:1999; Cooper et al. (2005); BS IEC 62198:2001; BS ISO 31000:2009	6	(1)Establish context → (2)Identify → (3)Assess → (4)Response & Treat → (5)Monitor/Review → (6)Communicate/Consult
IEEE Std 1540:2001; ISO/IEC 16085:2006 (IEEE Std. 16085-2006	6	(1)Establish context → (2)Identify → (3)Analyse → (4)Monitor → (5)Response & Treat → (6)Monitor/Review
CMU/SEI-94-SR-5	6	(1)Establish context → (2)Identify → (3)Analyse → (4)Response & Treat → (5)Monitor/Review → (6)Communicate/Consult
NASA NPR 8000.4A	6	(1)Establish context → (2)Identify → (3)Analyse → (4)Response & Treat → (5)Monitor/Review → (6)Communicate/Consult
BS 6079-3:2000	7	(1)Establish context → (2)Identify → (3)Analyse → (4)Evaluate (5)Response & Treat → (6)Monitor/Review → (7) Communicate/Consult

Table 8.1(a): Number of steps or stages of risk management by various standards, frameworks and guidelines

Standard/ Guideline/ Author	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8
PRM Guidelines (D. Cooper, et al., 2005)	Establish context	Identify	Assess- (Analyse)	Assess- (Evaluate)	Treat the risks	Monitor & review	Communicate & consult	-
AS/NZS 4360 (AS/NZS-4360, 1999)	Establish context	Identify	Assess- (Analyse)	Assess- (Evaluate)	Treat the risks	Monitor & review	Communicate & consult	-
PMI's PMBOK® (PMI, 2004)	RM planning	Identify	Qualitative analysis	Quantitative analysis	Response planning	Monitor & control	-	-
PRAM Guide (APM, 2004)	Initiate-Define scope	Initiate-Focus RM	Identify	Assess- structure, ownership	Assess- estimate, evaluate	Plan responses- risk event & project risk	Implement responses & monitor	Manage process
MoR (OGC, 2007)	Identify-context	Identify- risks	Assess-estimate	Assess-evaluate	Plan-responses	Implement-action	-	-
RAMP (ICE, et al., 2002)	A: Process launch-plan, organise & launch process	A: Process launch- establish baseline	B: Risk review- plan, initiate, identify	B: Risk review- evaluate, mitigate, assess	B: Risk review- plan & communicate response	C: Risk management- implement strategy	C: Risk management- control risks	D: Process close down-assess outturn, review RAMP process
BS 6079-3:2000	Context	Risk identification	Risk analysis	Risk evaluation	Risk treatment	Monitor and review	Maintain database	Communicate & explain
BS IEC 62198:2001	Establish context	Identify risks	Assess risks- analyse	Assess risks- evaluate	Treat risk	Monitor & review	Communicate & consult	-
BS ISO 31000:2009	Establish context	Risk assessment- identification	Risk assessment- analyse	Risk assessment- evaluate	Risk treatment	Monitor & review	Communicate & consult	-
IEEE Std 1540-2001 ;	Technical & mgmt processes	Plan & implement RM	Manage project risk profile	Perform risk analysis	Perform risk monitoring	Perform risk treatment	Evaluate RM process	-
ISO/IEC 16085:2006 (IEEE Std. 16085-2006)	Technical & mgmt processes	Plan & implement RM	Manage project risk profile	Perform risk analysis	Perform risk monitoring	Perform risk treatment	Evaluate RM process	-
CAN/CSA-Q850-97	Initiation	Preliminary analysis	Risk estimation	Risk evaluation	Risk control	Action monitoring	Risk communication	-
DoD (US) 2006	Risk identification	Risk analysis	Risk mitigation planning	Risk mitigation plan implementation	Risk tracking	-	-	-
CMU/SEI-94-SR-5	Initiate	Team	Identify	Analyse	Plan	Track	Control	Communicate
NASA NPR 8000.4A	Identification of alternatives	Risk analysis of alternatives	Risk-informing alternative selection	Identify	Analyse	Plan	Track	Control, Communicate

Table 8.1(b): Summary of steps or stages of risk management by various standards, frameworks and guidelines

Based on the above, the research advocates that risk management process should commence with establishing the context or baseline before proceeding to the identification of risk. The risk assessment, analysis, and evaluation stages suffer the most as they have been interpreted and implemented differently in the various standards and guidelines. The sequence of the steps is proposed to be as follows:

(1) Establish context > (2) Identify Risk > (3) Assess Risk > (4) Analyse Risk > (5) Evaluate Risk > (6) Response/Treat > (7) Monitor & Review > (8) Communicate & Consult

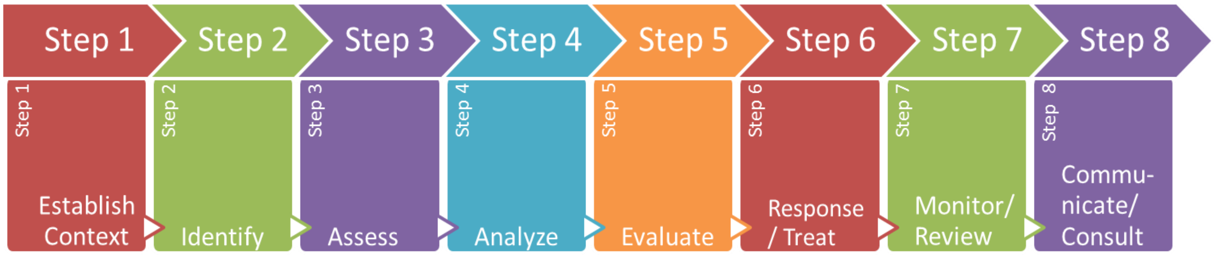


Figure 8.4: Summary of the detailed process of managing risk – eight steps

All steps are identified as a stand-alone activity, and thus avoiding any misinterpretation and providing a clear process to be implemented. Figure 8.4 summarizes the eight steps of managing risk, derived from the various processes in different documents. The details for the proposed eight-step project risk management processes are as follows:

1) Establishing the context

This is the first activity which needs to be conducted before identification of risk. It must be included as part of the process structure, ensuring that people will not neglecting the important tasks beforehand, namely the planning process. The essence of successful risk management lies beyond the knowledge and understanding through the process. Besides, it also provides an understanding of the risk in the project environment itself, by asking questions such as '*what needs to be delivered*' and '*what needs to be done*'. Risk must be addressed carefully and understood to avoid spending unnecessary resources to manage cause, task and other management issues rather than the actual risk. This can be done through meetings and discussions. The task of establishing context involves the following activities:

- Establishing baseline by defining the scope, roles and responsibilities.
- Planning the risk management process and the methodology to perform the process.
- Obtaining the necessary information such as project management plan and project scope statement.
- Developing a structure for risk identification.
- Developing the success criteria namely cost, schedule and performance.

2) Identifying the risks

The next task is to identify potential risks that could occur and potentially impacted the project. Risks can be identified through various means such as through workshops, risk register, and learning from experience. It is important to clarify what are the risks and wording them appropriately by adding the cause and effect. Risks are identified before and during the workshop sessions. Additionally, we can also look at learning from experience to identify the risks from the stock of data and lessons learnt register. This is usually conducted before any risk workshop. The risk identification task involves the following activities:

- Answering the question of ‘what can go wrong?’
- Exploring the associated root-cause and existing conditions.
- Monitoring results of previous process and highlighting and monitoring any potential shortfalls and negative trends.
- Exploring and extracting information and project objectives using various methods.
- Productions of a risk register as a live document.

3) Assessing the risks

Although there were different ideas pertaining to the exclusivity of risk assessment, analysis and evaluation, it is important that each task is explained as a separate task in the overall process of managing risks. It is conducted qualitatively to create a better understanding of the process, asking the questions such as what to expect and to be done. Risk assessment is important due to the following reasons:

- It increases the understanding of identified risk for effective decision making.
- It is an overall process whereby it includes analysis and evaluation of risks.
- It involves estimating of the probability and impact of the risks should they occur.
- The identified risks will be prioritized according to likelihood and consequence.
- It involves analysing and evaluating the overall effect of each risk.

4) Analyse the risks

Risks are analysed based on the likelihood or probability of occurrence and impact and these are presented and weighted in a form of matrix scoring system, represented by a band from low to high. The results from the scoring system are listed down according to the priority ranks. Additionally, a root-cause analysis can be used to produce the prioritisation and impact analysis. These prioritisations are used as the basis of action. Besides the matrix scoring, assumption analysis can be used to look at the assumptions made on the project, the robustness, stability and sensitivity of the project to the assumption. Therefore, risk analysis is important due to the following reasons:

- Answering the question of 'how big is the risk?'
- Establishing the likelihood of occurrence, root cause analysis and the consequences of the risks.
- Estimating the threats and opportunities, in terms of their probability and impact.
- Involves qualitative analysis, semi-quantitative analysis and quantitative analysis.
- Quantitative analysis depends on the nature and quality of the data.

5) Evaluating the risks

Although there are concerns over the overlapping between analysis and evaluation phases, the research found that having a separate process can help the project team to observe different views and issues. The risks are brought to the controllable level in the evaluation process. By evaluating the risks, the project team can observe their major risks and can start to identify the owner of the risks. The risks are evaluated in terms of financial impact or significance as one way of understanding what risks mean to the project. Therefore, the risk evaluation process is summarised as follows:

- Increase the understanding of the net effect of the identified threats and opportunities.
- The process of estimating the significance of the risks.
- Comparing the risk priorities with its initial analysis against other risks.

- Involves adjusting risks that are too high or too low by moving them up and down.
- Recording ownership of each risk for tracking purposes.

6) Responding or treating risks

The analysed and evaluated risks are brought to this stage whereby they are being mitigated, known as response or treatment. It is a process of controlling by allocating action plans to deal with each risk. At this stage, there will be various types of risk appetite involved such as awarding contracts to sub-contractors. The response can be in the form of signing-off and control and continuously follow-up on the performance of the risks until closed-out. It is considered as an output treatment and strategy of managing risk. The summary of risk response and treatment processes is provided below.

- Minimizing the impact of threats and maximizing or exploiting the opportunities.
- Identifying options to reduce the likelihood of consequences by using matrix.
- Determining the potential benefits and cost for the options and selecting the best possible options.
- Negative risks are avoided, transferred, or mitigated, while positive risks are exploited, shared, or enhanced.
- Involves various techniques such as prevention, avoidance, elimination, share, retention, and impact mitigation.

7) Monitoring and reviewing the risks

Monitoring and reviewing is part of the governing process whereby it involves accountability and responsibility, ensuring that actions are identified, managed and implemented accordingly. Once the response or treatment planning have been laid down to be managed, the risks have to be monitored and reviewed continuously. The task is conducted after completing the full risk management process to see whether the risks are closed out or there are other risks which are still relevant. New risks sometimes emerged as a result of the process or action taken and therefore they are addressed through the same process. The process is summarised as follows:

- Conducted to keep track on the identified risks and on the watch list.
- Involves reanalysing the existing risks, monitoring the residual risks, and reviewing the risk response.
- The process is managed to ensure that the risk management process itself is effective and reviewed.
- It is linked with other management process like management meeting cycle.
- It involves tracking of the risks, which include activities such as monitoring the mitigation plans, reviewing, and displaying the status within the matrix.

8) Communicating and consulting the risks

A report on the risks that have been reviewed is prepared and presented periodically to the higher management for further action. In essence, the process of communicating and consulting the risks is summarised as follows:

- This task helps the understanding of the risks by ensuring that all parties involved are fully informed.
- It avoids the unpleasant surprises, maintaining consistency and the reasonableness of the risk assessment.
- It involves regular reporting of the risk status to the management, communicating it to all affected stakeholders, and alerting the management.
- It ensures that the lessons learnt are transferable.

Based on the above discussions, the research is proposing a theoretical framework that summarises the process of managing risks, which include their purpose and activities within. This framework is shown in Figure 8.5. The dotted lines reflected the dynamic process of risk management, whereby reviews can be conducted once each step is completed. Additionally, new risks may emerge as a result of actions taken at any stage during the process and thus, they need to be managed through the same process. The framework is presented using different colours to differentiate each step. However, the assess, analyse and evaluate steps are presented with similar colour, indicating that there are issues on overlapping between them, involving quantitative and qualitative methods. Nonetheless, these steps are to be conducted separately using different methods and with different purposes rather than said to be similar or overlapped each other in many guidelines which can be found in several documents such as PRAM guide (APM, 2004), PMBOK, MoR (OGC, 2007a) and IEEE Standard 1540-2001. Meanwhile, the framework biases can be overcome through the use of a structured and well explained framework for risk management. This conceptual framework provides a better understanding of how risk can be managed.

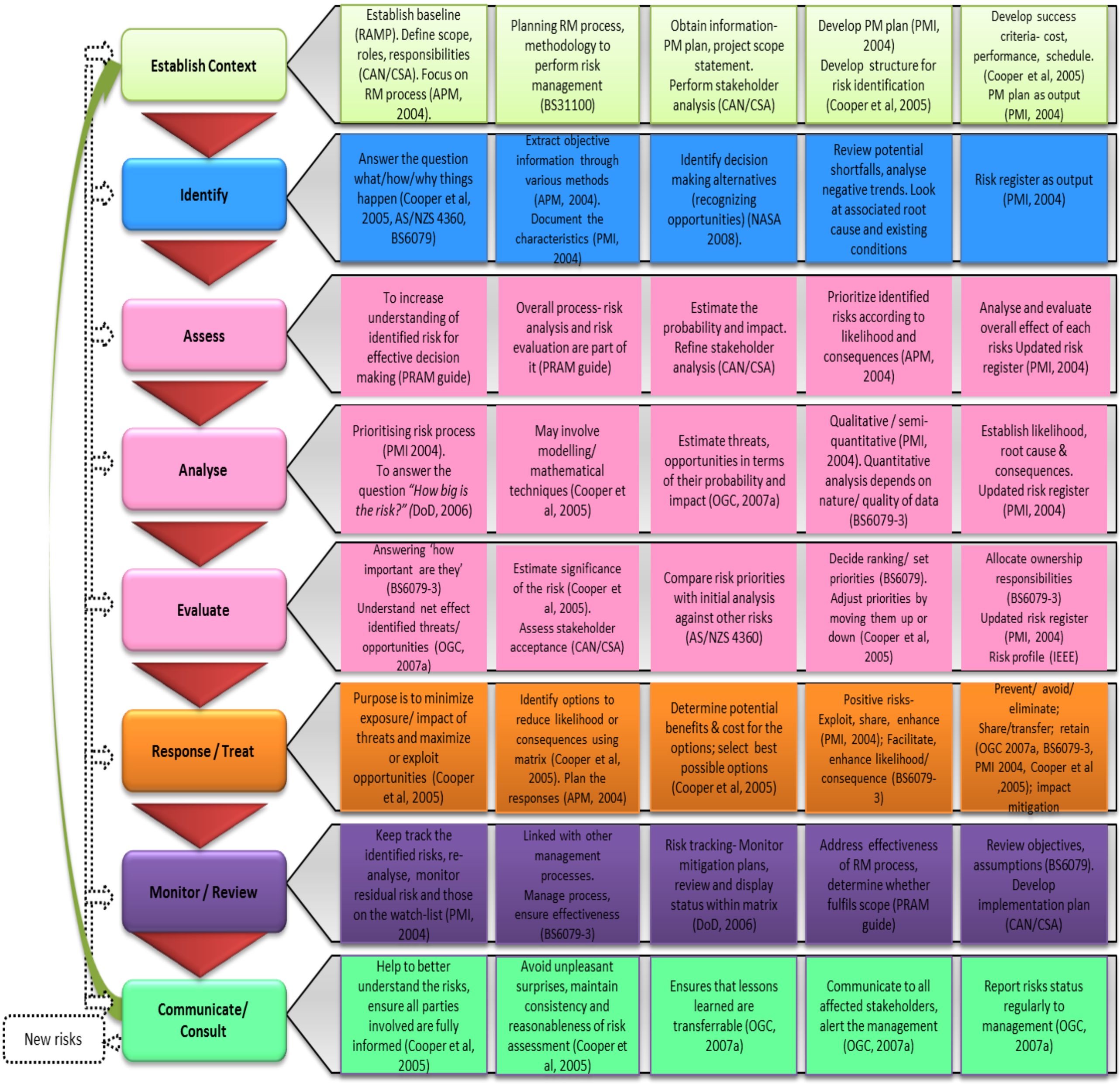


Figure 8.5: Summary of the theoretical framework process of managing risk for projects

8.3 Structure of the Current Understanding and Practice of Project Risk Management.

Objective 2: To investigate the current practices of risk management for projects by different organisations in different industries.

