MANAGEABILITY AND CONTROLLABILITY OF PROJECT RISK: THEORETICAL CONCEPTS AND MANAGERIAL PERSPECTIVES

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Abstract

This study explores the concepts of manageability and controllability of project risk, from academic and managerial perspectives. It aims to understand the managerial perception of these concepts, distinguish the differences between them from academic and managerial perspectives and also recommend useful definitions of the concepts.

This study begins by examining academic perspectives of manageability and controllability by reviewing the existing literature relating to these concepts. Subsequently, in order to capture the managerial perception, a semi-structured interview is conducted with four participants from three different project areas, namely IT, energy and business improvement. The results of the interviews are then analysed and interpreted using NVIVO software, and validated by the participants to confirm the consistency and accuracy of the data collected.

Three main findings are presented in this study. First, from a managerial perspective, most of participants perceive that the concept of manageability is related to the management process, structure and system, such as identifying and understanding project risk; on the other hand, the concept of controllability is perceived as being related to controlling the output of processes by addressing risk. Second, the differences between managerial and academic perspectives in relation to controllability reside in the activity conducted and the decision making process, whilst the differences between these perspectives in terms of manageability relate to the activity conducted and the advantage of information. Third, this study also recommends useful definitions for both manageability and controllability, whereby manageability is defined as the capability of an internal and external project team to select and utilise information important for identifying and understanding project risk in order to reduce risk and increase opportunity within a project, and controllability is defined as the ability of the project team to monitor and control the output of the project risk management process through effective communication.

Keywords: project risk management, manageability, controllability, risk perception.

Contents

List of Figure

List of Table

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

This chapter will explain the underlying issues motivating this study. These issues are identifiable in reference to substantial existing literature in the fields of project management (PM), project risk management (PRM), risk management (RM) and management science (MS), which is particularly critical of defining and prioritising risk by utilising the probability and impact (P-I) matrix. For instance, according to Aven *et al*. (2007), APM (2008), Ding, Liu and Sun (2010), Taroun (2014), Kuvaas (2002) and Leijten (2009), two issues emerge when performing the P-I matrix. The first relates to the categories used in the P-I matrix, which are quite rough and too broad to represent overall risks. The second issue is that there is, at present, no single way of obtaining an overall risk level, including the P-I matrix. Therefore, other concepts must be considered in order to improve the performance of the P-I matrix in defining and prioritising project risk.

The concepts of manageability and controllability in relation to project risk are commonly employed to identify and prioritise project risk rather than probability and impact (Aven *et al.,* 2007; APM, 2008; Ding, Liu & Sun, 2010; Taroun, 2014; Kuvaas, 2002; Leijten, 2009). Langevin and Mendoza (2008) argue that the two concepts can help decision makers to select the proper risk reduction strategy by distinguishing the manageable, unmanageable, controllable and uncontrollable risks. Furthermore, if these concepts are implemented correctly in the project, massive budget savings can be achieved (Choudhury, 1986).

Unfortunately, although many researchers have conducted studies of the concepts of manageability and controllability, the definitions of these concepts within existing literature are inconsistent and thus cause confusion amongst researchers as well as the practitioners who seek to implement those concepts. This means that practical applications of these concepts in order to identify and prioritise risk will suggest different project risk levels as well as project risk mitigations, owing to different understandings of those concepts amongst researchers. For this reason, this research aims to recommend a useful definition of manageability and controllability in a PRM context, synthesising existing definitions and data obtained through in-depth interviews, to provide a workable definition for project management practitioners working across different projects and areas.

1.2. Motivation

Theoretically, PRM proposes to improve project performance by systematically identifying and assessing risks, developing strategies to reduce or avoid these risks and maximising opportunities (Seyedhoseini & Hate 2009). Furthermore, if implemented correctly, the impact of project threats can be minimised and the project opportunities - with the objective of being on time, on budget and on quality - can be maximised (PMI, 2008).

Notably, a study conducted by Taroun (2014) claims that the practical implementation of PRM is not conducted correctly, in accordance with PRM theory. Taroun states that there is a clear gap between the theory and practice of risk modelling and assessment. Theoretically, PRM begins with a quantitative risk assessment, employing objective probabilities and frequencies. However, the quantitative risk assessment is difficult to implement in practice. Winch (2003) states that project managers rely on subjective probabilities when they encounter risk; accordingly, the result of the risk assessment is influenced by their individual knowledge, experience, intuitive judgment and rules of thumb (Dikmen *et al*., 2007). Unfortunately, this individual knowledge, experience, intuitive judgment and rules of thumb are not structured; hence, the implementation of PRM in practice is not yet conducted correctly (Taroun, 2014).

A survey conducted by Standish Group in 2012 supports the argument that PRM is currently implemented incorrectly in real projects. It presents an overview of software project performance, a major factor causing software projects to fail, and the key features that can reduce project failures (Standish & Report 2012). This survey was distributed to 365 respondents from large (any company with over $500 million dollars in revenue per year), medium (any company having $200 million to $500 million in yearly revenue) and small companies (any company having $100 million to $200 million in yearly revenue) that handle software projects, for example banking, securities, manufacturing, retail, wholesale, healthcare, insurance, services, and local, state, and federal organisations.

According to the survey, the top three risks are: incomplete requirements (13.31%), lack of user involvement (12.4%) and lack of resources (10.6%), all major factors that contribute to project failure, as project teams are unable to manage them correctly. It is thus unsurprising that 61.5% of large companies find themselves over-budget, over time and offering fewer features and functions than originally specified. At 46.7% and 50.4% respectively, medium and small companies are also experiencing failure as a result of not managing these risks correctly.

One of the major challenges in the practical implementation of PRM is how to assess risk (Taroun, 2014). Taroun states that most project management practitioners assess project risk utilising just one approach, namely the probability impact (P-I) matrix, which has been subject to criticism from several researchers ((Williams, 1996; (Aven et al. 2007) (Dikmen et al. 2007). They point out two issues with the P-I matrix; the first issue is that the categories used in the P-I matrix are quite rough and are too broad to represent overall risks, and could lead to many risks being put into the same category. The second issue is that there is no single way of obtaining an overall risk level using the P-I matrix, which is relatively arbitrary in its ability to determine the level of risk. The relative importance of uncertainty and impact may not be correctly represented by the scoring system used in the P-I matrix; for example, the score of a high impact and low probability risk event could feasibly be the same as that of a low impact and high probability event. Therefore, critics argue that other concepts must also be considered to improve PRM implementation so that project management practitioners can manage and control risk properly and findings such as those of the survey conducted by Standish Group can be prevented in advance.

Several authors propose that the concepts of manageability and controllability should be considered when assessing risk, as alternatives to probability and impact (Aven *et al.,* 2007; APM, 2008; Ding, Liu & Sun, 2010; Taroun, 2014; Kuvaas, 2002; Leijten, 2009), as these concepts better account for the fact that some risks are more manageable and controllable (Aven et al. 2007). It is argued that, in theory, a risk cannot be described only in reference to its probability and impact, but every risk has a different level of manageability and controllability. Furthermore, Langevin and Mendoza (2008) agree that these concepts are useful in assessing risk, as they can help and influence decision makers when selecting the proper risk reduction strategy for risk reduction, rather than probability and impact which is quite rough and broad to be an input for decision makers to decide the proper risk reduction strategy. Choudhury (1986) also argues that manageability an controllability factors can lead to huge budget savings if they are implemented correctly within a project. It is thus unsurprising that several authors propose that the concepts of manageability and controllability should be used define risk as an alternative to the P-I matrix.

Unfortunately, although many researchers have conducted studies of the concepts of manageability and controllability for use in projects (Aven *et al.*, 2007; APM, 2008; Ding, Liu & Sun, 2010; Taroun, 2014; Kuvaas, 2002; Leijten, 2009), the definitions of these concepts within existing literature are inconsistent, causing confusion amongst researchers and practitioners alike. For instance, APM (2008) defines manageability as a function of controllability and response effectiveness, while Ding *et al.* (2010) argue that it is combination of controllability and transferability. Furthermore, the existing body of research lacks any empirical study of the perception of these two concepts from a managerial perspective. For this reason, a study defining and distinguishing the manageability and controllability of project risk, both theoretically and empirically, will help develop these concepts to become more useful in their practical implementation.

1.3. Aims and Objectives

Various authors have conducted studies of manageability and controllability in a project-based environment (Aven *et al.*, 2007; APM, 2008; Hillson, 2004; Ding *et al.*, 2010; Taroun, 2014; Kuvaas, 2002; Lam *et al.*, 2007; Leijten, 2009). However, as yet, no empirical study has been conducted examining perceptions of these concepts from managerial perspectives. Furthermore, their definitions are inconsistent, causing confusion amongst researchers and practitioners. Consequently, this study aims to examine the concepts of manageability and controllability in relation to project risk from both academic and managerial perspectives, with a view to developing these concepts for practical application.