The second objective was achieved based on the findings of the analysis discussed in chapters 5, 6 and 7. Twenty six interviewees from varying organisations participated in this research and shared their views and information relating to the practices of risk management. The interviewees are experienced managers responsible for project risk management processes and have the capacity to make decisions for their organisations. The collective information regarding the processes of managing risk is presented using a diagram, an evident to the current practices. Besides that, there were other issues debated by the interviewees relating to the practices of PRM and are discussed in details next.

8.3.1 Six Major Steps of the Risk Management Process

Earlier in this chapter (section 8.2.1), this research advocates that there can be up to eight steps or stages for risk management. This eight-step process has been conceptualised (see Figure 8.5) based on the reviews conducted on fifteen PRM approaches. However, findings from the data collection and analysis indicate that although different approaches to risk management were adopted by the organisations, the processes involve six major steps: defining context, identification, analysis/ assessment, evaluation, response/ treat, and monitoring and reviewing (including communicating). This has been discussed in section 6.2.3.1. These steps are further grouped into four main stages and are discussed below:

a) Step 1 (Stage1): Defining the context

Defining the context is the first step of the process. It defines the context, scope and objectives of the project as well as the roles and responsibilities. As discussed earlier in this chapter, risk must be addressed carefully and understood to avoid any unnecessary spending of resources. The risk management steps must be planned properly during this stage. Meetings, discussions, and workshops are the most common techniques used by the organisations to define the context.

Task	Source
Meeting, discussion on what to do	Interviewees 005, 008
Establish baseline, define scope, roles, and responsibilities.	Interviewees 001, 005, 011, 015, 019, 026
Focus on RM process i.e. planning the process or steps, methodology to perform risk management	Interviewees 009, 011

Table 8.2: Defining and establishing context

b) Step 2 (Stage 1): Identifying the risks

At this stage, risk is defined without any cost data, focusing on the key risks that could occur and potentially impacted the project. A high quality description is needed using a clear risk language, differentiating between cause, risk, and effect. A root cause analysis should be conducted to identify the source of the risks. The risks are identified from various source means such as learning from experience, workshops, risk register, and interviews. At this stage, all risks will be assigned to specific owners and they are responsible for any action on the risks.

Task	Source
The first stage of RM process	Interviewees 005, 006, 026
Define, clarify and describe risks properly, understand the risks	Interviewees 001, 003, 005, 006, 015, 016, 019, 021, 023, 026
Consider key risks, different types of risks Document the characteristics	Interviewees 016, 019, 021
Risks are identified from experience, from risk review of previous process (residual risk), including risk owner. Extract objective information through various methods	Interviewees 005, 013, 014, 019
Root cause analysis is conducted to identify risk, including its effect	Interviewees 001, 016, 019

Table 8.3: Identifying the risk

c) Step 3 (Stage 2): Analysing / assessing the risks

Once the risks are identified, they must be analysed or assess in terms of their likelihood to occur and the consequences to the project should they occur. There are various methods used by the organisations for this purpose. The most common methods are the probability-impact (P-I) matrix and risk ranking. This can be conducted by looking at the assumptions made on the project, the robustness, the stability and also the sensitivity of the risks. Quantitative analysis is done to quantify the risk exposure and to estimate the cost of the risk. Besides that, a questionnaire survey can be distributed to the project team to support the P-I matrix, focusing on the root-cause with simple impact-analysis.

Task	Source
Estimate threats, opportunities in terms of their probability and impact, establish likelihood, root cause & consequences, prioritising identified risk	Interviewees 001, 016
Look at assumption made on project , robustness, stability, sensitivity	Interviewee 001
P-I matrix and ranking	Interviewees 003, 011, 014, 015, 016, 017, 020, 021, 023, 025, 026
Quantitative analysis, quantify the exposure, cost down the risk	Interviewee 007
Using balance scorecard to score on same basis	Interviewee 004

Table 8.4: Analysing or assessing the risks

d) Step 4 (Stage 2): Evaluating the risks

The purpose of this stage is to bring the risks to the controllable level. The evaluation activities involve filtering the risks and non-risks, prioritizing the significant risks, scoring in terms of money and time, estimating the financial impact, and planning the mitigation actions.

Task	Source
Risks brought to controllable level	Interviewee 008
Estimate significance of the risk, filter risk & non-risk	Interviewee 006
Compare risk priorities with initial analysis against other risks, adjust priorities, decide ranking	Interviewee 006
Evaluate the financial impact, time	Interviewees 005, 022, 025
Plan the mitigation actions, risk appetite	Interviewees 006, 013, 017, 020, 021, 022, 025

Table 8.5: Evaluating the risks

e) Step 5 (Stage 3): Responding or treating risks

Risk response or treatment is tied up with the previous processes whereby it translated the analysis and evaluation steps indicating that something must be done on the risks. It is also conducted to keep the value of risk down. There must be actions in place and decisions on how to deal with the risks, including the person responsible to a particular risk. The mitigations actions are divided into reduce, transfer, eliminate. There was no information provided on the acceptance of risk as one of the mitigation actions.

Task	Source
Translate previous process & do something about risk, related to controlling risks	Interviewees 005, 009, 016, 022
Put actions in place & decide how to deal with the risks, decide who will do what	Interviewees 011, 014, 016
Negative: prevent/ avoid/ eliminate; Share/transfer; retain; impact mitigation	Interviewee 013, 020, 021, 026

Table 8.6: Responding and treating the risks

f) Step 6 (Stage 4): Monitoring and reviewing the risks

Monitoring and reviewing is conducted to make sure that the risks are closed out. If they are still relevant due to the emergence of residual or new risks, the same process applies. This step is also a medium of governance; allocating accountability and responsibility to the respective persons, auditing the processes involved, and preparing periodical report. These are means of controlling and measuring the exposure of the risks. The report has to be communicated and presented to the management for decisions. There were also views that monitoring and reviewing should be conducted throughout the process and not just to leave it to the last. The idea is to ensure that there is a mean to review each process and new risks may emerge at any step of the process.

Task	Source
To see risks are closed out, still relevant, residual or new risks emerged	Interviewees 001, 006, 017, 020
Address effectiveness of RM process, determine whether fulfils scope; a medium for accountability & accountability (governance), control mechanism, identify who will monitor and document	Interviewee 006, 014
Review objectives, assumptions , used to drive audit process	Interviewees 014, 026
Control & communicate; reported periodically, communicate to all affected stakeholders, alert the management, help to better understand the risks, ensure all parties involved are fully informed	Interviewees 004, 006, 011, 014, 019, 020, 021, 022, 023, 025, 026

Table 8.7: Monitoring and reviewing the risks

The collective information on the risk management process is shown in Figure 8.6. Details on the findings have also been discussed in Chapter 6. The steps are presented in red boxes. The process is continuous and is represented by the green arrows. Residual or new risks are presented using dotted-lines. Should new risks emerge from the process; they are managed through the same process, from defining the context to monitoring and reviewing. The green rectangle boxes provide information derived from the interviews, and allocated accordingly to describe the steps. Meanwhile, the common techniques used to support the steps are presented in the green square boxes. Figure 8.7 renders a summary of the information with regards to the process description and methods to conduct the PRM processes at each step. It offers an understanding of how the process can be conducted.

The proposed framework is conceptual; being empirically developed based on the combination of information from the fifteen PRM approaches as well as from the interview with practitioners. It has yet to be validated externally thus owing to its suitability and ability to be implemented by the industry. Therefore, validating this framework in practice would be beneficial.

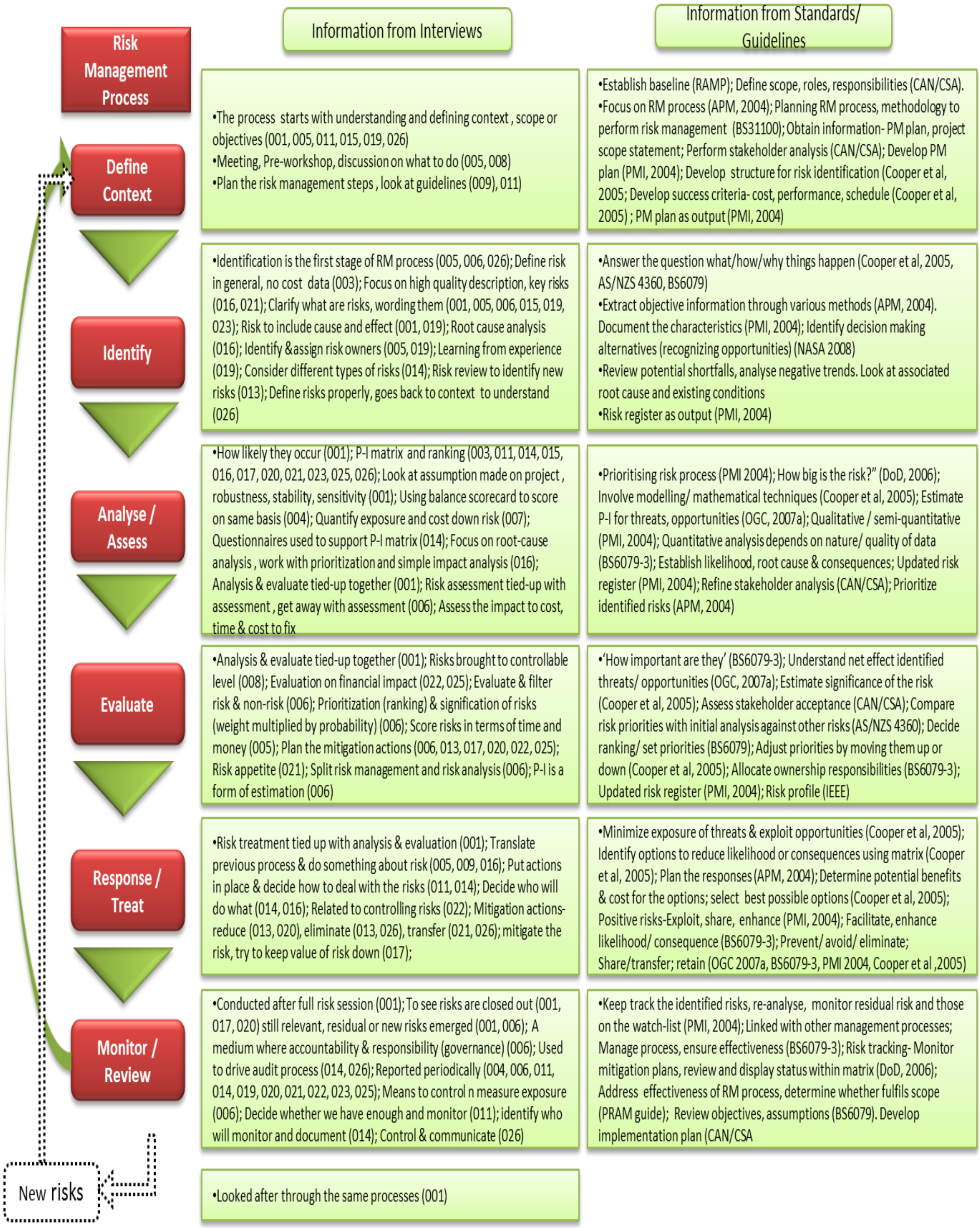


Figure 8.6: The risk management process – collective information from analysed data

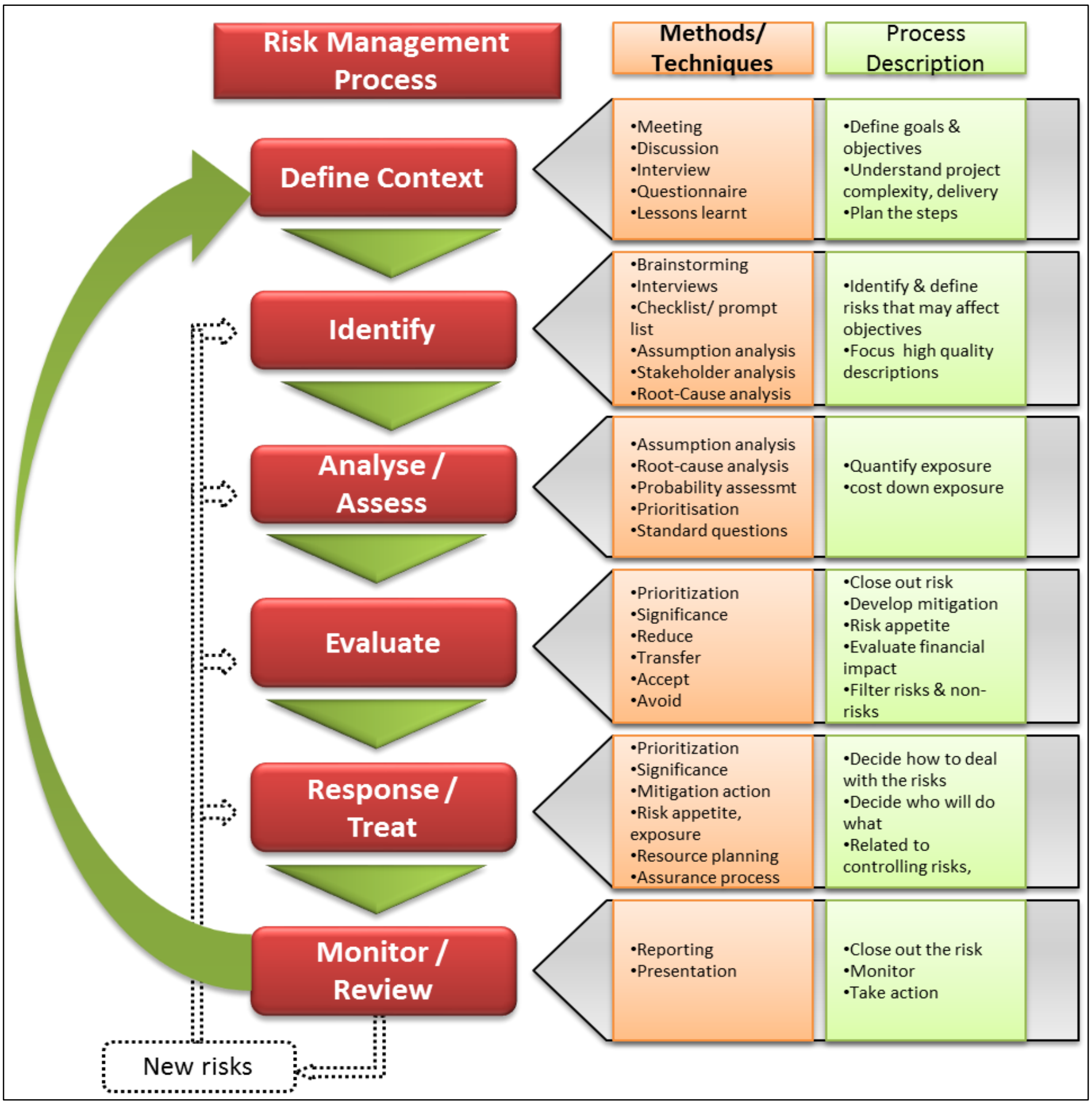


Figure 8.7: The risk management process – summary of collective information

8.3.2 Governance and Risk Management

The findings from this research indicate that risk management can be the responsibility of several functions such as programme management office (PgMO), and other business units. However, risk management is primarily governed within the project management office (PMO). PMO is responsible to advice and guide the projects, ensuring that the objectives are achieved successfully. Additionally, it controls the practices and processes of project management across the organisation. The head of PMO is accountable to develop the tools and processes as well as reviewing the project and the team's performances. Project team are formed and governed in different ways, according to the nature of the business.