The aims give rise to the following research objectives:

1. To understand the perceptions of project management practitioners regarding the manageability and controllability of project risk from managerial perspectives.
2. To distinguish the differences between manageability and controllability of project risk from academic and managerial perspectives.
3. To recommend helpful definitions of manageability and controllability in relation to project risk, from academic and managerial perspectives.

The achievement of these objectives will involve addressing the following research questions:

1. How do project management practitioners perceive the concepts of manageability and controllability in practice?
2. What are the differences between the academic definitions and managerial perceptions of manageability and controllability?
3. What are useful definitions of manageability and controllability from academic and managerial perspectives?

1.4. Research Limitations

This study relies on data provided by just four participants across different project types. Therefore, the results of this study cannot be generalised and taken to represent the conditions of projects and project managers' opinions universally. However, the in-depth interview process means that the study is able to obtain rich information about the concepts of manageability and controllability drawing on the participants' experiences, and this information may prove useful in constructing workable definitions of those concepts.

1.5. Structure of the Thesis

This thesis will consist of five chapters: Introduction and Background, Literature Review, Methodology, Results and Discussion and Recommendations. More details regarding what will be addressed in each chapter can be found below:

Chapter 1 introduces the study and explains the motivations for conducting it, the aims and objectives and the limitations of the study.

Chapter 2 will examine the existing literature regarding concepts related to manageability and controllability in relation to project risk management, namely: project management, project risk, project risk management, decision making in projects, control theory and the manageability and controllability concepts of project risk.

Chapter 3 will explain the research methodology and the rationale underpinning the research methodologies employed by the researcher.

Chapter 4 will present the results and analyse the data obtained in this study.

Chapter 5 will present the conclusions of the research study and make recommendations for future research.

2. LITERATURE REVIEW

2.1. Introduction

This chapter will provide an overview of the underpinning literature regarding the research problem and the area of project risk management. Project risk management (PRM) is a rapidly growing area of the engineering field (Bedford & Cooke, 2001) that provides significant benefits to project management in the real world. The APM PARM Guide states that PRM can provide projects and organisations with hard as well as soft benefits (Simon *et al*., 2007). In terms of hard benefits, PRM can help projects and organisations to fulfill corporate governance requirements, gain a greater potential for future business with existing customers and reduce their cost base. On the other hand, the soft benefits include the fact that PRM can help project-based organisations create a less stressful working environment and improve their reputation by having fewer headline project failures and better customer relations due to improved performance on current projects.

However, in practice, the implementation of PRM is not yet conducted correctly (Taroun 2014), as reflected in the results of a survey conducted by Standish Group with 365 respondents who handled software projects in 2012. This survey revealed that various risks, specifically incomplete requirements, lack of user involvement, lack of resources, unrealistic expectations, lack of executive support, changing requirements and specifications, lack of planning, lack of IT management and technology illiteracy at present are all not managed correctly. Consequently, 61.5% of large companies are commonly over budget, over their time estimates and offer fewer features and functions than originally specified. Medium and small companies also suffer; experiencing failure rates of 46.7% and 50.4% respectively, where they cannot manage risks correctly.

One of the reasons that project practitioners cannot apply PRM correctly is because of the limitations of the P-I matrix, which is commonly utilised in risk management strategies. This matrix takes a relatively rough and broad approach to defining and prioritising risk. Thus, several authors have proposed two alternative concepts, namely manageability and controllability, in order to improve the application of PRM in practice (Aven *et al*., 2007; APM, 2008; Ding, Liu & Sun, 2010; Taroun, 2014; Kuvaas, 2002; Leijten, 2009). Those concepts represent a different approach to defining and determining project risk in practice. However, several authors examining the manageability and controllability aspects of project risk take various points of view when defining those concepts. Moreover, no empirical study designed to capture the perceptions of these concepts from managerial perspectives has yet been conducted. Therefore, this study attempts to recommend a useful definition and distinguish the implementation of manageability and controllability concepts of project risk from academic and managerial perspectives.

2.2. Project Management

A project is "*a temporary endeavour undertaken to create a unique product, service or result*" (PMI, 2008, p.5). The definition of a project provided by PMI (2008) implies that there are two underlying characteristics of a project, namely that they are temporary and unique. 'Temporary' means that a project must be completed within a particular duration, to a particular budget, and to meet certain requirements. The 'unique' element of a project refers to the particular characteristics that a project has, including its duration, scope, output, process, risk, actors and resulting product. Therefore, it is likely that project teams will never encounter or work on similar projects even where they are working on constructing the same building.

These two characteristics of projects, their temporal and unique, nature, mean that managing one project will be very different to managing another. For instance, managing a project over a five-year duration will be different experience from managing a project over three months. Longer projects will likely have a broader scope of deliverables, a higher number of constraints in accomplishing the objectives, and a greater degree of risk, compared with short-term projects. Hence, it is necessary to approach the management of different projects in particular ways in order to accomplish the objectives of the project.

Identifying the best approach to managing a project is a critical skill required of project management practitioners across all projects. Unfortunately, existing project management theory suggests that some project managers are not able to perform their role. A misleading paradigm of project management, for instance, is presented in the software jargon used in a British project magazine, which states "*if you can move a mouse you can manage a project*". This assumes that by using particular software for PRM (*move a mouse*), project management practitioners can manage all different types of project correctly, and leads scholars to compete to create sophisticated project management software that can be used to manage projects generally (Fan & Yu, 2004; Charette, 2005; Elkington & Smallman, 2002; Jiang, Klein & Ellis, 2002). However, sophisticated software is only a tool helping project management practitioners to better manage their projects. They key to successful project management lies in the ability of project management practitioners to perform project management properly, not the software that they use (Addison, 2002; Müller & Turner, 2010).

Project management is a concept that must be understood by each participant involved in managing and controlling a project. PMI (2008) states that project management is "*the application of knowledge, skills, tools, and techniques to project activities to meet the project requirement*". Theoretically, project management provides several advantages to the project. For instance, Müller & Turner (2010) argues that it provides an economic benefit, in that it can save time as well as costs when applied effectively. On a practical level, though, Taroun (2014) states that project managers are not yet able to apply project management effectively; this is reflected in an empirical study conducted by White & Fortune (2002), who conducted a survey with 995 project managers regarding the effectiveness of project managers in terms of using project management methods, tools and techniques, as depicted on Figure 2.1.

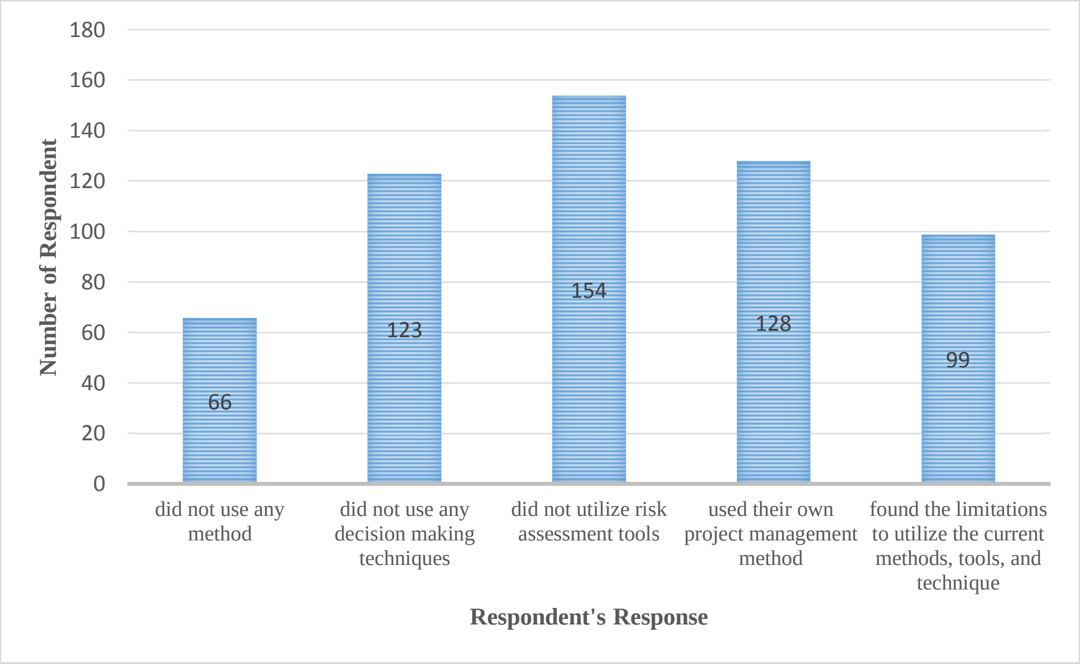

Figure 2.1. The Results of an Empirical Study by White &Fortune (2002)

This study reported that 66 respondents did not use any PM method, 123 respondents did not use any decision making techniques and 154 respondents did not utilise risk assessment tools; 128 respondents used their own project management methods and 99 respondents encountered limitations with utilising the current methods, tools, and techniques. According to this study, the most common reason why practitioners do not utilise risk management methods, tools and techniques is because they are unsuitable for use in a complex project. For this reason, improvement of current risk assessment methods, tools and techniques is required particularly to make them more suitable for application in complex projects and generally to improve the effectiveness of project management application in practice.