Once a project is secured, the PMO and the project team are accountable to manage and deliver according to the objectives. Thus, there must be a means of controlling and monitoring to be imposed as projects are driven by the ability to complete in time and within budget. The research also observed four mechanisms of governance, namely, organisational framework process, milestones and stage gates, steering group, and audit process. The organisational framework lays down a procedure or process for managing risks whereas milestones or stage gates are used to monitor the project performance against the work programme. The stage gates are similar to the gateway processes such as the one produced by OGC that represents layers of approval processes. Meanwhile, steering groups are formed to provide guidance especially for large-scale projects, ensuring that projects comply with the rules set by the board. The audit processes are conducted to ensure that projects conform to the guidelines and deliver the objectives.

Reviewing and reporting are also part of governance process. As discussed earlier, the reviewing and reporting become important steps within the risk management process, allocating accountability and responsibility to respective persons. Effective communication is the key challenges in project and risk governance (van Asselt and Renn, 2011), therefore it is important that the outcome of the reviews to be reported periodically and communicated or presented to management for decisions. When the decision is made, it has to be communicated back to the project team for action and implementation.

The usage of standardised process for project management and risk management is driven by various reasons. By having such process, the task of delivering project expectations will become easier especially for organisations that ran many projects. The details regarding standardised process will be discussed next.

8.3.3 Risk Management Standards and Guidelines

Twelve existing risk management related standards and guidelines were mentioned by the interviewees. However, this does not mean that the list is exhaustive as the interviewees were not asked to name any specific documents. The main idea was to get hold of the interviewee's understanding concerning what standards and guidelines mean and how they function. The functions of standards and guidelines are as shown below. Figure 8.8 depicts the scope and limitations of the standards and guidelines. Generally, there are nine (9) common scopes and limitations highlighted by the interviewees based on their understandings of the available standards and guidelines.

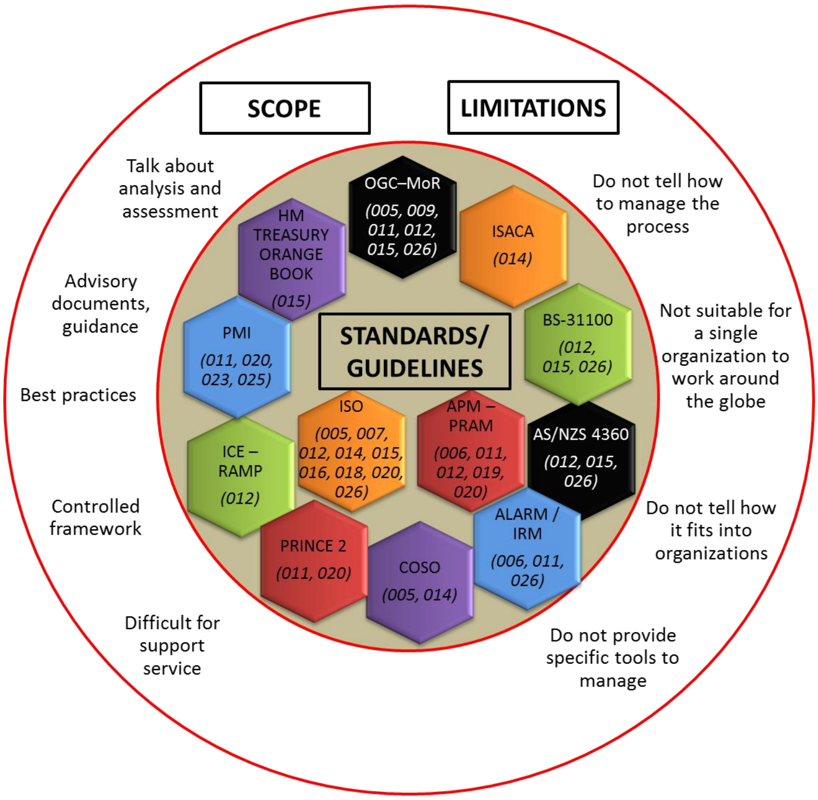


Figure 8.8: Functions and current understanding of standards and guidelines

8.3.3.1 The use of standards and guidelines in practice

The usage of standards and guidelines generally depends on the organisation and individual's knowledge and training. The generic documents are not ignored but rephrased, manipulated and tailored to fit an organisation's need and to make sure that it works for the projects. Additionally, the generic documents may be used as a basis to develop their own guidelines. The issues and concerns regarding the standards and guidelines are as follows:

a) Words might be different but activities within the words are similar.
b) Guidance on implementation is needed.
c) It was just different organisations looking at risk with a different interpretation.
d) Historically most guidelines were based on risk management in the manufacturing industry, which were later introduced and developed to suit the needs of different environments.
e) Standards reduce the level of thought.
f) It is bureaucratic and very statistical and usually there will be other software packages introduced alongside the standards and guidelines.

8.3.3.2 Available standards and guidelines

The research found that six standards and guidelines have been adopted by eight organisations as mentioned by the interviewees. They are the APM's PRAM (006, 011), PRINCE2 (011), BS31100 (012), ISO27000 (014), COSO (005, 014) and ISACA (014). The motivations or reasons to use these documents relate to the difficulties to develop their own documents due to internal and external resistance.

8.3.3.3 Own developed guideline

From twenty interviewees who mentioned that they were using their own-developed guidelines, sixteen of them have clearly identified a particular name and four did not mention any name. Fourteen interviewees have associated their guidelines with external standards and guidelines, which were used as the basis to develop theirs. APM-PRAM and OGC-MoR are common UK-based standards and guidelines used as the basis of their documents. Guidelines have been developed for quite sometimes, with up to twenty-five years of usage. The guidelines were developed due to the lack of availability of existing standards that suited their requirements or businesses. Besides that, the guidelines are used as a mechanism for governance, ensuring that risks are managed systematically. These guidelines are being updated and reviewed regularly to ensure that they are aligned with the latest developments and changes in the industry. There are also issues and problems related to the guidelines. The main issue is related to the implementation, of which people are resistant to use them. Additionally, the guidelines may not suit to small project due to time consuming.

Interviewee	Name of guideline	Year / Duration Used	Basis of guideline
001	Guide for Railway Investment Projects (GRIP), Investment Regulations	6-8 years	ISO, BS, AS/NZS
004	Group Framework for Opportunity & Risk Management (GFORM)	2005	N/A
005	Gateways (similar to OGC)	12-18 months	ISO, OGC-MoR
007	CMS Systems	5 years	Best practices
009	Life Cycle Management Guides	N/A	N/A
010	N/A	7-8 years	N/A
012	N/A	2006	APM-PRAM
013	(Company name) Risk Management	N/A	N/A
014	Statement of Risk Management	N/A	N/A
015	Risk Manual, Risk Management Handbook	>10 years	OGC-MoR
016	Risk-Six	2002	N/A
017	Risk Strategy Plan	13 years	External Standards
018	N/A	10-15 years	/
020	Risk & Opportunity Management	15 years	APM-PRAM
021	Management Systems	N/A	N/A
022	Project Management @ (Company name), Project Management Model	>10 years	N/A
023	Risk Management Procedure	10 years	N/A
024	N/A	2 years	OGC-MoR
025	(Company name) Project Risk Management Method	>25 years	External Standards
026	Group Quality Procedure (GQP), Local Operating Procedure (LOP)	>15 years	N/A

Table 8.8: Own-developed guidelines

There were also expectations that these guidelines provide full guidance in conducting risk management. However, due to the absence of guideline that can serve these anticipations has made the practitioners or the organisations decided not to use any particular guideline but only adopting some best practices from various sources and embed them into the systems indirectly.

8.3.3.4 Own guidelines to be used by others

There are mixed reaction regarding the possibility of implementing the own-developed guidelines into other organisations. Thirteen interviewees support the idea that there is a possibility of expanding their own-developed guidelines into other organisations. This research found that there are two ways to accomplish this. First, it is possible to be used within a similar type of industry or business. This has been proven by three interviewees that their guidelines have already being used by other organisation within the same business. Second, it is possible with some modifications to suit their environment. Meanwhile, two interviewees have opposed this idea, attesting that their guidelines are not suitable to be used by others, even by an entity within the same parent organisation. This is because the other entity may operate on a different process with varying liabilities; hence there are always restrictions to adopt a particular guideline.

8.3.3.5 Industry-specific standards and guidelines

There were concerns by the interviewees about the possibility of having industry-specific standards and guidelines. Besides reducing the level of thought, the industry standard is going be very basic because it is an amalgam of all the other standards, which are made applicable for a broader audience. Each industry and organisation is formed on a different platform and with different objectives, which requires different management methods as well as interpreting the standards differently. Standards are generally for guidance and not mandatory. However, the research found that an industry-specific standard is possible provided that there is an immense effort to ensure that it will work. Additionally, there is a need for a regulatory body or an institution to lead this.

8.3.4 Comparisons of Standards, Guidelines or Frameworks Adopted

There are similarities in terms usage of the standards, guidelines or frameworks by the organisations. The same documents are applicable for risk management, project management, governance processes, or a combination of them. This indicates that their documents are non-specific and contain common procedures or processes that can include other functions.

Interviewee	RM Standards/ Guidelines Mentioned	RM Standards/ Guidelines Used	PM Standards/ Guidelines Used	Governance Standards/ Guidelines	Similarity
001	N/A	GRIP	PM Manual, GRIP	N/A	RM & PM- GRIP
004	N/A	GFORM, Balance Scorecard	Balance Scorecard	GFORM, PDF; Risk Report	RM & PM- Balance Scorecard RM & Gov- GFORM
005	COSO; OGC MoR; ISO	Gateways (OGC Style)	PM Manual, OGC	Project Progress	RM & PM- OGC, PM & Gov- Own documents
006	IRM/ALARM; APM-PRAM	N/A	APM	N/A	N/A
007	ISO	CMS Systems (Management Systems)	Quality Plan, Management Systems, PM Manual	N/A	RM & PM- Management Systems
009	OGC MoR	LCM	APM, PMI, LCM, PM Manual	Operational Framework; Project Progress; Contract Status	RM & PM- LCM
010	N/A	N/A	Gateways	Control Mechanism	PM & Gov- Own documents
011	IRM/ALARM; APM-PRAM; PRINCE2; PMI	N/A	APM, PRINCE 2, PM Manual	N/A	N/A
012	AS/NZS4360; APM-PRAM; BS31100; ICE-RAMP; OGC MoR; ISO	N/A	APM, OGC,	N/A	N/A
013	N/A	Company RM	PM Manual	N/A	RM & PM- Own documents
014	COSO; ISACA; ISO	RM Statement	Gateways	Controlled Framework; Risk Report	RM, PM & Gov- Own documents
015	AS/NZS4360; BS31100; HM Treasury; OGC MoR; ISO	RM Manual	OGC, PRINCE 2,	Risk Report; HR; Finance; Operational Analysis; Contract Status	N/A
016	ISO	Risk-6	Gateways (or PM Framework)	Risk Report; Compliance; Test Analysis; Contract Status	RM, PM & Gov- Own documents
017	N/A	Risk Strategy Plan	N/A	N/A	N/A
018	ISO	N/A	Six Sigma, Lean 21, Management Systems	N/A	N/A
019	APM-PRAM	N/A	APM	N/A	N/A
020	APM-PRAM; PRINCE2; PMI; ISO	Risk & Opportunity Management	PRINCE 2, LCM, PM Manual	N/A	RM & PM- Own documents
021	N/A	Management Systems	Management Systems	N/A	RM & PM- Management Systems
022	N/A	PM @ Company	PM Manual	Controlled Framework; Project Progress; Finance	RM, PM & Gov- Own documents
023	PMI	RM Procedure	PMI, Management Systems	Project Progress	RM & PM- Own documents
024	N/A	N/A	Management Systems	N/A	N/A
025	PMI	Company PRM Method	PMI, PM Manual	Project Policy	RM, PM & Gov- Own documents
026	AS/NZS4360; IRM/ALARM; BS31100; OGC MoR	GQP/ LOP	APM, Management Systems	GQP/LOP	RM & Gov- GQP/LOP

Table 8.9: Comparison of standards, guidelines and frameworks used

8.3.5 The Practice of Risk Management

The practice of risk management varies between organisations but generally includes the following:

a) Risk management process is adopted anywhere within the project life cycle.

b) Every project must have a risk register; a live document that reports the status of risks and is reviewed regularly.

c) Workshops are the regular method to conduct risk management but not a mandatory because risk management is an ongoing process.

8.3.6 Risk Management Workshops

The research found that workshops are normally conducted by the organisations and may or may not include a pre-workshop session. Pre-workshop is conducted to get to know the basic information regarding the project prior to the actual workshop. A workshop is conducted to review the current situation and to present the status of information. There might be a series of workshops conducted separately and sub-workshops for certain work-streams. The duration largely depends on the complexity of the project and ranges from one hour to one day, facilitated by internal or external experts. Figure 8.9 shows the information on workshop which is developed based on the data.

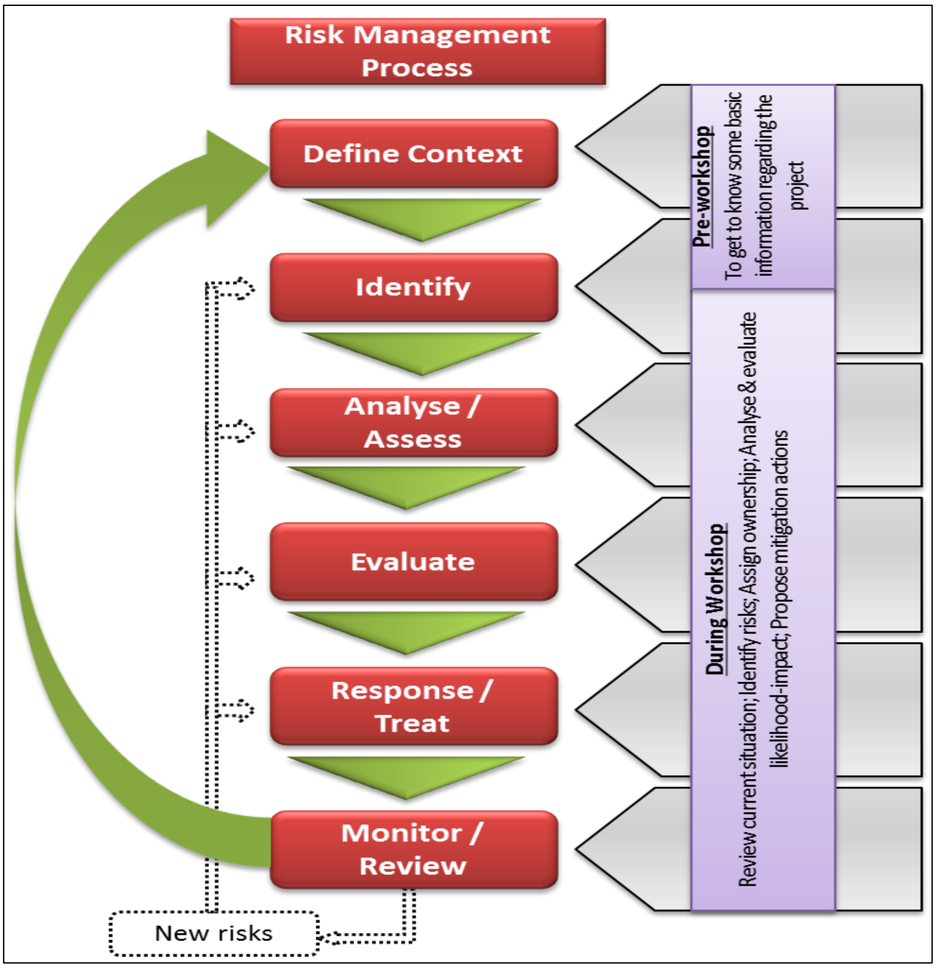


Figure 8.9: The risk management process – Risk management workshop

8.3.7 Software and Tools for Risk Management

Seven types of computer software and tools, generally known as computer programs, were found to be used at present by various organisations, namely, @Risk, Active Risk Management (ARM), Monte Carlo Simulation, Microsoft (MS) Excel, Pert master, Predict, and Primavera. Additionally, other computer programs have also been developed by the organisations for internal use. At present, Microsoft Excel is the most popular and commonly used tool albeit the existence of other computer programs specifically developed for risk management and project management.