2.2.1. Traditional Project Management (TPM)

Project management refers to the general concept of managing and controlling a project in order to complete the project on time, on budget and to the specified quality. However, though it is a general concept, it cannot be applied effectively in all projects using the same approach. Two approaches are commonly employed to manage and control projects, namely traditional project management (TPM) and agile project management (APM). One of these approaches may be suitable for one project, but inappropriate for another.

TPM has certain similarities and differences compared with APM (Špundak, 2014; Fernandez & Fernandez, 2009). The first similarity relates to the phases through which project management is conducted; this begins with initiating the process, planning the process and executing the process, and ends with closing the process. However, the key difference is in how these phases are run. In TPM, the phases are run sequentially, which means that tasks in each phase must be completed one after another in an orderly sequence. It also assumes that once a phase has been completed, it will not be revised. However, in some projects, a change in requirements can occur. Consequently, project members should apply APM, which allows project members to continuously revise the previous phases to execute the project correctly.

Second, TPM leads to more rigid and deliberate planning and control methods than APM, in order to increase the possibility of project success in the future. For example, in a construction project, the project team members must thoroughly determine the requirements, design and plan for the entire building in order to understand the full scope of the effort required.

A particular type of project, such as project for which the customer requirement has been described precisely at the outset of the project might be suitable for TPM application. Since these changes may not occur during the project, the PM requirement can be certain. However, if the customer requirement for the project is rapidly changing, for instance in an IT and software project, TPM is not an appropriate approach. In this case, the APM approach, which is more flexible, is the more appropriate strategy.

2.2.2. Agile Project Management

Agile project management (APM) is a concept that was introduced to overcome the limitations of TPM. The key difference between the two approaches is that APM allows for changing customer requirements by managing and controlling the change. APM is a twenty first century approach, commonly used in IT and software projects. According to the existing literature, the objectives of APM are not only to deliver projects on time, on budget and of the expected quality, but also to build good teamwork and leadership amongst team members in order to achieve value for the customer (Kathleen & Hass 2007).

Fundamentally, there are three possible frameworks within which to conduct APM. The first framework is known as The Next Methodology (TXM). This framework utilises five phases, namely exploration, planning, development, release and maintenance. The second framework is CHAPL, which is different to TXM, but also works through five different phases, namely contextual analysis, historical analysis, analysis by analogy, phenomenological analysis and linguistic analysis (CHAPL). The third framework is known as Scrum; this consists of three phases and nine sub phases, as shown in Figure 2.2.

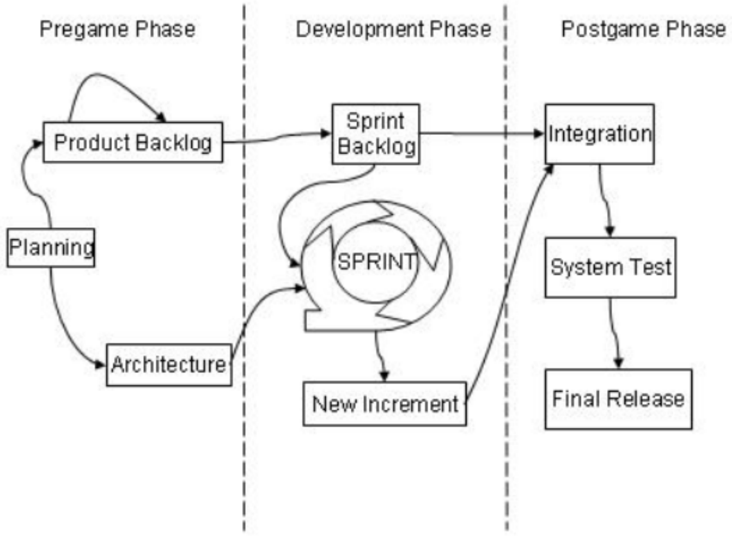

Figure 2. 2. Scrum Pattern adopted by Ramsin and Paige (2008)

According to Figure 1, Scrum and other frameworks, including TXM and CHAPL, follow a particular system for performing APM, known as the closed-loop system. This system employs an iteration and feedback process that is flexible and responsive, in order to respond to change within a project (Tignor, Court & Park, 2009; Kathleen & Hass, 2007; Elliott, 2008; Coram & Bohner, 2005; Karlesky, Object, Voord & Rapids, 2008; Hoda, Noble & Marshall, 2008). Thus, by applying APM, a project manager can more easily understand and update changing requirements early on, until the customer feels satisfied with the product to be delivered (Boehm & Page 2006).

In order to make APM responsive and flexible, simple rules, a plan, documentation and informal communication should be maintained (Augustine, Payne, Sencindiver & Roject (2005)). In contrast to TPM, which applies formal communication and documentation, Coram and Bohner (2005) argue that formal schedules and plans are less important under APM, stating that reducing the amount of documentation and informal communication can not only make this system more responsive and flexible, but can also enhance the productivity of the team and minimise costs. Additionally, they observe that using informal communication will be more useful than proper documentation in collecting and collating the knowledge of each team member.

In addition to its responsiveness and flexibility in the case of changes within a project, APM can also prevent risk early, as this approach makes it possible to prioritise the most important project requirements and the most risky project requirements (Tignor, Court & Park, 2009; Kathleen & Hass, 2007). Hence, the project manager can make sure to not only fulfil the most important project requirements, but also to prepare as soon as possible any risk mitigation in relation to the most risky project requirements (Hoda et al. 2008).

Additionally, according to Hoda *et al.* (2008), APM is also an effective approach in terms of utilising human resources, for two key reasons. First, only a few skilled project members are required to run the project. For instance, only seven (plus/minus two) project members are required to run the project in the Scrum framework. This approach argues that the fewer people who are involved in the project, the more effective the project manager will be in leading the team. Second, APM takes a leadership and collaboration approach to managing a project, rather than command and control (Kathleen & Hass 2007). Thus, customers can be involved in the project, to provide and update their requirements and to control and give feedback on the project (Coram & Bohner 2005).

Unfortunately, although APM presents several advantages, such as being highly flexible, responsive and effective, only some types of project are suited to this approach. The first type is projects with a short duration, such as IT projects. These kinds of projects are suitable because they require less documentation and informal communication (Elliott, 2008). By contrast, for long duration projects, informal documentation and communication make it difficult to identify and reflect on the previous decisions made in years before. Therefore, for long duration projects, TPM, with its formal documentation and communication, is more appropriate than APM. The second type of project is small scale projects, as employing a few skilled team members for a project is difficult in large scale projects, which commonly necessitate the involvement of a large number of team members. The third type of project is local projects, which do not involve another party from a different location, as APM is more effective when a customer is on site and eager to be involved in the project. In international projects, where the customer could be at a different location to the project team members, it would be difficult to apply the APM approach.

2.3. The Definition of Risk

Research in risk is growing popularity. Nowadays, there are several disciplines conducting research in risk. From the existing studies in many disciplines, risk can be defined in several perspectives. The world ‘risk’, for instance, can be defined according to either a negative or positive interpretation (PMI, 2008; Hillson, 2004). In the 1980s, risk was typically associated with a negative interpretation. A study conducted by March and Shapira (1987) in this era reported that almost 80% of managers associated the word ‘risk’ with negative connotations that could be perceived to impact negatively on a situation. Project executives thus always perceived risk as a danger, hazard or threat of poor outcome. In line with March and Saphira (1987), an earlier study conducted by Kaplan and Garrick (1981), and a later one carried out by Keil, Wallace, Turk, Dixon-Randall and Nulden (2000) both found that qualitatively risk is associated with loss and damage. Furthermore, they state that the notion of risk involves uncertainty regarding the form of loss or damage. Hence, they defined risk as meaning uncertainty plus hazard.

On the other hand, some of the existing literature from later decades (PMI, 2008; Hillson, 2004; Raftery, 1996) offer another interpretation of risk, and defines risk not only in terms of a negative interpretation, but also a positive one. For instance, the definition provided by Raftery (1996) states that risk can be depicted in terms of two directions, referring to the best or the worst possible outcome or impact on a particular event. Raftery uses the terms ‘upside risk’ to describe the best outcome and ‘downside risk’ for the worst outcome.

Regarding to Rosa (2003), the different of risk definition is due to the different philosophical underpinnings in each discipline. Regarding to the positivist paradigm, risk is defined by the probability of an adverse event multiplied by the consequences (P-I). This definition is the most commonly used and well-known definition of risk. However, Rosa (2003) argued that this definition is too narrow. Therefore, from constructivist paradigm, risk is defined more entire than the positivist paradigm by adding other key aspects.