8.3.7.1 Software and tools as an enabler for information processing and decision making

Although the use of a computer program for risk management is common, the interviewees indicated that it is used mainly to support the process. A computer program is just an aid for information processing and decision making. However, to some extent, it does not help the risk management process because the decision depends on the behaviour of those of make decisions. Among factors that contributed to the decision making are stable attitude towards risk and choosing the best alternative (Shapira, 1995), a given probabilities to analyse risks (Ramsey, 1926) and known utilities (Bernstein, 1998). The research also found the following shortcomings of using a computer program.

a) Certain organisations have been successfully managing and delivering projects without it, and, to some extent; it does not help the risk management process.

b) Computer programs are not part of the risk philosophy and do not add value.

c) Internally developed computer programs are not user friendly as they do not use the Windows operating system.

d) Certain computer programs hardly report risks and are not used as a management tool.

e) It is not the number or the tools that is important but the application of the results and how people decide out of it.

f) It is the understanding of risk, and the exposure that is important. The computer should not drive the process.

g) Focusing on the sophistication and running simulations and analyses is found to be a different philosophy; engaging with figures and losing contact with reality.

8.3.8 Surprises from Risk Management

Primarily, the results of risk management are found to be positive. However, there are also surprises encountered from the risk management activities and are listed below.

a) Unforeseen events emerged during or upon completion of the projects. These were termed as ‘new things’ or ‘new risks’, which had not been forecasted.

b) Lack of experience, knowledge and information contributed to the surprises. This happens when appropriate measures are not taken as part of a risk management process. Additionally, inaccurate information and unavoidable issues also contributed to such surprises. Although equipped with knowledge and information, it is hardly possible to correctly forecast future events.

c) Risk itself was also found to contribute to the surprises. Risks, which are not captured anywhere, might suddenly emerge.

As discussed in Chapter 6, these surprises are human related, due to the lack of information which leads to the problems in decision making. Thus, this has resulted in poor decisions being made and not all risks are forecasted and managed. The decision maker may overstate the amount of information on hand due to limited knowledge of what the future lies, consistent with Arrow (1951) and Bernstein (1998). These surprises are also associated with uncertainties and can be managed the same way as risk.

8.3.9 Practices to be Improved

Improvements are needed for the risk management process, the culture and knowledge, and also on the technical aspects such as budgeting, auditing and opportunity management.

8.3.9.1 Risk management process

Generally, improvements are needed in the identification, analysis/ assessment, and monitoring stages.

a) Identification

There is a need to improve risk description and understanding of risk to make sure that risk is identified and described correctly. The use of a risk register has become complicated, and software for a database is welcomed.

b) Analysis and assessment

The scoring sheets and analysis software need to be more user-friendly. It is also important to focus on the scheduled impact of risk rather than the financial impact.

c) Monitoring

Performance monitoring is very important for a better visual understanding of the project and needs to be looked into. The quality of presentation of the risk report also needs some improvement, particularly for the top management.

8.3.9.2 Culture, education and training, understanding, experience

This research also found that improvements are needed on the following aspects:

a) Culture

There is a need to change people's attitude and thinking towards risk management appreciation by introducing behavioural component (reward), transparent in managing risk, reminding people that there is a process, and identify experienced people who are aware about risk.

b) Education and training

People from the industry should be involved in the education and training, sharing their experience and knowledge.

c) Understanding

The people also need to be educated to understand risk and to improve the way of thinking that risk is part of project management rather than risk management.

d) Experience

The risk management process could be improved through experience, observation and learning from others.

8.3.9.3 Budgeting, risk and audit, opportunity management

The technical aspects such as budgeting, auditing and opportunity need to be improved as well.

a) Budgeting

Improvement is required on the forecasting especially the amount of money to be spent, the cost to manage risk and the contingency allowance.

b) Risk and audit

There is a need to improve the link between risk and audit and linking risk controls and governance to provide assurance for the project.

c) Opportunity management

People need to try to find opportunities in the tasks that can achieve savings and to make sure they are materialised, rather than looking only on the threat.

8.4 Findings on the Current Practices of the Risk Management Process

Objective 3: To develop a structure that explains the current understanding of risk, uncertainty, and opportunity concepts.

The third objective was achieved through qualitative data collection and analysis, adopting the semi-structured interviews methodology. Various organisations from different industries were contacted to participate in this research as discussed in Chapter 4. Twenty-six interviews were conducted with the managers in charge in the management of project risks from various sectors of the industries. This research adopts the semi-structured interview method with the use of an *aide-memoire* as guidance. As indicated in Chapter 4, the central phenomenon for this research is the understanding of the concepts of project risk and uncertainty. The collected data from the interviews were transcribed, coded using NVivo, analysed and presented for the discussion. The research discovered significant findings relating to the current understanding of risk, opportunity and uncertainty, of which the details are empirically presented and discussed next.

8.4.1 Findings on Risk, Uncertainty and Opportunity

The economists have been debating the concept of risk and uncertainty since the formal incorporation of the concept in the history of economic thought which was introduced by von Neumann and Morgenstern in 1944. Thereafter, the concept of risk and uncertainty have been very contentious, with two major groups of economists have disintegrate after this concept and tried to place their arguments in the EUT. This has made the process of defining the concept of risk and uncertainty difficult. Based on the analysis conducted in Chapter 5, the research findings relating to the understanding of risk, uncertainty and opportunity are discussed in the following sub-sections.

8.4.1.1 Definition of risk, uncertainty and opportunity

Definition of risk

The current understanding of risk is mixed and dependent on individual knowledge. This is analogous with Aven (2011a, 2012b) that there is no consensus exists on the definition of risk. Figure 8.10 shows the understanding of risk in practice. This research found that in practice, risk has been commonly viewed as threat and having negative impact. As discussed in Chapter 5 (Figure 5.1), nineteen (19) interviewees and twelve (12) documents broadly construed risk negatively. This is in conformity with Kahkonen (2006:212) that people associated risk with adverse outcomes. Additionally, the idea that risk has negative outcome is unavoidable and this has been highlighted by Aven (2004). Despite being negative, it is possible to have positive outcomes if risk and has been discussed within the EUT domain [see (Arrow, 1951, Aven, 2004, Marschak, 1950)]. However, according to March and Shapira (1987), people tend to be risk averse when dealing with risky alternatives due to its negative associations. This is proven with the lesser number of interviewees and documents which were found to associate risk with positive outcome compared to negative. Risk was also associated with uncertainty and this understanding was provided by eight (8) interviewees and fourteen (14) documents. This contradicts with the K-K proposition that risk and uncertainty is not similar. This shows that people's understanding of risk and uncertainty is not corresponding with the standards, frameworks and guidelines. Thus, this shows that not all information suggested in the documents are applicable and adopted in practice.

Based on the above understandings, the definition of risk can be formulated using the following information.

a) Risk is the future uncertainty.
b) Risk is the uncertainty of achieving objectives.
c) Risk is a threat to the achievement of strategic and business objectives.

d) Risk is the probability of something occurring, which has a negative impact.

e) Risk impacts on the achievement of the objectives.

f) Risk is a threat or opportunity that could occur in the life of a project.

g) Risk has two sides – positive or negative.

h) Risk is the chance of specific things happening.

i) Risk is the probability of the fault.

From these definitions, the research found that the main components in defining risk are future uncertainty; impact on the achievement of the objective; chance or probability of something happening and; a threat or opportunity. Therefore, it can be concluded that risk is:

> *"The future uncertainty, the probability of something happening, which might be a threat or opportunity and will have an impact upon the achievement of the objective"*

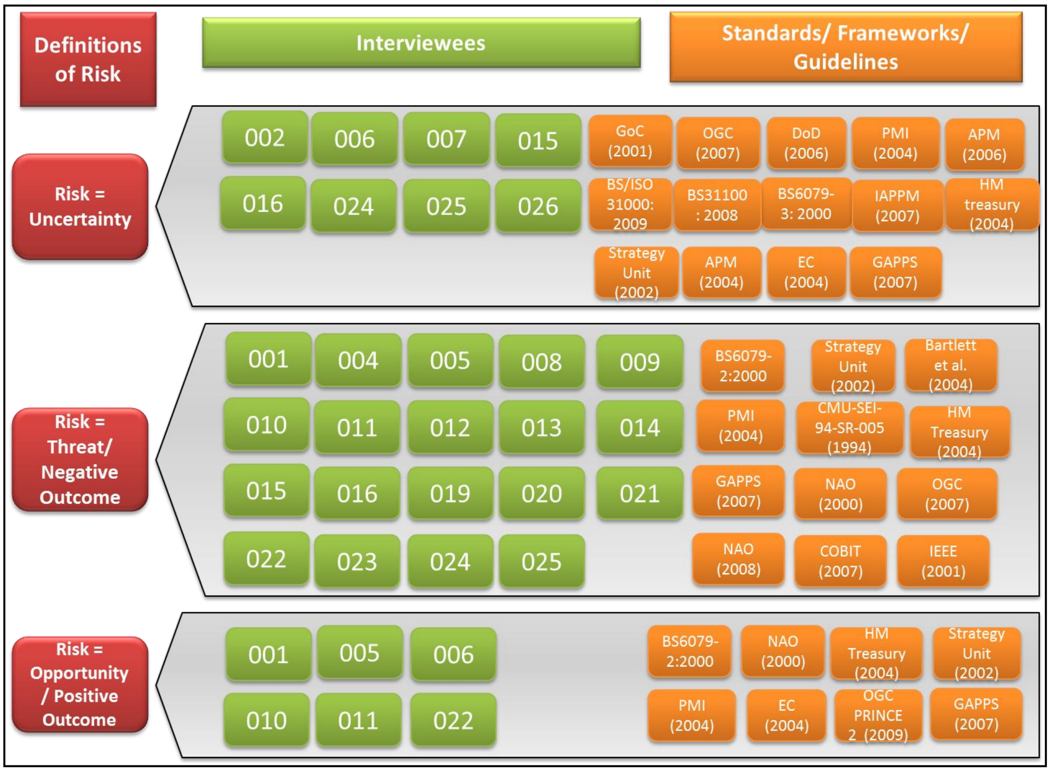


Figure 8.10: Definitions of risks in practice

Definition of uncertainty

Unlike risk, uncertainty has not been defined broadly by the interviewees and by most of the documents. Ten (10) interviewees and nine (9) documents have provided their understandings or definitions. Majority of the practitioners and documents have associated uncertainty with risk in many ways such as risk and uncertainty has their likelihood and impact and thus can be quantified; which is not parallel with the K-K proposition. This shows that the understanding of uncertainty is still deficient. Only three (3) interviewees clearly specified that uncertainty and risk are not similar and have different meanings. There are two distinct definitions of uncertainty found from this research. First, uncertainty is an unknown or uncertain event. Second, it is associated with the lack of knowledge. These definitions are very close to the K-K proposition. Another definition is that uncertainty is not quantifiable. This has been highlighted by Arrow (1951) that uncertainty does not involve mathematical probabilities, and, thus, it should not be confused as risk. Figure 8.11 shows the understanding of uncertainty in practice.

Based on the information gathered, the definition of uncertainty can be formulated as follows:

a) Uncertainty is an event that cannot be quantified.
b) Uncertainty is unknown.
c) Uncertainty is an uncertain event.
d) Uncertainty has potential upsides and downsides.
e) Uncertainty is the total range of potential impact.
f) Uncertainty is based on incomplete knowledge.

From these definitions, this research concludes that uncertainty is:

> *"An uncertain or unknown event with a total range of potential impact, which could not be quantified as a result of incomplete knowledge"*

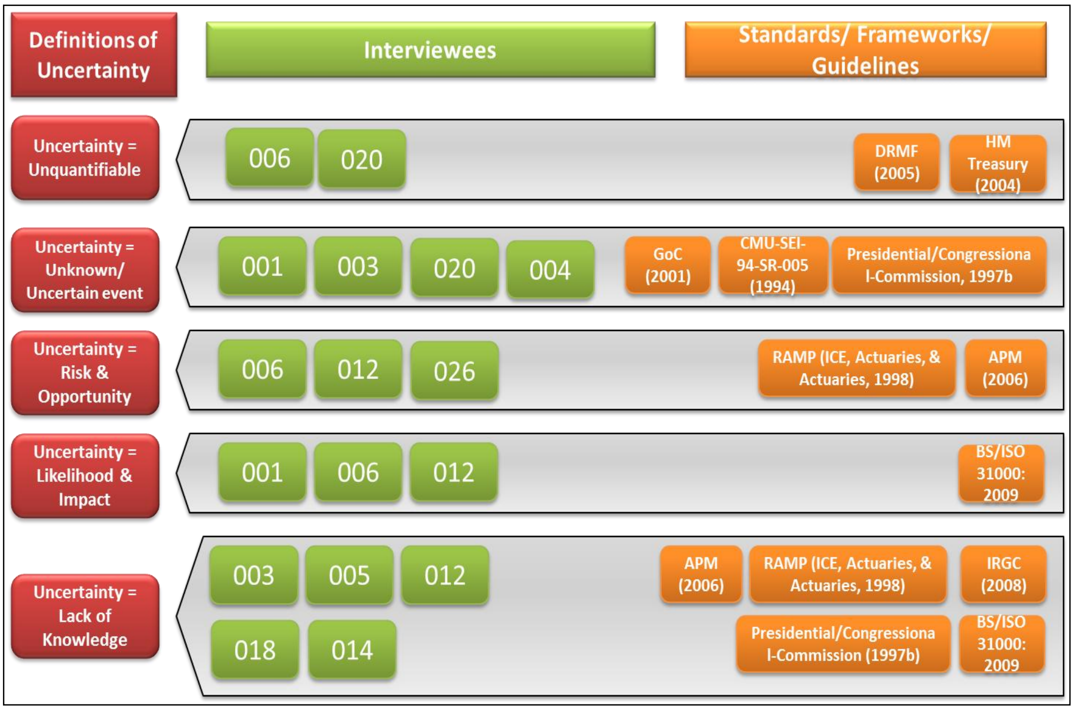


Figure 8.11: Definitions of uncertainty in practice

Definition of opportunity

The definition of opportunity was the least that was provided by the interviewees as well as the documents. This shows that people hardly go beyond the negative outcome of risk and explore the possibility of turning risk into profitable outcomes. In this situation, the decision makers should take the challenge to make risky decisions in their investment [see (Marschak, 1950)]. The research findings indicate that people understood opportunity as positive risk and it provides benefit. This is shown in Figure 8.12. Therefore, the definitions of opportunity can be formulated as follows:

a) Opportunity is a positive uncertainty that could occur.
b) Opportunity is something that provides a benefit if it materialises.
c) Opportunity is a positive risk or an upside risk.
d) Opportunity is the converse of risk.

It can be concluded that the definition of opportunity is:

> *"A positive uncertainty, the converse of risk or an upside of risk that could occur and provides a benefit if it materialises"*

The above definition provides two terminologies, “converse of risk” and “upside of risk” and these are discussed next.

Figure 8.12: Definitions of opportunity in practice

8.4.2 Current Understanding of the Concepts of Risk, Opportunity and Uncertainty

From the data, the research found that the risk-opportunity-uncertainty relationship does exist. Risk and opportunity are said to be uncertain; neither the risk will not always occur nor the opportunities will always materialise. In practice, there are views that uncertainty consists of risk and opportunity; if there is certainty, people would not have risk and opportunity. In addition, the research found that APM (2006:163) and COSO (2004) adopted the same notion. This relationship can be translated into a structure that contains three levels. Uncertainty is positioned on the higher level, while risk and opportunity lie beneath. Risk is the negative side or downside of uncertainty while an opportunity is the positive side or upside of uncertainty. Thus managing uncertainty can be described as managing down the risks and exploiting the opportunities. Therefore, the decision maker has to analyse the alternatives and make decision based on his judgement, which will result in either positive (opportunity) or negative (risk) outcomes [see (Shapira, 1995, Aven, 2004)]. The understanding of the relationship can be translated into a diagram for a better vision of how they relate to each other. Figure 8.13 suggests the level of risk-opportunity-uncertainty relationship, which is developed based on the interviewees' view and understanding, supported with the definitions provided in the standards and guidelines. This has been discussed in Chapter 5 (section 5.4.1). Potentially, uncertainty is a source of risk, and, an ill-defined risk is a source of uncertainty, which goes back to the problems in decision making, of which the decision maker may not behaving rationally. The level of understanding and information about a risk event is vital to manage uncertainty.

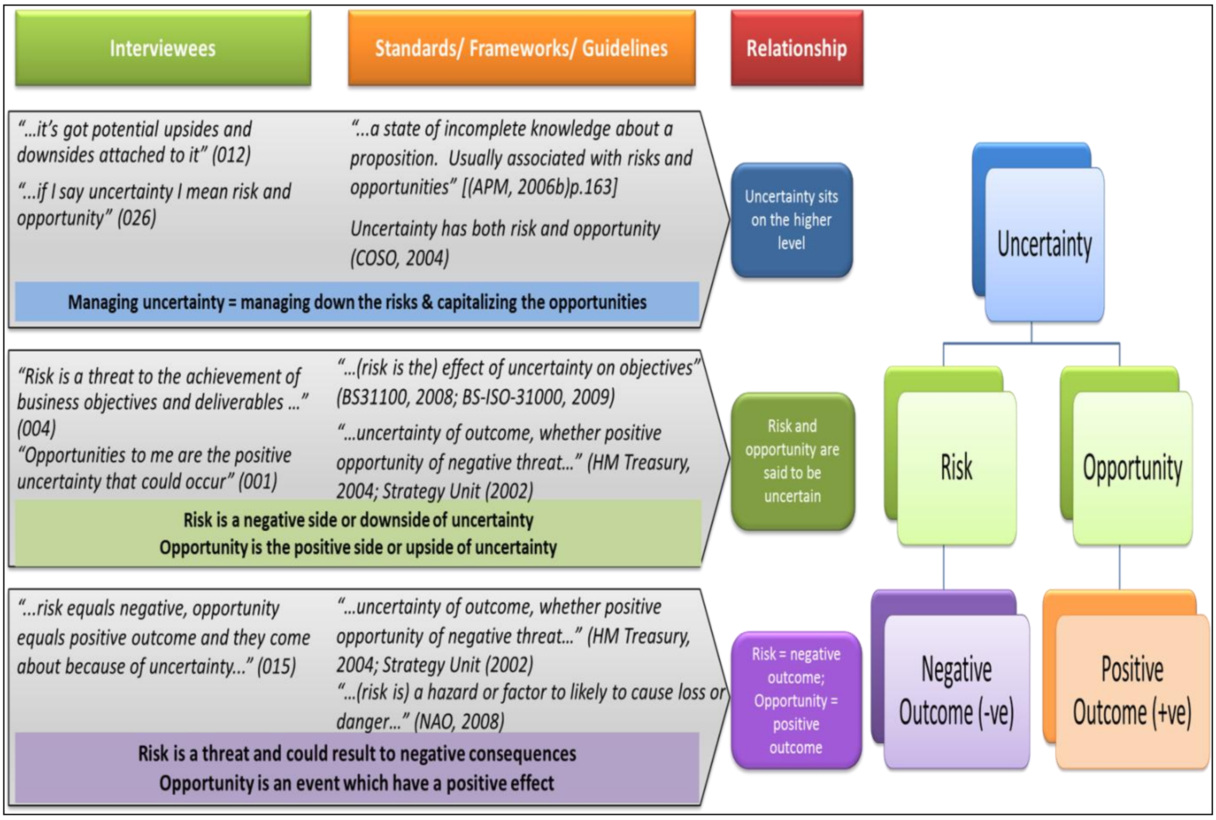


Figure 8.13: The risk-opportunity-uncertainty relationship: The two sides of uncertainty

Besides the above relationships, there is also the risk-opportunity relationship, which does exist and was highlighted by the interviewees. Opportunity does not emerge by itself but has to be exploited and capitalized. However, should it not materialise then there will be risk associated with it. This means that risk is being used as a basis to pursue an opportunity. The general understanding of risk implies that when people discuss about risk, they would include an opportunity as well. In this case, risk is seen to have two sides; threat and opportunity. By considering risk as a threat means that it is recognized as the downside and could impact negatively on the project or the business. Contrariwise, opportunity is also known as the upside of risk which could have a positive impact. These relationships have been discussed in Chapter 5 and are further refined in Figure 8.14 below.

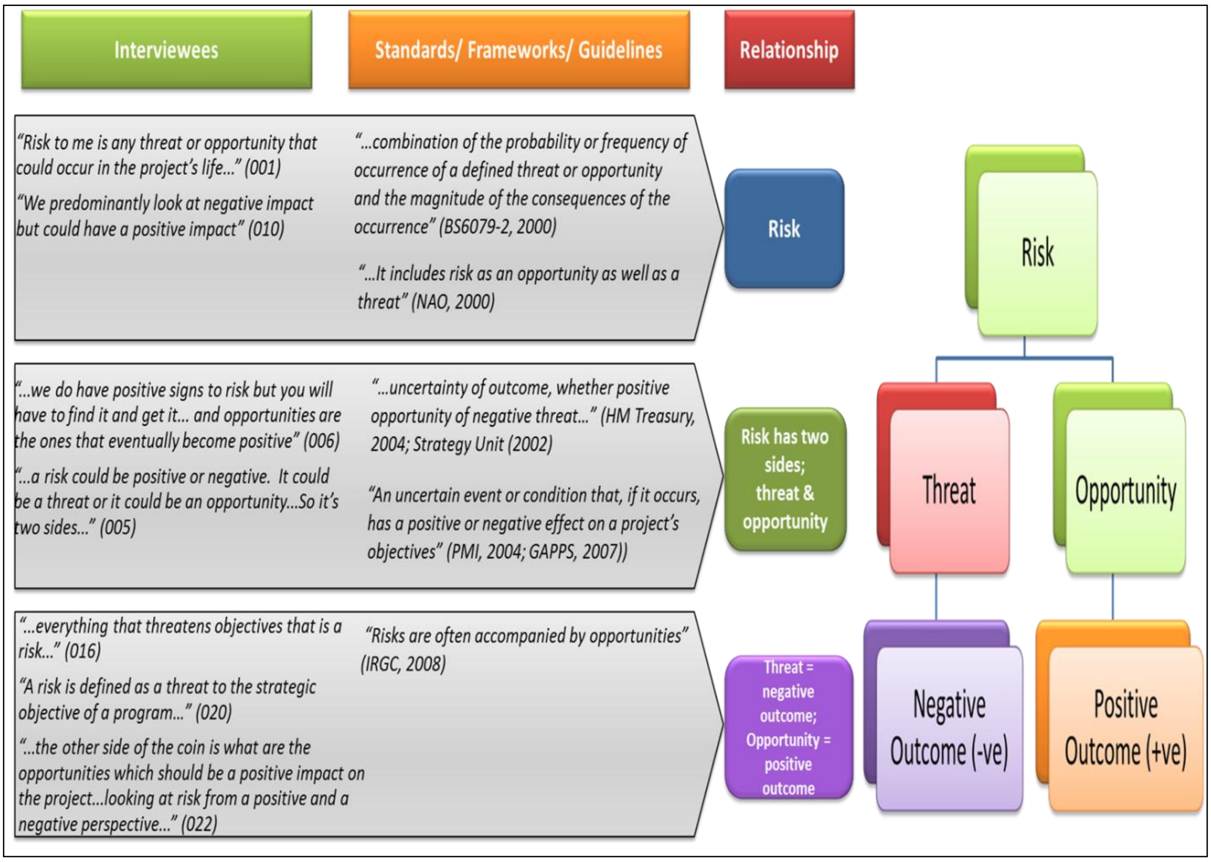


Figure 8.14: The risk-opportunity relationship: The two sides of risk

By integrating the relationship diagrams from Figure 8.13 and Figure 8.14, opportunity is found to be a sub-set of uncertainty as well as risk. Therefore, the research suggests improved illustrations, developed from the combination of the understanding of risk, opportunity and uncertainty. Figure 8.15 and Figure 8.16 exhibit the results of the integration.

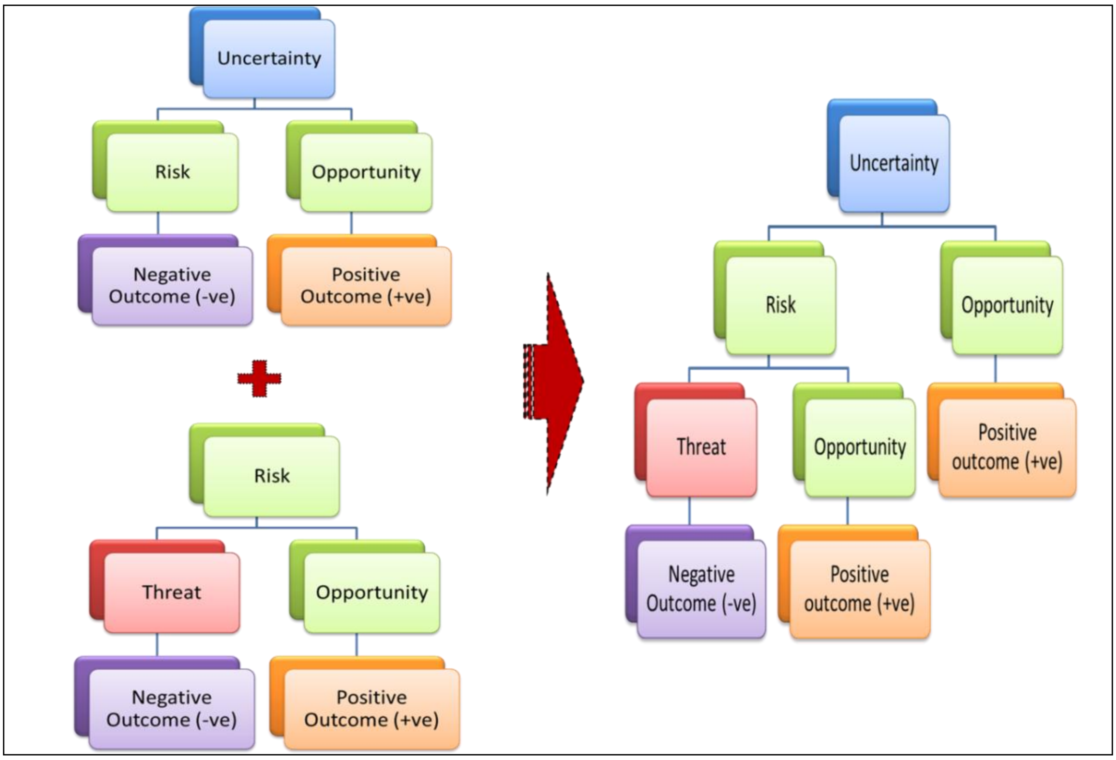


Figure 8.15: The combined relationships

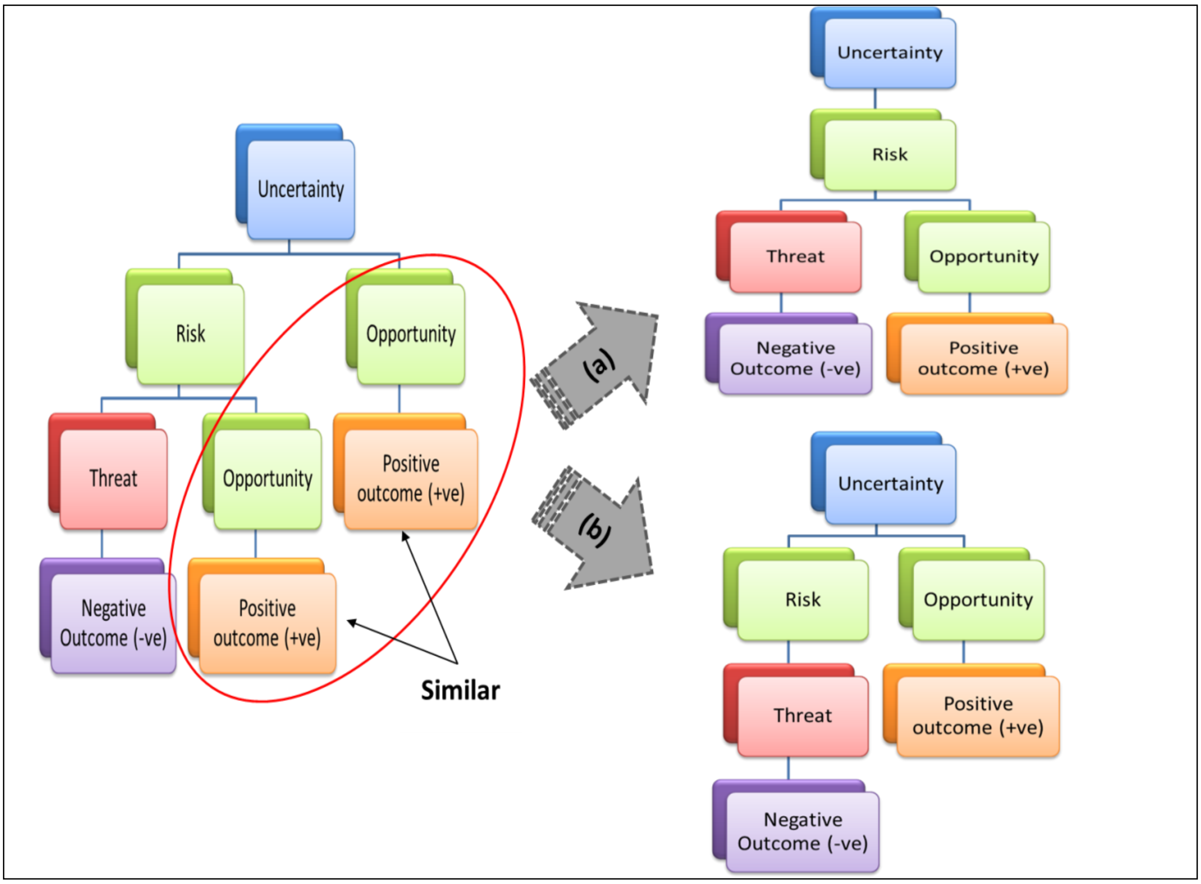


Figure 8.16: The improved relationships: (a) risk is sub-set of uncertainty and equals threat and opportunity; (b) risk and opportunity are sub-sets of uncertainty

The difference between (a) and (b) in Figure 8.16 concerns the understanding of opportunity. The first shows that opportunity is understood as an upside of risk, which results in positive outcomes whereas a threat is the downside of risk and results in negative outcomes. The latter reveals that uncertainty results not only in risk but also opportunity whereby risk is the downside and opportunity is the upside. The similarity is that uncertainty sits on the highest level in both diagrams.

Based on the above discussions, the research discovered four significant findings relating to the understanding of the concepts of risk, opportunity and uncertainty, as follows:

a) Risk and uncertainty are synonymous and interrelated.

   Predominantly, the current understanding of the concepts of risk and uncertainty is that both are synonymous, contradicting with the K-K concepts. In practice, some interviewees viewed risk as uncertainty in achieving objectives. Risk and uncertainty are interrelated, and they happen as an outcome of each other's occurrence.

b) Uncertainty is positioned at the highest level of the hierarchy.