Rosa (2003) states that there are two key aspects considered to define risk. The first aspect which must exist in the risk definition is an uncertainty of the outcome. If the event with impossible outcome (p = 0) and certain outcome (p = 1) then they are not considered as risk because no uncertainty regarding the outcome. Otherwise, if the event has uncertain outcome (0>p>1) then the event can be considered as risk. The second aspect considered by Rosa (2003) in defining risk is that the uncertainty which can effect on human reality in some way. Therefore, Rosa (2003) defines risk as "*a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain*" (p.56).

Supporting two aspects of Rosa (2003), Aven (2015) also defined risk into the activity which leads to some uncertain consequences affecting human values, such as health, environment, assets, and so forth. Regarding to this definition, he argued that risk can be assessed by specifying the consequences and using a description to measure uncertainty.

Quantitatively, people usually express uncertainty into probability to assess risk. Risk is determined by interval or formulating probabilities for various consequences. For example, the risk of three fatality probabilities (0.1, 0.6, and 0.3) and three consequences (-10, 0, and 100) can be obtained by calculating the centre of gravity of the probability distribution known as expected value shown in Equation 1.

$$EX = (-10) \cdot 0.1 + 0 \cdot 0.6 + 100 \cdot 0.3 = 29 \qquad (1)$$

Unfortunately, in fact, uncertainty cannot be reflected only based on the value of probability. Uncertainty may in fact be hidden in the background of knowledge. Aven (2015) argued that probability is formed from the degree of belief concerning the occurrence of an event given some background knowledge. If there is no data, no information or insufficient knowledge to supprot the value of probability, then the value of probability is meaningless to define risk. Accordingly, people must be careful to draw conclusion of risk only from probability alone. They must fully consider the strength of background of knowledge once defining risk.

Indeed, there is no universal agreement to define risk (Rosa, 2003). The debates of risk definition will not be resolved and the multiple definitions of risk are considered as a better work than the single definition of risk (Snary, 2004). It is because the term risk is an elusive word which will be hard to be described as a single definition from numerous disciplines in which risk is studied. The following section will discuss comprehensively the definition of risk in project.

2.3.1. Project Risk

As with other activities, such as business, medical treatment and so forth, all projects are subject to risk. Latham (1994, p.14) states that *"no project is risk free. It can be managed, minimised, shared, transferred or accepted, but it cannot be ignored."*

Project risk is thus *"an uncertain event or condition that, if it occurs, has an effect on at least one project objective"* (PMI, 2008, p.275). According to the PMI definition, project risk shares two similar attributes with general risk, namely probability (*uncertain event*) and impact (*project objectives*). Even though these attributes are beneficial in distinguishing risk and uncertainty as well as prioritising risk, they are subject to criticism by several authors who seek another attribute to distinguish risk and uncertainty as well as prioritise risk.

The authors who highlight the need for a study of project risk (Williams 1996; Aven *et al*., 2007; APM, 2008; Cagno *et al.,* 2007) specifically criticise two attributes of risk, probability and impact, which together form the P-I matrix. They argue that project risk cannot be adequately described in reference to probability and impact alone, as these terms are not helpful in prioritising risk. They further suggest that the categories used in the P–I matrix are overly broad, and also that the relative importance of uncertainty and impact may not be correctly represented by the scoring system used. They argue that when using the P-I matrix, the risk of a high impact and low probability event may be the same as that of a low impact and high probability event.

A further critique of the P-I matrix is offered by Bannerman (2008), who argues that utilising the P-I matrix is not suitable for assessing project risks and is difficult to apply in real project contexts, as a project management practitioner will tend to be more concerned with the severity of the potential loss than the probability of it occurring. Therefore, another concept must be considered in order to improve PRM implementation so that project management practitioners can properly manage and control risk to prevent losses in terms of cost, time or scope.

2.3.2 Project Risk Management (PRM)

Project risk management (PRM) is the process of identifying, evaluating and controlling risk within a project (PMI, 2008). This concept cannot only provide a significant benefit to a project team in reducing costs, but it also provides significant benefits to all stakeholders, both strategically and technically (Turner, 2014). The technical benefit can be obtained for the project team member at a technical level, such as by enabling staff to solve a technical problem in a project that could cause risk. Meanwhile, the strategic benefit can be obtained at the strategic business and corporate level, in producing a policy to reduce project risk.

In general, there are four steps required to conduct PRM, namely risk classification and identification, risk assessment, risk analysis and risk control (Lee et al. 2009). Several studies name the PRM steps differently, but they do not change the meaning of each stage (Bedford & Cooke, 2001; Boehm, 1991; Chapman, 1997; PMI, 2008; APM, 2008). Smith *et al.* (2006), for instance, have five different appellations for PRM application steps, namely the risk assessment process, project definition process, risk identification process, risk analysis process, risk response process and the risk register process. However, regardless of the names assigned to the commonly used PRM stages, their meanings are similar. The common steps of PRM are depicted in Figure 1.

According to Figure 2.3 there are several characteristics of the PRM process. First, PRM is described as a continuous process that involves different stakeholders. The continuous process of PRM is shown in the interaction between steps (PMI, 2008). Additionally, in each stage, different stakeholders are also involved (Smith *et al*., 2006).

Second, each PRM step involves different tools and techniques, inputs and outputs (PMI, 2008). For instance, the risk identification process has different inputs to the risk analysis process. In the risk identification process, the input could be the risk management plan, the activity cost estimation, the activity duration estimation and so forth. Meanwhile, in the risk analysis process, the input could be the risk register, the risk management plan and the cost management plan. On the other hand, the tools and techniques in the risk identification process and the risk analysis process are also different. For instance, the tools and techniques used in the risk identification process could be the documentation reviews, the SWOT analysis, the checklist analysis or an expert judgment. Meanwhile, in the risk analysis process, modelling and simulation, sensitivity analysis and expected monetary value analysis could be utilised.

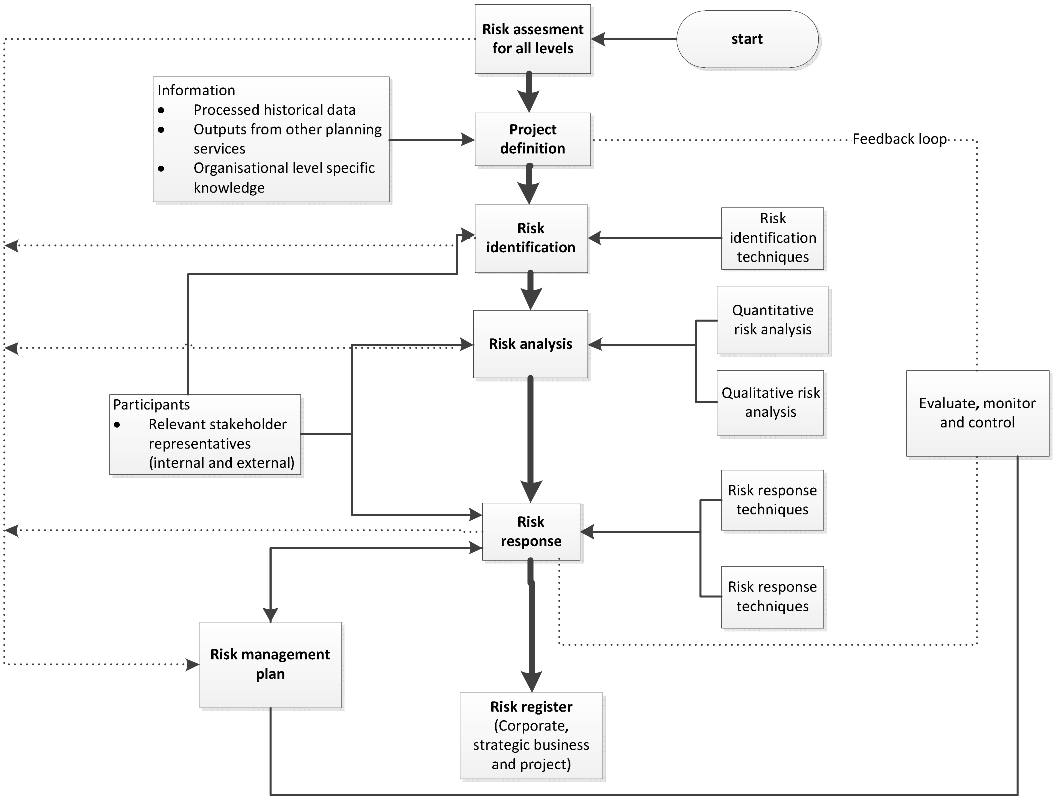

Figure 2.3. Project risk assessment for all levels of organisation by Smith *et al.* (2006)

Surprisingly, even though each PRM step involves different stakeholders, inputs, outputs, tools and techniques, this does not mean that one process is more prominent than any other. However, as a sequence process that follows the concept of *"Garbage in Garbage out"* (GIGO), it should be ensured that the first step in the project risk assessment process runs properly (Bininda-emonds et al. 2004). This is because the first process can significantly influence the output of other processes. Thus, unsurprisingly, many scholars and practitioners seek to create and develop the best project risk assessment method in order to implement PRM properly.