   In any situation, uncertainty is found to be on the top level of the hierarchy. The impact of uncertainty, should it occur, could be negative or positive.

c) Risk is a threat or downside and has a negative impact.

   Risk is viewed as threat and is found to have a negative impact. In both cases, risk is a subset of uncertainty.

d) Opportunity is understood differently; either an upside of risk or as a result of uncertainty.

   Currently, there are different understandings of opportunity. It could be either an upside of uncertainty, which is the converse of risk, or, an upside of a risk, which is a positive outcome of risk. However, it is clearly understood that opportunity leads to a positive outcome.

8.4.2.1 The three domains

There are three domains in the definitions, classified as uncertainty, opportunity (positive) and threat (negative). Besides known to have likelihood and impact, risk was defined as a future uncertainty; an uncertainty of achieving outcome; an opportunity; and a threat. Therefore, risk is similar or is associated to uncertainty and opportunity. The definitions of uncertainty were also found to have links, and this time with risk and opportunity. Uncertainty is an unknown event and happens due to lack of knowledge, thus it cannot be quantifiable. Additionally, uncertainty was also defined in terms of risk and opportunity. Meanwhile, opportunity has been defined as positive risk as well as positive uncertainty. These relationships have been discussed in detail in Chapter 5 (Section 5.4.1). Figure 8.17 illustrates the relationships of risk, opportunity, and uncertainty. This indicates that due to the confusions and lack of proper terminology, the practitioners are not in corresponding with K-K proposition, but tending to agree with the idea of Ramsey (1926), Marschak (1946, 1950), and Tintner (1941), that risk and uncertainty is similar. Meanwhile, Figure 8.18 suggests a different view of the relationships of these domains. It highlighted that uncertainty cannot be separated from risk and opportunity, and in fact, is similar. Essentially, the current practice is conflicting with the K-K concept of risk and uncertainty.

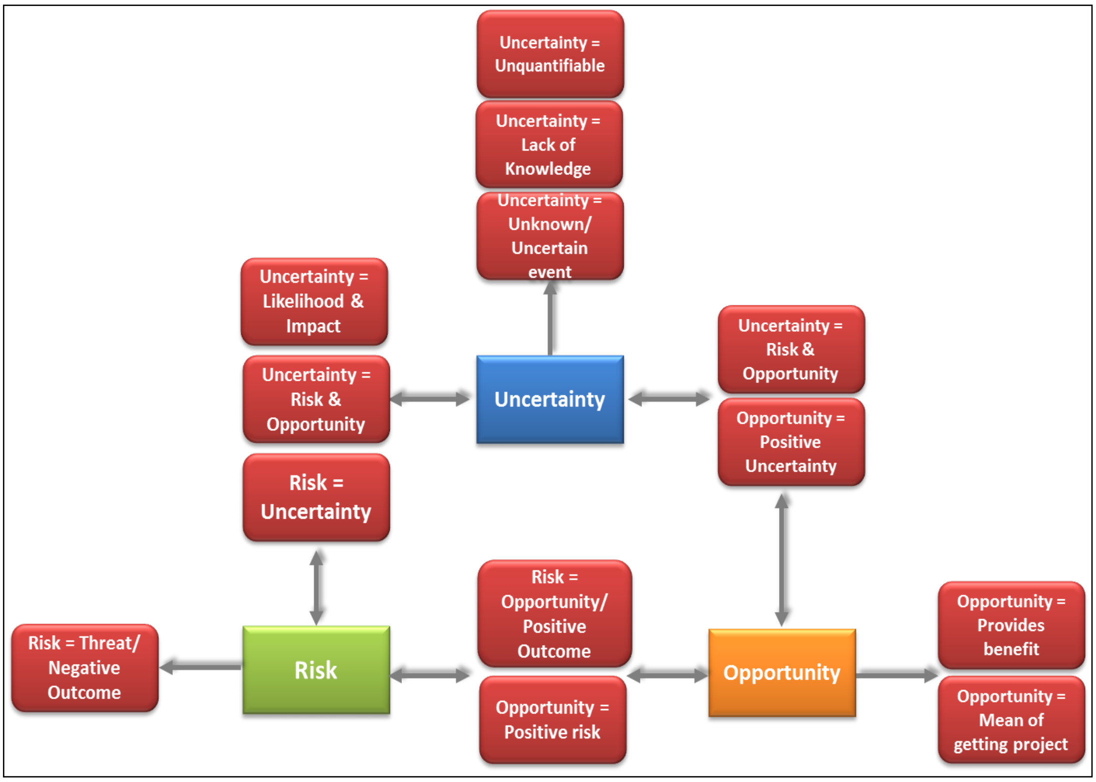


Figure 8.17: The 3 domains: Relationships of the definitions of risk, uncertainty and opportunity.

Figure 8.18: The 3 domains: Uncertainty, risk and opportunity.

8.4.3 Opportunity is Managed Together with Risk

From the analysis, the research found that opportunity is managed alongside with risk, either formally or informally, in a structured process is called risk and opportunity management [see (Hillson, 2002)]. Opportunity might be managed as early as the bid stage where risk is being considered, and at some point it might also be managed during the evaluation and mitigation steps of the risk management process. In these steps, there are registers for risks and opportunities, which are managed and evaluated simultaneously. In terms of monitoring and control, opportunity is reviewed regularly together with risk during the monthly meeting. In contrast, there are views and practices that isolate opportunity from risk. This is due to the different nature that they have; risk has been the major concern to the organisation, and people tend to observe negative or threat more than an opportunity. Furthermore, exploiting an opportunity would take extra effort to make sure that it is worth pursuing.

8.4.4 Knowledge and Understanding of Risk

The actual understanding of risk is found to be mixed and can be concluded as follows:

a) Understand and have the knowledge of risk.

   Those who understand risk are able to focus on the cause of risk and to differentiate between risk and issue, looking at risk as the downside and upside. Additionally, they are also found to understand the project objectives and the process of managing risk.

b) Did not understand and have a lack of knowledge on risk.

   Some still have inadequate knowledge to distinguish between risk and issues and relate risk to contingencies. There is a need to raise awareness on risk management before it becomes a culture. Therefore, education and training are the fundamental solutions to the understanding of risk and risk management.

8.5 The Process Framework of Project Risk Management

Objective 4: To formulate a generic framework for conducting risk management for industry use

The fourth or final objective was achieved based on the findings on the analysis discussed earlier whereby the structure of the current understanding is formulated as an outline process framework to conduct project risk management.

According to the data analysis, there were different views such that defining context or objectives should be the first step while others commenced with identification as their first step. The research proposes that these steps are combined in Stage 1, which consists of 1(a) defining context or objectives, and 1(b) identification. Similarly, there were also views that analysis, assessment and evaluation overlap. The research proposes combining these two steps into Stage 2 by which 2(a) is analysis or assessment, and 2(b) is evaluation. Stage 3 is risk response or treatment while Stage 4 is for monitoring and reviewing. The revised process is shown in Figure 8.19. This 4-stage process is similar to the mainstream conceptual steps discussed in Chapter 3. The idea is to make sure that it will be easily understood and accepted before being implemented in detail.

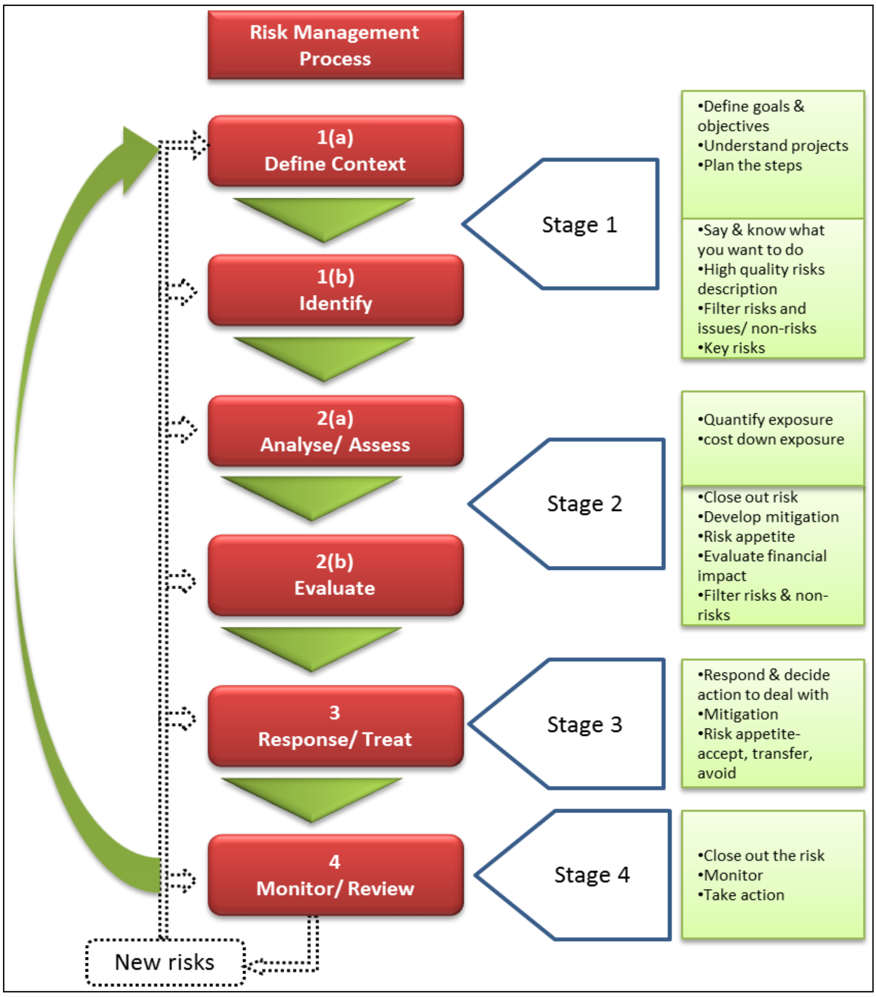


Figure 8.19: The proposed 4-stage process of a risk management process

Figure 8.20 shows a preliminary risk management plan, and process or framework developed based on the information derived from the analysed data in Chapter 6. It provides collective information concerning how to conduct risk management, which includes the tools and techniques to be adopted, methods to conduct, process description, as well as the potential output. The process can be explained as follows:

a) The process consists of four main stages, which has been proposed earlier.

b) There are six different steps which must be conducted upon completing the previous.

c) New or residual risks may emerge at any steps and not only upon completing the whole process. Therefore, they must be managed through the same process, starting from establishing/ defining the context. The process is presented using the green arrows.

d) Communication and consultation are vital in risk management. They must be conducted continuously at every step. This is presented using the dotted lines.

e) Step 1 (establish/define context) and Step 2 (identify) are usually conducted during pre-workshop session.

f) The process of establishing/ defining context helps the project team to understand the project better. The team will plan for the risk management process in detail including the methodology involve and further develop the success criteria i.e. the project triple constraint (time, cost, performance).

g) Risk identification involves the process of identifying key risks and filtering them from issues and non-risks. Risk must be described clearly using a high quality risk language. A risk register is created and will be maintained as live document for the project.

h) Next is the risk analysis/assessment. During this stage, the identified risks are analysed in terms their likelihood to occur and their consequences should they occur. This is conducted using the probability-impact matrix. It quantifies and costs down the exposure of the risks, estimates threats and opportunities, and prioritizes the risks accordingly. Assumption analysis and root-cause analysis are among common methods that can be used.

i) Evaluation process aimed to close out the risk, and, in doing so; various tasks have to be completed. Risks are evaluated in terms of their financial impact to the project. They are filtered and adjusted according to priorities and significances. Mitigation plans are also developed, to see whether the risks should be accepted, reduced, transferred to third party, or avoided. Risks are also assigned to specific owner, who will be responsible to make sure that actions are taken on the risks.

j) Once the risks are evaluated, the team need to decide on how to handle them and who is responsible for the action. There is a need to identify options to reduce the likelihood and consequences and to determine the potential benefits. The risk appetite at this stage is that all risks have to be moved, using the risk mitigation actions.

k) Risks that have been responded and treated using the mitigation action will be monitored and reviewed for tracking purposes. The main aim is to make sure that the risk is closed out. The process involves preparing the close-out report and presenting to the top management through periodical or scheduled management meetings. Residual risks may also emerge at this stage and they have to go through the same process. Experience and lessons learned are recorded for future projects.

l) There are various tools and techniques to be used in the risk management process. Tools are normally found to be software or models that are meant to support the process, but not to the extent of making decisions on project. Decision making involve judgement and human behaviour. Meanwhile, techniques can be in the form of activities such as brainstorming, workshop, and interview, involving the project parties or stakeholders.

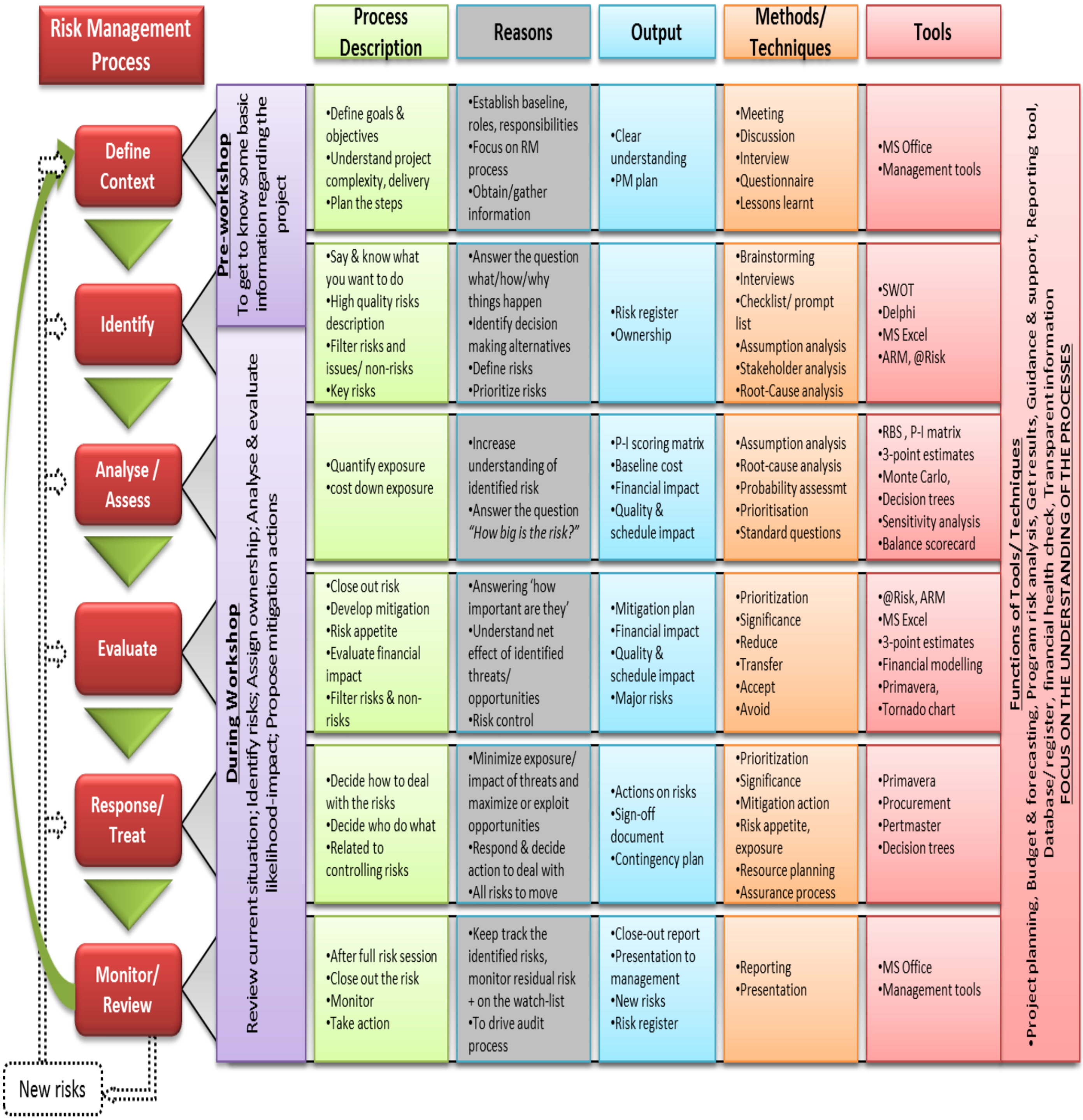


Figure 8.20: The risk management framework – comprehensive information

8.6 Summary

This research has successfully achieved all objectives set earlier. Fifteen existing PRM related processes were evaluated and the results are presented in a form of a comprehensive theoretical framework. Additionally, this research also proposes a new definition of risk management, empirically developed from the collective definition, both in theory and in practice. Meanwhile, the current understanding and practices of PRM is presented using another structured framework. Unlike the theoretical framework developed earlier which consists of eight steps, this practical framework contains six major steps. This six-step risk management process is developed based on the collective information provided by the practitioners. The research has taken into consideration factors such as governance and also the critiques and arguments of use of existing standards and guidelines.