Unfortunately, most of the methods of developing project risk assessment are very advanced, hence they are difficult to apply in real projects (Kwak & Ibbs, 2000; Ropponen, 1999; Ropponen & Lyytinen, 1997). This is reflected in a study conducted by Rapponen (1999), which finds that some project managers do not utilise the formal methods of PRM effectively once the project is running. Hartono *et al.* (2014) and Riabacke (2006) agree that project managers only use basic PRM analysis to counter project risk.

2.4. Decision-Making Process in Project

Smith *et al.* (2006) states that PRM can be defined as the decision making element of project management, as it not only predicts future outcomes but also enables better decisions intended to achieve project success in the future. It is common in projects for the decision making process to be performed continuously. It is conducted prior to the initiation of the project and is still required at each PRM stage. Experts who are experienced in conducting similar projects are invited to a special meeting prior to the start of the project to identify all aspects of the project that potentially could involve risk. In addition to making a list of possible risks, the attendants of this meeting also rank the possible risks by assessing the probability and impact of each, based on their own experiences. At the end of this process, the experts must come up with the strategy to counter project risk.

The decision making process of PRM is definitely desirable, and needed to provide a strategy for countering project risk. However, involving experts in the decision making process has several limitations. PMI (2008) suggests, for instance, that the experts' bias could be one such crucial limitation. One of the reasons for this is because the experts could have a particular irrational behaviour that they exhibit when they face conditions of uncertainty. On the other hand, the limited availability of information could also cause bias in the decision makers (Bazerman & Moore, 2009). Thus, it is clear that experts' bias should be taken into account when participating in a decision making process as part of PRM.

2.4.1. Expected Utility Theory

The expected utility theory is a concept of preference where a quantitative utility is assigned to each severity, a probability to each state of the world, and then the best alternatives are selected by maximising the expected value of the resulting utility (Parmigiani & Inoue, 2009). Equation 2 presents the expected utility function (Aven & Vinnem 2006). Typically, the decision-maker will select the best alternative of several choices. According to Bedford and Cooke (2001), the best alternative, as chosen by the decision-maker, should reflect the highest expected utility value. Aven and Vinnem (2006) also add that if a person is rational about their preferences among the impact and uncertainty quantities, they will choose between the alternatives in such a way that maximises the expected utility.

$$E[u(i,X)] = u(i,0)\ P(X=0) + u(i,1)\ P(X=1) \qquad (2)$$

However, in the real world, it is difficult to have rational decision makers. They might face complex problems, which often make it more difficult to select the best strategy. Consequently, they tend to select the satisfaction strategy by applying a discourse and negotiation process instead of optimal strategy, using mathematical optimisation (Aven & Vinnem, 2006).

In project management, the decision-making process is also intended to prioritise risk and to produce the best strategy for countering this risk. Unfortunately, the project decision makers are rarely rational and follow the expected utility theory when prioritising and selecting the best strategy to counter risk, as this theory is difficult to apply to real projects, owing to difficulties in obtaining information to support the decision from similar projects (Aven *et al.*, 2007; Bazerman & Moore, 2009) . Consequently, decision-makers in PRM tend to make decisions irrationally, using gut feelings to produce fast decisions and reduce workloads (Hartono *et al*., 2014).

2.4.2. Value of Information (VOI)

Bedford and Cooke (2001) state that decision-makers will naturally require information prior to making a decision. For instance, to define probabilities and expected value, certain information is needed, as determining probabilities and expected values not only involves computing objective values, but also conducting subjective assignments conditioned on background information, including assumptions and suppositions (Aven, 2009). Accordingly, the more perfect information is obtained, the more accurate the resulting probabilities and expected values will be.

Unfortunately, in reality, perfect information is difficult and expensive to obtain. Therefore, decision makers must select the most valuable information to support their decisions. The amount a decision maker is willing to pay for information before a decision is made is known as the value of information (VOI). Bedford and Cooke (2001) define VOI as an upper bound estimation of the amount of extra benefit obtained through certain observations. In its implementation, VOI follows a rational decision making process whereby the decision maker must be systematic and thoughtful in collecting information, analysing it and making a risky decision (Hartono *et al*., 2014). Accordingly, VOI can be used to assess conditions when the decision maker must make a systematic decision regarding what they consider the information to be worth (Clemen & Reilly, 2001). VOI is illustrated in more detail in Equation 3.

$$\sum_x p(x)U(F|x) \qquad (3)$$

According to Equation 2, VOI can be defined as the mean value where the sum is over all states of the world x, $p(x)$ is the prior probability of the state of the world, and $U(F|x)$ is the utility of the optimal decision given that the state of the world is x. From this equation, all additional information is worth to obtain once the cost to collect all information is less than the VOI. Otherwise, the information is not essential to be collected and considered to make a decision.

In PRM, VOI is a prominent concept; it can be utilised to decide upon the degree of uncertainty and manageability of risk (Aven *et al.,* 2007). In their study, Aven *et al.* (2007) show that the degree of uncertainty and manageability is high at the beginning of a project and will decrease gradually as a function of time, due to the availability of information. Unfortunately, decision makers must commonly make decisions at the beginning of a project when the degree of uncertainty is high, as the information is not yet available. Consequently, VOI is required to define whether it is worth making an observation or not in order to obtain worthwhile information to support PRM where this information is not already available.

2.5. Manageability and Controllability of Project Risk

The decision making process in PRM takes place in each project phase, from the risk identification and classification process to the risk control process. As a continuous process that follows the GIGO concept, the first phase of PRM, that is, the identification and classification process is the first prominent phase that must be taken into account to ensure that PRM is performed correctly.

Unfortunately, the current risk identification and classification method commonly utilised by project practitioners, known as the P-I matrix, is subject to criticism by several authors, for two reasons (Aven *et al.,* 2007; APM, 2008; Hillson, 2004; Ding *et al.*, 2010; Taroun, 2014; Kuvaas, 2002; Lam et *al*., 2007; Leijten, 2009). The categories used are overly broad and the relative importance of uncertainty and impact thus may not be correctly represented in the scoring system used. Accordingly, another concept should be included instead of probability and impact to improve the P-I matrix.

The concept of manageability and controllability suggests that some risks are more manageable and controllable than others (Aven *et al.,* 2007). It is believed that the concepts of manageability and controllability provide massive benefit, such as budget savings (Choudhury, 1986). On the other hand, those concepts are also useful to help identify and prioritise risk(s) and influence decision makers in selecting the proper strategy of risk reduction, rather than solely focusing on probability and impact (Langevin & Mendoza 2008). An empirical study conducted by Du, Keil, Mathiassen, Shen and Tiwana (2007) adds that the perception of controllability is significant factor influencing decision makers in their prioritisation of risk.

Various researchers have conducting studies of these concepts in relation to projects (Aven *et al.,* 2007; APM, 2008; Ding, Liu & Sun, 2010; Taroun, 2014; Kuvaas, 2002; Leijten, 2009). However, the definitions of manageability and controllability provided in existing literature are inconsistent, and there is still debate regarding whether they are the same concept; this leads to confusion amongst researchers and practitioners alike. For instance, APM (2008) defines manageability as a function of controllability and response effectiveness. Meanwhile, Ding *et al.* (2010) state that manageability is a combination of controllability and transferability. In addition, there remains a lack of any empirical study examining perceptions of these concepts in practice. For this reason, a study defining and distinguishing the manageability and controllability of project risk from both academic and managerial perspectives is needed to develop these concepts to be more useful in practice.

2.5.1. Controllability of Project Risk

There are several studies describing the concept of controllability in terms of project risk (Tian, Ph & Zhao 2012; Cagno *et al.,* 2007); APM, 2008; Ding *et al.*, 2010; Kuvaas, 2002; Gao & Jiang, 2008; Lam *et al*., 2007). However, like the concept of manageability, the definition of controllability in existing studies is inconsistent and unclear. The authors explain the concept only roughly, with no in-depth explanation of the characteristics of controllability in relation to project risk. They state only that controllability refers to the ability of risk owners to control the risk outcome.

A study conducted by Kuvaas (2002), for instance, which attempts to identify the relationship between information availability and top managers' perceptions of control (controllability), management (manageability) and data searching, is not clear on the definition of manageability and controllability. This study employed a questionnaire, distributed to 231 top management team members of the 93 largest newspapers in Norway. In the study, Kuvaas (2002) distinguishes the concepts of manageability and controllability in reference to internal and external problems that need to be managed by top management. Once the potential risk is related to the internal problem then it is categorised as controllable. On the other hand, if the potential risk is related to external problems, then it is categorised as relating to manageability. Nevertheless, the classification of manageability and controllability provided by Kuvaas (2002) does not refer to any existing references or examples. Furthermore, the dimension used to measure these concepts in the questionnaire is also not suitable for accurately reflecting their implementation within a project. This is because this study is not conducted within a project domain; it is conducted within industry, whereby industry practitioners may have different perceptions of manageability and controllability compared with project based practitioners.