There are mixed understandings on the concepts of risk, uncertainty and opportunity. The research developed its own empirical-based definitions of risk, uncertainty and opportunity, collected from the interview data as well as the existing documents reviewed. Aven (2011a, 2011b) has highlighted the non-existence of the consensus definition of risk. In practice, risk has been commonly viewed as threat, consistent with Kahkonen (2006) and Aven (2004). Although risk has also been associated with positive outcome within the EUT domain by Arrow (1951), Marschak (1950) and Aven (2004), majority of the practitioners are found to be risk averse. Besides that, risk was associated with uncertainty, contradicting with K-K proposition that risk and uncertainty is not similar.

Majority of the documents reviewed are lacking on clear information and understanding of the concept of uncertainty. Therefore, majority of the practitioners have associated uncertainty with risk, having the similar method to quantify. Thus, this is also contradicting with K-K’s concept of uncertainty. Nonetheless, there were also clear understandings of uncertainty, close to the K-K proposition such as associated with lack of knowledge, an uncertain event, and not quantifiable; similar as to the one highlighted by Arrow (1951).

Opportunity suffers the most in terms of knowledge, understanding as well as practice. This indicates that the practitioners have yet to move towards seeking the positive or profitable outcome of risk. Thus this is consistent with Marschak (1950) that the decision makers need to challenge themselves to make risky decisions in their investment and materialise the positive outcome.

This research also presents the practical understanding regarding the risk-uncertainty-opportunity relationship, which is called the three domains. There are two sides of uncertainty, namely, risk and opportunity. The similar relationship was found in APM (2006) and COSO (2004). This is also consistent with Shapira (1995) and Aven (2004). Besides that, there are also two sides of risk, which are threat and opportunity. Risk is used as the basis to pursue opportunity as the positive outcome rather than threat only.

The concept of three domains is derived from four significant findings of this research. Practically, opportunity is understood to be an upside of both risk and uncertainty, whereas risk and uncertainty are understood to be synonymous. The lack of proper terminology and understanding of risk and uncertainty concepts have led to such confusions, hence be inconsistent with the K-K propositions. Therefore, the practitioners are tending to be in agreement with Ramsay (1926), Marschak (1946, 1950), as well as Tintner (1941).

The formulation of a hypothetical process framework of PRM is in respond to the practitioners' views, understanding and information as well as the evaluation of the existing documents relating to risk management. This conceptual framework is a comprehensive one, contains six major steps together with supportive information to assist the process successfully. Besides recommending the use of workshop to conduct PRM, the framework provides extensive details for each step including the reasons for conducting the steps, the process descriptions, methods, tools and techniques, and also the expected outcome of the steps.

CHAPTER 9

CONCLUSIONS AND RECCOMMENDATIONS

9.1 Introduction

The overriding purpose of this research was to formulate a framework for project risk management by evaluating the current understanding and practices. To accomplish this goal, it became necessary for the research to reach an understanding about the concepts and fundamental issues of risk and uncertainty management. It was only upon the achievement of these fundamental understandings that the research was able to go forward. This research also sought to know how organisations in different industries manage risks and uncertainties for their projects. Additionally, it focused on the critical investigation on the current project risk management process adopted by the organisations. The development of the framework was preceded by well-organized investigation of available risk management processes, combined with the current understanding and practices by the participating organisations. This has resulted in several conclusions which are discussed next.

9.2 Summary of findings

This research was confined to the study of the understanding and practices of PRM by established or influential organisations in aerospace and aviation, oil, gas and petrochemical, power, telecommunication as well as construction industries with matching criteria as listed in Chapter 1, Section 1.7.2. This research addresses the gap by providing empirical insight into the current understandings and practices of risk and uncertainty management against the research questions set earlier. It may be generally concluded that the primary goal of this research has been achieved based on the successful formulation of the framework enabling a systematic approach and usable tool for managing project risks. The research questions are addressed as follows.

9.2.1 How do organisations manage risks and uncertainty for their projects?

This research found fundamental difference in the understandings of the concept of risk and uncertainty which was discussed verbosely in Chapter 2. The differing understandings of the concepts are held by individuals largely related to their experience with projects. This research recognizes the existence of the different understandings of these concepts as it explains how contradictory interpretations of events may emerge from the risk managers or project managers. Such a lack of clear understanding allows for misinterpretations of these concepts, resulted from different levels of development and practise of risk management. The finding of this research is consistent with Aven and Renn [see (Aven, 2004, Aven and Renn, 2009, Aven et al., 2011, Aven, 2012, Renn, 2004, Renn, 2008, Renn et al., 2011)] that the concept of risk is understood in different ways, interpreted from various perspectives and relied partly on erroneous judgements and simple lack of knowledge. This has been discussed in Chapter 2, Section 2.3. Apparently, projects are also people-centred, involving personal experiences and practices that triggered the future shaping and the growth of project management. Section 3.2.3 of Chapter 3 clearly pointed out that it is the practitioners who shared their pasts and future thinking that contributed to the rich context of what we have at present. Thus this research has discovered a variety of definitions of project, project management, risk, risk management as well as uncertainty. It is therefore important to recognize the existence of different understandings of the concept of risk and uncertainty as it explains how people interpreted the concept and responded to their project issues.

The theoretical literatures were found to have tendency to focus on managing risks rather than managing uncertainty. However, this does not mean that literature on managing uncertainty is not available. Section 2.4 of Chapter 2 expounded three main sources of information that contributed to the theory and practices of risk and uncertainty concepts in the area of project management. They are the PRM team (Chapman and Ward), the INSEAD team, and the Risk Doctor (David Hillson). Their approaches to PRM were found to embrace the theories related to the people’s behaviour in decision making, derived from the key areas in the economic theory such as rationality, decision making, judgement under uncertainty and theory of games and behaviour.

The notions by Knight (1921), Keynes (1921), Arrow (1951) and Debreu (1971) that risk and uncertainty concepts are dissimilar was adopted in this research. Furthermore, the concept of risk and uncertainty by Knight and Keynes or K-K was chosen for this research due to their significant theoretical contributions. From the findings, it is apparent that the current understanding of risk and uncertainty contradicts with K-K proposition. Section 8.4.2 of Chapter 2 has highlighted that the practitioners viewed risk as an uncertainty in achieving objectives and they happen as outcome of each other's occurrence. Consequently, this research surfaced a relationship called the three domains, arising from a phenomenal analysis of the information provided by the individuals during the interview processes. Thematic analyses were used to compress and summarise the large amount of data into internally consistent understandings of risk and uncertainty. This has been presented diagrammatically in Figure 8.13 and Figure 8.14 of Chapter 8. Practically, risk and uncertainty are found to be interrelated whereby uncertainty sits on the highest level, and it consists of risk as its downside and opportunity as its upside. The impact of uncertainty could be negative or positive. Uncertainty cannot be separated with risk and opportunity and are managed together. Therefore, managing uncertainty is a process of managing down the risk and exploiting the opportunity.

9.2.2 How a project organisation conducts its project risk management process?

Given that there are various published standards, framework and guidelines relating to risk management, the practitioners and organisations were also found to adopt other processes. A typical cycle of a mainstream risk management process contains four steps: identification, assessment, response and, monitor and review. However, based on the review of literatures, the generic process is found to be composed of five steps: identification, analysis, evaluate, treatment and, monitor and control.

Fifteen published documents were reviewed in Chapter 3, particularly Section 3.4, to investigate their risk management steps. Upon examining the processes, this research concluded that there are eight steps involved. These processes have been tabulated in Table 8.1 and a summary of these processes were conceptualised and presented in Figure 8.5 of Chapter 8. The proposed framework incorporates their purposes and activities within, providing a better understanding of how risk can be managed. Findings from the analysis indicated that the risk management process actually involve six major steps: defining the context, identification, analysis and assessment, evaluation, response or treat, and monitoring and reviewing. It is a continuous process.

Although there can be several functions that are responsible to govern risk management, this research found out that risk management is primarily governed within the project management office (PMO), a management function responsible to advice and guide the project towards achieving the objectives successfully. As a dedicated project-driven function, PMO is liable to develop tools, techniques and processes to manage project risks. Issues relating to mechanisms of governance have been explained in Chapter 7 based on the findings. This has been further discussed in Chapter 8, Section 8.3.2. There are four mechanisms of governance practised by the organisations particularly relating to risk management: organisational framework process, milestones and stage gates, steering group, and audit process.

The usage of generic documents was driven by various reasons, depending on the organisations and individuals' knowledge. Due to certain limitations, these documents may not necessarily be implemented but manipulated to fit the organisations' specific needs and environment. Majority of the organisations have their own-developed risk management processes which were developed for a clear reason: lack of availability of existing documents, and used as a mechanism for governance. Therefore, the framework developed from this research could be used by the organisations to complement their existing approaches.

9.2.3 What are the techniques adopted by organisations to manage project uncertainty? How can these techniques be included and harmonised in existing risk management methods for projects?

Although there are literatures claiming to have discussed and explain the process of managing uncertainty such as PUMA, SHAMPU and PRM, this research concluded that there is still a lack of information relating to a clear process of uncertainty management. From the analysis, it is evident that the process was deemed to be similar with risk management, and to the extent that it is conducted as though it is a risk. This goes back to the understanding of the concept of risk and uncertainty discussed earlier. The methods to conduct and the process description are presented in Figure 8.6 and Figure 8.7 earlier in Chapter 8.

9.2.4 What are the tools adopted by organisations to manage project risk and uncertainty? What is the significance to the PRM process?

Section 3.4.6 of Chapter 3 pointed out that tools are commonly held as software products used to carry out the technique. Microsoft excel is the most popular tool in PRM. Besides that, other software and tools such as @Risk, Active Risk Management (ARM), Monte Carlo simulation and Predict are found to be commonly used by the organisations for PRM. However, this does not mean that software and tools did everything. They are used as supporting function and as an aid for information processing. Making decision is very significant to the PRM process and it requires understanding of the philosophy and the exposure of the risk, which software did not do.

9.3 Contributions of the research

This research contributes theoretically and practically to the risk management process, particularly in the area of project management.

9.3.1 Theoretical contributions

Primarily, the theoretical contributions are closely related to the body of knowledge especially in the understanding of the concept of risk and uncertainty. The theoretical contributions are reflected according to the findings, and methodologies adopted, which underpinned the interrelationships of the concept of risk and uncertainty.

a) Fundamental concepts of risk and uncertainty

   Through the review of the literature relating to the history of economic thought in Chapter 2, the research has highlighted the CEPA’s method by distinguishing the thinking and theories according to different schools of thought relating to the concepts of risk and uncertainty. The following are the outcomes of the review:

i) The concepts of risk and uncertainty were introduced and integrated into the economic theory by von Neumann and Morgenstern in 1944 and Savage in 1954. They were developed from the probability theory, utility theory, as well as the theory of games and behaviour which became the fundamental of risk aversion.

ii) The relationship between decision-making and human behaviour has been debated throughout the history of economic thought. As human, the decision makers are rational and understand their preferences with the objective of maximising the EU. This has been expanded and discussed by various scholars such as von Neumann and Morgenstern (1953), Savage (1954), Markowitz (1952a, 1952b), Kahneman and Tversky (1979) and Bernstein (1998).

iii) There are two main streams that divide the thinking and understanding of the concepts of risk and uncertainty. The first argued that risk and uncertainty are different. Among the theorists who distinguish these concepts are Knight (1921), Keynes (1921), Arrow (1951) and Debreu (1971). Knight and Keynes or K-K clearly stated that risk is subject to known probabilities and can be measured (Knight, 1921, Keynes, 1921a). Uncertainty occurs due to a limit of knowledge of which decisions are made based on intuition and judgement (Knight, 1921, Bernstein, 1998). Uncertainty cannot be calculated (Keynes, 1921b) as it does not involves mathematical probabilities (Arrow, 1951, Debreu, 1971) . On the other hand, the other group stressed that both are alike. Ramsey (1926), Marschak (1950) and Tintner (1941a, 1941b) argued that risk is a subjective probability and cannot be separated from pure preference over outcome whereby people do not act on numbers but on probable event. At the end of the day, both risk and uncertainty make clear profits.

b) Standards, frameworks and guidelines related to PRM.

Various standards, frameworks, and guidelines relating to project management, risk management as well as project risk management have been reviewed, and the outcomes are as follows:

i) This research introduces various new definitions that were empirically-developed from the review of literatures. These definitions have taken into account important keywords that have significant contributions for the enhancement of the understanding and practice of project risk management. It is hoped that these definitions will intensify the current understanding and knowledge on the subject.

Definition of project

Project is defined as *"a unique temporary endeavour that consists of coordinated and controlled activities with predetermined start and end point undertaken to create unique deliverables and values"*.

Definition of project management

Section 3.2.3 of Chapter 3 offers a contemporary definition of project management: "*a defined or structured process that organizes, manages, or delegates the activities of planning, monitoring, controlling, delivering, motivating, reporting, and reviewing required in achieving project objectives, missions, and goals. It involves the application of relevant knowledge, skills, tools, and techniques by the project team*".

Definition of risk management

Risk management is a continuous process of making decisions. It involves the process of identifying, analysing, evaluating, treating, monitoring and reviewing the risks. Risk management is defined as *"a systematic, structured, coordinated, disciplined, directed or controlled process involving the sub-processes of identifying, analysing, evaluating, treating, monitoring or tracking, and reviewing the risks."*

Definition of uncertainty

The definition of uncertainty has been given a limited attention by the documents reviewed. Uncertainty is defined as "*the deficiency, incomplete,* *vagueness, ambiguity, insecurity, variability and lack of clarity of information, knowledge, values, or data".*

ii) Bodies of knowledge (BoKs) and competency standards are developed in response to the need for common terminology and practices in project management. This has been discussed in Chapter 3, Section 3.2.4. It is the professional bodies who call for the certification in project management to fulfil its primary function: facilitating the exchange of information and promoting the profession.

iii) In Section 5.4, this research apparently found out that there is no streamlining in the definition of risk provided by the standards, frameworks, and guidelines. At one point, risk is defined as a probability or likelihood of an event to occur, which is consistent with the K-K proposition. However, at another point, risk is defined as an uncertainty, which contradicts the K-K proposition. Therefore, the research discovered that these definitions provide links or relationships with each other. Evidently, the risk-uncertainty-opportunity relationship does exist and is currently being understood by the practitioners.

iv) From the documents reviewed, uncertainty was found to be affiliated to risk in the sense that risk results from uncertainty, and they can be quantified. They have negative and positive aspects. Risk is also affiliated to opportunity. Thus, risk can be said to have three domains: uncertainty, opportunity (positive) and threat (negative). The relationships between risk and uncertainty were deliberately discussed in Chapter 5, Sections 5.2 and 5.4. Therefore, it is evident that the practitioners' understanding of risk and uncertainty concepts differs from the K-K proposition.

v) Based on the empirical evidences and findings presented in Section 3.4.5 of Chapter 3, the process of managing risks consist of eight conceptual steps, namely, establish the context, identify, assess, analyse, evaluate, response or treat, monitor or review, communicate or consult. However, the analysis and assessment processes overlapped with each other and are considered as one step. Communicate and consult should be conducted continuously, at each step. Additionally, the steps can be further grouped into four stages, namely, stage 1 (establish context & identify), stage 2 (analyse/assess &

evaluate), stage 3 (response/treat), and stage 4 (monitor/review). This will help the practitioners to have a better understanding of the processes.

c) Qualitative study – interview methodology

This research has contributed to the qualitative stream of research, drawing on the rich qualitative data. The research has been conducted through semi-structured interviews and has generated empirical evident understanding and practice of PRM. Section 4.3.2 of Chapter 4 of this research has highlighted that although there were previous researches in PRM that adopts semi-structured interviews within a single setting or organisations [see (Greene, 2002, Baccarini et al., 2004, Kutsch and Hall, 2009)], none of these researches investigated and compared the practice in multiple settings. By doing so, the research has contributed significantly to the small but growing body of empirical literature in PRM research.