From a different perspective to Kuvaas (2002), a study conducted by Cagno *et al.* (2007) explains another aspect of the controllability concept. Unfortunately, in this study Cagno *et al.* (2007) do not clearly define the concept of controllability, which can lead to misinterpretation by readers. They argue that the degree of controllability of each risk is different and will depend on the mitigation action performed. Hence, according to Cagno *et al.* (2007), the controllability (*C*) is the ratio between the expected value of losses caused by the risk after (E*) and before the mitigation process (E) conducted, as shown in Equation 4.

$$C = \frac{E^*}{E} \quad (4)$$

Based on Equation 4, it can be deduced that a lower value of controllability reflects a more effective mitigation process. Meanwhile, if the value of the controllability is one, or greater than one, then the mitigation process is considered ineffective in reducing risk. However, a low value for controllability in this formula depicts a high degree of controllability; this can cause the reader to misinterpret this, if they do not have a comprehensive understanding of the formula.

A study conducted by Tian and Zhao (2012) also provides another perspective on the concept of controllability. They propose a different formula to determine controllability; according to this study, controllability can be calculated by comparing the time margin with the time required once the accident occurs. The time margin is the time available to control the accident, while the time required refers to the real time needed to control the mishap. Therefore, if the time margin is less than the time required, the accident is deemed less controllable. By contrast, if the time margin is more than the time required then the accident is more controllable.

Unfortunately, measuring controllability using this formula may be inappropriate for application within a project. The study specifically targets the aviation industry, which has historical data recording the time aspects of mitigating accidents. Hence, top management in the aviation industry can easily predict the controllability level of any accident by using this formula. On the other hand, projects are by nature extremely unique, as described earlier. This means that the same risks are not present in every single project; therefore, the project manager will face difficulty in predicting controllability levels using this formula, as data relating to time margin and time required for previous projects may not exist.

Cybernetics and control theories are two approaches that can be utilised to comprehensively reflect the controllability of project risk, as they suitably describe several project characteristics. Together they offer three key benefits; first, they offer an advantage if they are applied to complex systems, such as projects, rather than simple ones. Hence, these theories can deal with the interrelations of the multiple inputs, multiple factors and multiple effects involved in a complex system (Ashby, 1961).

Second, cybernetics and control theories not only tackle complexity, but also deal with “change” (Ashby, 1961). Change refers to differences occurring within the same objects before and after a particular treatment at a particular time. In project management, change is one of the indicators representing the project progress. For instance, in a construction project, change is reflected in the transformation of the project from planning to product delivery.

Third, as projects are characterised as dynamic and continuous, cybernetics and control theories also pay attention to these aspect. To represent continuous control and change, generally, the closed feedback loop is utilised in both control theory and cybernetics theory, as shown in Figure 2.4.

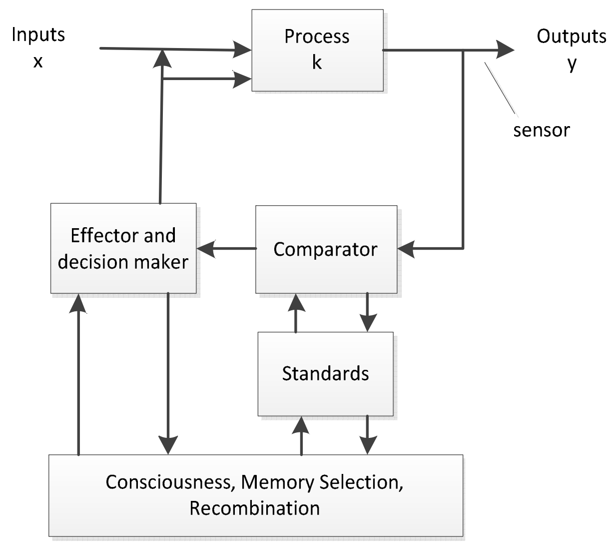

Figure 2.4. The third order feedback system by Dobre (2007)

Wiener (1948) describes cybernetics theory as fundamentally representing *"the science of control and communication between the animal and the machine"*. From this definition, two actors are implied - the animal and the machine - as well as two activities (communication and control), which play a crucial role in cybernetics theory. To implement cybernetics theory, Wiener (1948) adds that the capability of actors to generate information is required.

As well as cybernetics theory, another branch of engineering and mathematics sciences, known as control theory, can comprehensively explain the concept of controllability. Marshall (1978) describes how control theory explains the behaviour of dynamic systems consisting of inputs and outputs. In control theory, inputs can be transformed into agreed outputs until a stable system can be reached through a controller system. According to control theory, in order to reach stable system, the decision-maker must be capable of selecting and generating valid information.

According to previous research on controllability (Tian, Ph & Zhao, 2012; Cagno *et al.,* 2007; APM, 2008; Ding *et al*., 2010; Kuvaas, 2002; Gao & Jiang, 2008; Lam *et al*., 2007), cybernetics and control theory are definitely more able to comprehensively reflect on the controllability of project risk characteristics. According to these theories, in brief, the controllability of project risk can be explained as the capability of the decision maker to generate valid information and use it to inform a dynamic decision to obtain the agreed output (stable system) of the project.

2.5.2. Manageability of Project Risk

Manageability of project risk is different with risk management. Risk management is the concept which consists of several stages to identify, prioritise, assess of risks to minimise, monitor and control the probability and impact of unfortunate events as well as to maximise the realisation of opportunities (PMI, 2008). Meanwhile, the manageability of the risk is one of important aspects in risk management. As explained by Aven & Vinnem (2007), page 48: "*Some risks are more manageable than others, meaning that the potential for reducing the risk is larger for some risks compared to others*."

Several studies discuss the concept of manageability in relation to project risk (Aven *et al*., 2007; APM, 2008; Hillson, 2004; Aven, 2005; Ding *et al.*, 2010; Taroun, 2014; Kuvaas, 2002; Lam *et al*., 2007; Leijten, 2009). However, as with the definitions of controllability, most literature is also unclear on the exact definition of manageability of project risk. For instance, a study conducted by Ding *et al.* (2010) attempts to build a model to measure risk utilising three variables, namely the probability of event (*f* (r1)), the losses effected (*f* (r2)) and the manageability of event (*f* (r3)), shown in Equation 5

$$F = \sqrt[3]{f(r1), f(r2), f(r3)} \tag{5}$$

In Equation 4, each variable has its own formula to identify the value of each variable, with a range of between 0 to 100%. The formula of each variable is depicted in Equations 6 to 8.

$$f\ (r1) = e^{-a\pi\ (2r1-1)^2} \tag{6}$$

$$f\ (r2) = \frac{1}{2} + \frac{1}{2}(2r2 - 1)^{\frac{1}{2\beta - 1}} \tag{7}$$

$$f\ (r3) = \frac{1}{2} - \frac{1}{2}(2r3 - 1)^{\frac{1}{2\gamma - 1}} \tag{8}$$

r1 : probability of risk

r2 : impact of risk

r3 : manageability of risk

α : risk preference regulator of risk management subject

β : asset position regulator of risk management subject

γ : risk management ability regulator of risk management subject

Indeed, the study conducted by Ding *et al.* (2010) uses this method to calculate risk by considering several variables. Unfortunately, the study has several limitations. First, it does not explain how to assign each variable for calculation in the model. For instance, there is unclear guidance on how to assign the value of the risk management ability regulator of risk management subject (γ) to define the manageability variable. Second, the threshold to assign each variable is also unexplained. Third, it does not conduct any empirical study to test the validity of the model. Thus the study only provides an example of a calculation using the formula; it does not test the model in the case of a real project.

Another study, conducted by APM (2008), is also imprecise in its description of the manageability of project risk. Manageability refers to response effectiveness and controllability. Response effectiveness is *"the degree to which current risk responses can be expected to influence risk's outcome."* Meanwhile, controllability is *"the degree to which the risk owner (or owning organisation) is able to control the risk's outcome"* (APM, 2008, p.4). From this definition, APM implies that manageability considers only controllability and response effectiveness when measuring the level of manageability in a project risk. However, when measuring the level of controllability, it does not consider the effectiveness of the risk response conducted by the risk owner. However, in reality, the risk owners always take into account the effectiveness of their response in managing as well as controlling the risk.