9.3.2 Practical contributions

The research has demonstrated practical contributions to the applied research, which underpins the issues relating to the concept of risk and uncertainty, largely in the area of project management. The practical contributions are:

a) This research provides an insight to the industries concerning the availability of various documents that can be used in managing project risks.

b) The conceptual process of managing project risks formulated from the data collection and findings of the research can be used as a generic framework for all industries. This framework has been presented in Figure 8.20 of Chapter 8. It is refined in a robust way to aid the understanding of the whole process. It consists of six steps with detail explanations as well as a range of tools, techniques, methods, process description, and also output of the activities. It is also appears relevant across industries and organisations are encouraged to adopt this framework as it offers comprehensive information on how PRM can be implemented.

c) The current understanding of risk and uncertainty contradicts with K-K proposition. Practically, risk and uncertainty are predominantly synonymous and they happen as an outcome of each other's occurrence. Evidently, this research identified such relationships as the three domains, which has been presented diagrammatically in Figure 8.13 and Figure 8.14 of Chapter 8. These findings are very crucial and may lead to the change in the way we understand and practice risk and uncertainty management. The lack of clear understanding has led to the misinterpretation of these concepts, resulted from the different levels of development and practice of risk management in the industry. The findings from the phenomenal analysis of interviews' information conformed to the issues highlighted by Aven and Renn (Aven, 2004, 2012; Aven & Renn, 2009; Aven, Renn, & Rosa, 2011; Renn, 2004, 2008; Renn, Klinke, & van Asselt, 2011); that they are understood in different way, interpreted from various perspectives and also relied on erroneous judgement. Consequently, such understanding is brought into the industry through personal experiences and practices thus influenced the thinking and growth of the concept as to what we have at present. Literally, the imbalanced focus on managing risk as compared to managing uncertainty found from the various approaches has also triggered the shaping of the context in practice. As risk and uncertainty are said to be similar, it is therefore possible that they can be managed using a single but comprehensive process.

d) In Section 6.3 of Chapter 6, this research discovered that risk management is not a standalone function. Instead, it is part of other functions, largely the project management office (PMO). PMO provides advice and guidance to projects and to make sure that projects are consistent with the organisation's project management framework and manual. Section 7.2.1.1 discovered several overlapping tasks within the PMO: project managers assuming the tasks of risk managers although not all project managers have knowledge concerning how to manage the risks. Therefore, such practices need to be changed and improved by the practitioners so that the PMO will work efficiently and effectively for the projects.

e) Most of the published standards, frameworks, and guidelines reviewed in Section 3.4.4 are not mandatory to be used. They should be used as best practices or as advisory documents and guidance only. Additionally, they do not provide specific tools to manage and do not explain how an organisation should manage the process. There is no single framework that organisations can use and the choice of risk management framework varies according to the need. However, this research stresses that the implementation of its proposed empirical-based framework should be encouraged to foster sound project risk management practices through better informed decision-making as it can be tailored to fit different environment. Additionally, the framework also serves as a basis for establishing good governance and internal controls that will ensure risk is managed systematically. An immense effort to ensure that it will work and a regulatory body that can lead this are most needed for its successful implementation.

9.4 Limitations of the research

The broad scope of the topic has led to the research being conducted with the following limitations:

a) The research covers various industries, but it is limited to the organisations that produce clear engineered products; or have design, engineering and construction processes; or have project management and/or risk management in place.

b) The selected organisations are currently based in the UK or other EU organisations undertaking project arrangements in the UK. Thus, the findings of the research should be interpreted for the current management of project risks in the UK.

c) Time constraints have resulted in a limited number of organisations being willing to participate in this research. Additionally, organisations' resilience to participate in this research has resulted in the limited information despite a large number of requests.

d) The interviewees were representing the organisations, and they are the managers involved in the management of projects and management of risks.

e) The proposed project risk management process framework was developed based on the findings of the research. However, due to the time limitations, the framework has yet to be tested externally.

9.5 Recommendations for future research

This research provides a framework for managing risk for projects, which can be adopted by organisations in various industries. The proposed framework attempts to establish a creative approach to PRM. At the same time, this framework presented a practical and usable tools, techniques and methods to manage project risk in assisting the responsible managers to make decisions.

This framework provides a basis for future evolution of the PRM process. Besides that, it is generic framework and will be able to be tailored and fit to the needs and environment of the project organisations. The proposed framework provides a roadmap of the understanding of risk and uncertainty concepts, particularly in the area of project management.

The work carried out in this PhD thesis has identified a number of areas that can be the subject for further research:

- Since this framework has not been tested, it is recommended that future studies to be conducted on the application of the risk management framework formulated by this research as best practice for project related organisations limited to the specified industries mentioned earlier in chapter 1 of this thesis.

- An extension is recommended to this framework. Therefore, a future research should include a development of the process flow for this framework.

- Upon the successful application, this framework should then be extended into other industries. Each industry is to be treated separately in order to compare the outcome from the usage of the framework.

- This research was conducted in the UK. It is recommended that the research to be extended to other countries in the European Continent. Therefore, we can compare the difference practise of PRM between countries.

- Another possible research in the future should be conducted to investigate and compare the PRM processes between continents, including their lessons learned.

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APPENDIX A:
INTERVIEW QUESTIONS

RESEARCH ON PROJECT RISK MANAGEMENT

Interview Questions / Aide Me Moirés

Saipol Bari Abd Karim
PhD Candidate
Manchester Business School
University of Manchester

SECTION A: PROJECT MANAGEMENT

1. **Could you please describe how project management is practiced in your organisation?**
   a) **PMO**
   b) **Process Standardised**
   c) **Governance and accountability**

SECTION B: RISK MANAGEMENT & RISK MANAGEMENT FUNCTION

2. **How do you define risk?**
3. **How do you define uncertainty?**
4. **Can you please describe the risk management function in your organisation**

SECTION C: RISK MANAGEMENT PROCESS

5. **Can you please explain the processes of managing risk adopted in your organisation?**

SECTION D: OPPORTUNITY MANAGEMENT

6. **How do you define opportunity management?**
7. **How do you manage opportunity?**

SECTION E: VIEWS & COMMENTS ON THE RISK MANAGEMENT PROCESSES

8. **Based on your experience, how do you describe the results of risk management?**
9. **What is your opinion on the use of current guideline in your organisation in terms of suitability to projects, time and applicability to others?**
10. **If you have the opportunity, what changes or improvements would you suggest to your current guideline? Why?**
11. **How would you suggest of the guideline?**
12. **Do you think that it would be beneficial to your organisation to a standard guideline? Why?**
13. **Are there any other issues which you think ought to be addressed associated with project risk management process?**

APPENDIX B:
LETTER FOR ASSISTANCE

To Whom It May Concern:

PhD RESEARCH IN PROJECT RISK MANAGEMENT

Dear Sir/Madam,

My name is Saipol and I am a PhD candidate from Manchester Business School, University of Manchester. My supervisors are Professor Graham M. Winch and Dr. David J. Lowe, both from the Centre for Research in the Management of Projects, Manchester Business School. I am currently undertaking a research in Project Risk Management.

The aim of the research is to investigate how organisations conduct their risk management processes for projects. In this research, I would like to investigate the understanding of the concepts of risk, uncertainty and opportunity, the risk management guidelines or framework adopted and their processes.

The scope of this research will cover industries such as aerospace and aviation, oil, gas and petrochemical, power, telecommunication and construction with organisations suited with the following criteria:

a) Organisations that produce clear engineered products

b) Organisations that has design, engineering and construction processes

c) Organisations that has project management/ risk management practices in place

It is intended that an interview will be conducted with project managers/risk managers/ project directors or managers in charge of the process in the organisation. The interview will be guided by a series of questions derived for this research. All information will be treated confidentially and neither interviewee nor company will be identified in the production of the thesis. The interview will be conducted at your convenience and will normally last around 1.5 to 2 hours depending on the information discussed.

It is therefore very much appreciated if I can get some help and support to undertake this research in your organisation. Should you agree to participate in this research, kindly contact me for further arrangements. Please do not hesitate to contact me for further information.

Thank you and best regards

Saipol Bari Abd Karim
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Manchester Business School
University of Manchester
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M: +447515558995

APPENDIX C:
SELECTED NVIVO CODING

Tree Nodes

Name	Sources	References
Project Management	25	902
Risk Management	26	2300

Name	Sources	References
Current Practice	26	1431

Name	Sources	References
Risk management function	25	230
Risk management in practice	26	1148
Risk management issues	26	320

Name	Sources	References
Project management & Risk management	13	41
Risk management in general	25	371
Risk, Opportunity & Uncertainty	25	366

Name	Sources	References
Definition of Risk	25	72
Opportunity Management	24	181
Risk & Opportunity	23	153
Risk & Uncertainty	22	82
Uncertainty	20	85

Name	Sources	References
Standards, Guidelines, Framework	26	487

Name	Sources	References
Available guidelines, frameworks, standards	20	156
Framework, guideline to be used by others	18	60
Framework, standard for industry	21	126
Guidelines, framework, standards used	26	328

Expanded tree nodes on risk management (Level 1, 2 and 3)

APPENDIX C:
SELECTED NVIVO CODING

Tree Nodes

Name	Sources	References
Project Management	25	902
Project Governance	25	391
Mechanisms	22	198
Organisation Structure	22	134
Organisation type & scope of business	19	61
Project governance	25	224
Project management issues	9	56
Issues, problems	9	47
Motivation	5	10
Project management office (PMO)	25	277
Project management processes	25	365
PM process or method- why chose this	4	27
Software, Tools	15	56
Techniques, methods, standards, guidelines	25	312
Project procurement and contract	21	113

Expanded tree nodes on project management (Level 1, 2 and 3)

APPENDIX C:
SELECTED NVIVO CODING

Tree Nodes

Name	Sources	References
Project Management	25	655
Risk Management	26	2300
Current Practice	26	1431
Risk management function	25	230
No RM team	2	4
Within business & finance office	5	30
Within programme management office	7	29
Within project management office	14	43
Risk management in practice	26	1148
Knowledge, understanding	25	228
Practice	22	268
Practices to be Improved	19	80
Processes, steps, stages	26	614
Results of RM	21	100
Software, tools	25	185
Surprises	21	110
Techniques, methods	22	95
Risk management issues	26	320
Analysis & assessment	6	8
Budget & contingencies	3	9
Communication	2	3
Continuity	1	1
Defining risk	5	18
Insurance	1	1
Knowledge & information	10	16
Monitor & Review	1	1
Objective	2	2
Organisation & culture	14	51
Performance & reputation risk	3	7
Projects delivery	2	3
Risk register	3	9
RM guidelines & framework	2	6
Software & tools	6	22

Tree nodes on current practice of risk management

APPENDIX C:
SELECTED NVIVO CODING

Tree Nodes

Name	Sources	References
Project Management	25	655
Risk Management	26	2300
Current Practice	26	1431
Risk management function	25	230
Risk management in practice	26	1148
Knowledge, understanding	25	228
Practice	22	268
Practices to be Improved	19	80
Processes, steps, stages	26	614
Results of RM	21	100
Software, tools	25	185
Surprises	21	110
Techniques, methods	22	95
Risk management issues	26	320

Tree nodes on current practice of risk management

Tree Nodes

Name	Sources	References
Risk Management	26	2300
Standards, Guidelines, Framework	26	487
Risk, Opportunity & Uncertainty	25	366
Risk management in general	25	371
Project management & Risk management	13	41
Current Practice	26	1431
Risk management issues	26	320
Risk management in practice	26	1148
Techniques, methods	22	95
Surprises	21	110
Software, tools	25	185
Results of RM	21	100
Processes, steps, stages	26	614
Practices to be Improved	19	80
Practice	22	268
Knowledge, understanding	25	228
Understand what are the risks	16	40
Understand the project	3	4
Understand the processes	13	27
Understand the objective	3	4
Risks and issues	5	10
Education & training	11	26
Culture	7	15
Cost control	2	2
Budget & contingency	3	5
Awareness	7	11

Tree nodes on knowledge and understanding of risk management

APPENDIX C:

SELECTED NVIVO CODING

Tree Nodes

Name	Sources	References
Risk Management	26	2300
Standards, Guidelines, Framework	26	487
Risk, Opportunity & Uncertainty	25	366
Risk management in general	25	371
Project management & Risk management	13	41
Current Practice	26	1431
Risk management issues	26	320
Risk management in practice	26	1148
Techniques, methods	22	95
Surprises	21	110
Software, tools	25	185
Results of RM	21	100
Processes, steps, stages	26	614
Workshop	18	81
The processes	19	76
Stages & Steps	21	198
4) Monitor & Review	14	
3). Response	14	
2b). Evaluate	15	
2a). Analyse	17	
1b). Identify	20	
1a). Define project	9	

Tree nodes on stages and steps in managing risks

Tree Nodes

Name	Sources	References
Project Management	25	655
Risk Management	26	2300
Current Practice	26	1431
Project management & Risk management	13	41
Risk management in general	25	371
Risk, Opportunity & Uncertainty	25	366
Standards, Guidelines, Framework	26	487
Available guidelines, frameworks, standards	20	156
How does it relates to business and industry	14	38
Identified names	15	65
ALARM	1	3
APM & PRAM	5	9
AS-NZS	3	4
British Standards	3	5
COBIT & ISACA	1	3
COSO	2	2
HM Treasury Orange Book	1	2
ICE & RAMP	1	1
IRM	3	4
ISO	9	12
OGC MoR	6	9
PMI	4	10
PRINCE	2	7
Issues with standards	15	32
What does it provides	10	13
What it does not do	9	14

Tree nodes on available standards and guidelines

APPENDIX C:
SELECTED NVIVO CODING

Tree Nodes

Name	Sources
Risk Management	0
Standards, Guidelines, Framework	0
Risk, Opportunity & Uncertainty	0
Risk management in general	26
Project management & Risk management	0
Current Practice	0
Risk management issues	27
Risk management in practice	0
Techniques, methods	0
Workshop	13
Tornado chart	2
Scheduled meetings	2
Risk register	13
Risk analysis techniques	1
Quantitative method	1
QRA	1
Nominal groups	1
Issues	7
Ishikawa diagram	1
Interview	2
Exploring & challenging	1
Experience & Lessons learned	12
Estimate	3
Delphi	1
Certaintiably uplift	1
Cause, risk or fact	1
Brainstorm	10
Assumption analysis	1

Tree nodes on the techniques and methods used for risk management

Tree Nodes

Name	Sources	References
Risk Management	26	2300
Standards, Guidelines, Framework	26	487
Guidelines, framework, standards used	26	328
Framework, standard for industry	21	126
Yes, with condition	9	17
Yes, generally	9	11
No	7	18
Concern	13	45

Tree nodes on possibility of future standards and guidelines for the industry