Unlike other studies, the research conducted by Aven *et al.* (2007) defines manageability comprehensively and summarises the definitions provided by previous authors in relation to manageability (APM, 2008; Hillson, 2004; Aven, 2005; Ding *et al.*, 2010; Taroun, 2014; Kuvaas, 2002;, Lam *et al*., 2007; Leijten, 2009). According to Aven *et al.* (2005), manageability refers to the capability of the project team to reduce risk and increase opportunity within a project by considering both human and organisational (internal and external) factors to attain the desired project objectives. Equation 9 explains the measurement of degree of manageability degree based on the study by Aven *et al.* (2005).

$$EY = Es\,[Y(J) \mid d, K] \quad (9)$$

According to Equation 9 the degree of manageability and uncertainty can be measured by utilising the expected value taken at time s (Es) and related to the observation Y for the time interval J. Additionally, they add that the capability of project management practitioners to collect important information (K) is also crucial to define the level of manageability and uncertainty. Where project management practitioners have only a small amount of information, as in the beginning of a project, the level of risk manageability will be low. Conversely, when the information has already been collected, the level of risk manageability will be high.

On the other hand, the definition of manageability suggested by Aven *et al.* (2007) can distinguish between the two concepts of controllability and manageability. They judge that the key difference between controllability and manageability is located in how they deal with risk. In relation to controllability, the activity is to transform one form of risk to another, in order to obtain the agreed output, whereas, in manageability, this activity is reducing risk and increasing opportunity by carrying out mitigating actions to obtain the desired output. The differences between these concepts in relation to project risk are more thoroughly explained in the next chapter.

2.5.3. The Distinction between the Manageability and Controllability of Project Risk

According to existing literature discussing the concepts of manageability and controllability, as explained above these concepts can briefly be distinguished according to four aspects, which are: the activity undertaken to counter risk, the decision making process, the feedback system and the advantage of information. These are depicted in Table 2.1.

Table 2.1. Differences between Manageability and Controllability in PRM as Suggested in Existing Literature

Aspect of the Project	Manageability	Controllability
1. Activity undertaken to counter risk	Reduce risk	Change risk
2. Decision making process	Discrete	Continuous and dynamic
3. Feedback system	No feedback (open loop/linear)	Yes (Closed loop/non-linear)
4. Advantage of information	Predict the expected output	Decide the sensor and standard

The explanation of these terms is as follows:

1. The activity undertaken to counter risk

The activity engaged in to counter risk is different for the concepts of manageability and controllability. In relation to manageability, the activity used to reduce risk is similar to the traditional approach of risk management, namely reducing risk by conducting mitigation action.

Conversely, in relation to controllability, the activity to counter risk is changing the risk (Ashby, 1961; William, 1996). This means that the project manager will transform a particular form of risk to take another form. For instance, where a project manager desires to complete the project on time, they can add more employees in order to achieve this. In other words, in this case, the project manager will transform the risk of delay into a risk of being over budget.

2. Decision making process

The decision making process, particularly in a project risk context, is the process conducted by the decision maker through which to take decisions that control and manage risk in a project, in order to achieve the objectives of the project. In terms of the manageability and controllability of project risk, the decision maker takes different approaches to controlling and managing risk. In the case of controllability, Dobre (2007) and Hill (2011) state that the decision makers must apply a continuous process to the control system, since they argue that each project risk is likely to be related to others in different project stages. Accordingly, the decision makers cannot decide on one strategy only, discretely in a particular stage, but rather must make strategic decisions continuously throughout all project stages, in order to deal with interrelated risks at each stage. The continuous decision making process in relation to project risk can involve the activity of comparing the output of a strategy composed with the latest standards until it is agreed by project management practitioners. If the outcome is below standard (uncontrolled), then it must be repeated from the start of the process until the agreed outcome can be accomplished (Hill, 2011).

In relation to manageability, the decision makers must decide upon a strategy to confront risk discretely. They decide one a particular strategy to manage risk once, at a single point in time, so project managers decide on a particular risk response in each stage. Thus, according to this method, they assume that the risks in each stage are not related to other risks in other stages.

3. Feedback

Feedback refers to information relating to the past, which is likely to influence the future result. According to cybernetics theory (Hill, 2011), feedback in the controllability concept can be categorised as closed loop feedback, depicted in Figure 1. When the output is below standard, the system will provide feedback for the decision maker so they can decide whether the output is acceptable or not, and thus whether it should be continued in the next stage. Otherwise, if it is unacceptable, it should not be repeated after the first stage. This feedback process is conducted continuously until the output is agreed.

In relation to manageability, there are no feedback systems like those used in the controllability method. In the manageability concept, PRM is assumed to be a linear process of reducing risk to obtain the desired level (Saynisch, 2010). Accordingly, the first output of the PRM process will be the final output, as no iteration process is conducted to compare the first output with the standard.

4. Advantage of available information

Both manageability and controllability require information to decide the level of manageability and controllability that can be achieved. However, in practical terms, the advantages of available information are not only in the ability to measure the level of these factors; in relation to manageability, the information is also used to predict the output, based on the expected value (Aven & Kristensen, 2005). In terms of controllability, the information set is utilised by decision makers to update the latest standard as the sensor before the agreed output is obtained.

2.6. Literature Review Summary

According to existing literature, it can be concluded that PRM is a growing area that still needs further development because of the possible significant benefits that can be gained. One of the developments of PRM still required is to improve the P-I matrix to identify and prioritise project risk. Past researchers have stated that project risk cannot be described solely in terms of probability and impact, as these are not suitable for prioritising risk. This is because the categories used in the P–I matrix are overly broad, and the relative importance of uncertainty and impact might not be correctly represented by the scoring system used.

Two concepts in project risk management, known as manageability and controllability, are believed to be able to improve the current P-I matrix because they can identify and prioritise risk so that a proper strategy can be formulated and executed for risk reduction (Langevin & Mendoza 2008). Furthermore, the project will benefit from massive budget savings (Choudhury, 1986).

However, several authors studying the manageability and controllability of project risk offer various interpretations and definitions of these concepts. Moreover, most literature also does not feature any empirical study to validate the definition of these concepts and the usefulness in application of manageability and controllability from managerial perspectives. Therefore, this study attempts to recommend a useful definition and distinguish the implementation of manageability and controllability of project risk from academic and managerial perspectives in order to develop these concepts to be more useful in practice.

3. METHODOLOGY

3.1. Introduction

This chapter will discuss the research methodology and the rationale underpinning the selection of the research methodologies employed by the researcher in this study. The methodology selection is a crucial activity in any piece of research in order to produce a quality and valuable study and research results. Consequently, consideration of the research objectives and the nature of the research topic are required to determine the research methodology, and is the main factor in ensuring the credibility of the research.

This study has three aims, namely understanding the concepts of manageability and controllability from a managerial perspective, distinguishing the differences between these concepts from academic and managerial perspectives, and recommending definitions of the two concepts from academic and managerial perspectives. Thus, these objectives will be utilised to determine the underlying philosophical assumption of and the methodology with which this research will obtain a credible outcome.

3.2. Research Design

According to Taylor and Bogdan (1998), a methodology is "*the way in which we approach problems and seek answers*". Generally, there are three methodologies available for use in any particular research study, namely hypothetic-deductive, inductive and co-operative inquiries. However, prior to determining the methodology to be used, researchers should understand the nature of the assumptions made in and by their research, in other words their ontology and epistemology. Easterby-Smith *et al.* (2004) state that lack of consideration of the philosophical nature of the research can have a critical impact on the output of the research produced.

Regarding the research objective, this study tends to follow an objective ontology, which focuses on facts rather than data collection. This study identifies a research gap through a literature review process rather than through collecting data. Thus, at the beginning of the research process, a literature review was conducted in relation to the concepts of manageability and controllability of project risk, in order to highlight the issues in this area. This process involved reviewing articles from several journals in various areas, such as project management, risk management, management science, decision analysis and others.

Once the ontology has been identified, the epistemological stance of the research should be determined in order to make clear the researcher's perspective on the nature of the world. Based on the framework provided by Beech's (2005), the epistemology follows the ontology selected by the researcher. Easterby-Smith *et al.* (2004) explain that there are two possible epistemological paradigms that can be employed alongside an objective ontology, namely positivism and critical realism. On the other hand, where a subjective ontology is used, there are two possible epistemological paradigms available, namely the interpretivist and action research paradigms.

Regarding the ontology that has been defined, this study follows the critical realism paradigm. This was chosen because most characteristics of this study, such as the employment of multiple sources of data and perspectives, are suited to the characteristics of the critical realism paradigm, depicted in Table 3.1. In addition, this paradigm also offers the strengths and weakness of the positivist and interpretivist paradigms (Easterby-Smith *et al*., 2004).

The choice of ontology and epistemology typically inform the choice of methodology used within a research study. Depending on the ontology and epistemology selected, there are two possible methodologies that can be used, namely the deductive and inductive approaches. The deductive approach was selected for this study because the research objectives are composed via a literature review rather than a data collection process. Although most literature observes that that qualitative research tends to employ an inductive approach, Taylor and Bogdan (1998) state that a purely inductive research is impossible, as the researcher can never ignore all of their assumptions about the world.

Table 3.1. Ontologies and Epistemologies in Social Science Research (adopted from Easterby-Smith et al., 2004)

Elements	**Positivism**	**Critical realism**	**Interpretivism**
Truth	Is determined through verification of predictions	Requires consensus between different viewpoints	Depends on who establishes it
Facts	Concrete	Concrete but cannot be accessed directly	All human creations
Aims	Discovery	Exposure	Invention
Starting points	Formulation of explicit hypotheses which guide research	Suppositions/ Research Questions	Meanings/ Research questions
Research position (goal investigation)	Prescriptive, causal, deductive, theory confirming, ungrounded	Exploratory, descriptive, theory building, inductive, analytical	descriptive
Direction of research inquiry	Measurement and analysis of causal relationships between variables that are generalisable across tome and context	Development of idiographic knowledge based social experiences such as human ideas, beliefs, perceptions, values etc.	Development of idiographic knowledge based social experiences such as human ideas, beliefs, perceptions, values etc.
Designs	Experiment, survey	Triangulation, case study, convergent interviewing	Reflexivity, interviews, participant observation
Methodology	Outcome oriented, verification oriented	Process oriented, discovery oriented	Observation, process oriented
Techniques	Measurement	Survey	Conversation
Sample size	Large	Small	Very small
Data collection	Structured	Semi-structured, unstructured	Unstructured
Hardware, software	Questionnaires, statistical software programs	Tape recorders, interview guides, transcripts, qualitative software programs, visual methods	Tape recorders, interview guides, transcripts, qualitative software programs, visual methods
Type of data gathered	Replicable, discrete elements, statistical	Information-rich, contextual, non-statistical	Information-rich, contextual, non-statistical, somewhat subjective reality
Interview questions	Mainly closed with limited probing	Open with probing	Very open
Interaction of interviewer and phenomenon	Independent and value-free, a one way mirror	Mutually interactive but controlled by triangulating data, an open window	Passionate participant, transformative intellectual
Respondent's perspective	Emphasis on outsider's perspective and being distanced from data	Emphasis on the insider's perspective	Emphasis on outsider's perspective and being distanced from data
Information per respondent	Varies (specific to question)	extensive (broader question)	extensive
Analysis/ Interpretation	Verification/ falsification	Probability	Sense-making
Type of data analysis	Objective, value-free, statistical methods	Non-statistical, triangulation	Value-loaded, non-statistical
Causality	Cause-effect relations	Causal tendencies, generative mechanisms	Not addressed
Outcomes	Causality	Correlation	Understanding
Judgement of research quality	External validity and reliability are critical	Construct validity is important	Credibility, transferability, dependability, and confirmability

Once the methodology has been chosen, the next stage is for the researcher to determine the appropriate methods and techniques to be applied in the research. It is common for methods and techniques to be adjusted to the objectives of the research. This study has three research objectives, which aim generally to capture participants' perspectives and experiences in order to define and distinguish the concepts of manageability and controllability.

There are six possible methods and techniques that can be used in the inductive methodology, namely statistical testing, experiments, secondary data analysis, case study, observation and interviews (Beech, 2005). However, of these six possible methods, an in-depth interview is considered to be the most appropriate method for this particular study, as this method allows the researcher to gain an in-depth understanding of participants' stories, expressions, perceptions and experiences, as well as the meaning of a particular concept, in this case the concepts of manageability and controllability (Seidman, 2006; Silverman, 2005).

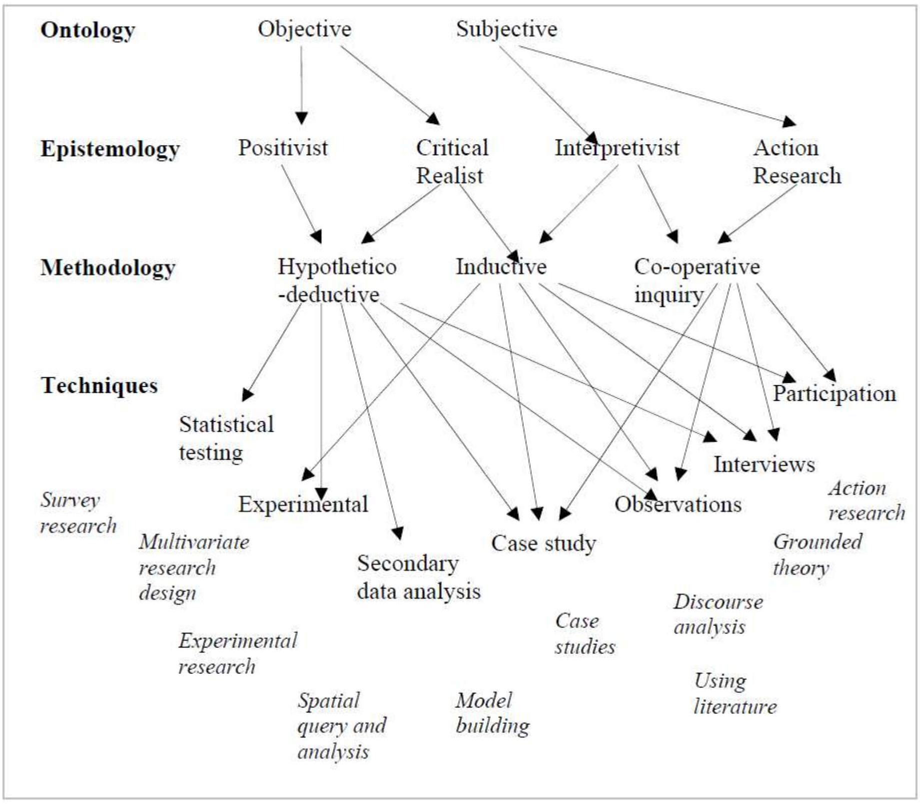

Figure 3.1. Research Design Map (Beech, 2005)

3.2.1. Semi-Structured Interview

This study utilises the in-depth interview method of data collection. By using this method, Sproul (1988) argues that the research will benefit from several advantages, specifically that the researcher can elicit information directly from the interviewee and thus will have the opportunity to probe, to clarify information, to explain complex information and to clarify or reflect on data previously collected from the interviewee.

There are three types of interview method: structured, semi-structured and unstructured. In the first method, the structured interview, pre-prepared questions are asked in the same question format, in the same intonation and in the same order, for each participant (Easterby-Smith, 2004). The advantage of this type of interview is that the researcher can ensure the same environment for the interview process; hence the output of the interviews can be easily controlled and analysed. However, when conducting a structured interview, the information obtained from the interview process will be more general than is achieved through other interview process types, as the researcher cannot add further questions during the interview process.

The second type of interview is an unstructured interview, which is very different to a structured interview. If using this interview type, the researcher does not require set, pre-prepared questions, as in the structured interview, rather they will ask questions based on a rough checklist of topics. This type of interview has advantages as well as disadvantages. The key advantage of this approach is that the researcher can elicit the interviewee's perceptions comprehensively, though these are difficult to analyse as the researcher may ask different questions to the interviewees throughout the interview process.

This study uses semi-structured interviews to elicit participants' perceptions of manageability and controllability in relation to project risk. According to Silverman (2005), a semi-structured interview can overcome the limitations of structured and unstructured interviews. By conducting a semi-structured interview, the researcher can be more flexible in preparing an initial list of questions prepared than they can for a structured interview.

Consequently, at the end of interview process, the researcher can generate richer and more contextually situated data.

Several prior researchers have stated that there are several stages that must be performed to obtain credible information by conducting a semi-structured interview (Taylor & Bogdan, 1998; Silverman, 2005; Seidman, 2006). The sub chapters below will comprehensively explain the stages of the data collection process, the data analysis process and the data validation process used in this study.

3.2.1.1. Selecting Participants

Taylor and Bogdan (1998) argue that the qualitative interview is a flexible research design in terms of the number and type of participants required to obtain the required information. Although it is flexible, the researcher should begin to think specifically in advance about who the participants representing the area of study will be. This is because the selection process for participants is a crucial task of conducting interviews, as the information obtained from the participants will affect the credibility of the research outcome.

According to Sproul (1988), there are two fundamental methods commonly used to select participants for the interview and observation process, namely the random method and the non-random methods. Both methods have their own advantages and disadvantages; hence the researcher should carefully decide which method will provide the most appropriate participants to represent the population under study.

The first method of selecting participants is the random method. This method consists of two approaches of participant selection, the simple random method and the stratified random method. Generally, both methods are bias-free, hence the sample has a high probability of being representative of the population. However, the disadvantage of these methods is that they are often more time consuming and costly, as they require a sizable number of participants.

The second method of selecting participants is known as the non-random methods. This method has four different approaches: the systematic approach, the convenience approach, the purposive approach and the quota approach. Compared with random methods, this method is cheaper and quicker. However, the method is potentially biased, as the researcher can be more subjective in determining the criteria used to select the participants. Consequently, to apply this method, the researcher should select the characteristics of the participants carefully, so that they accurately represent the population under study, prior to conducting the observation or interview.

In consideration of the two sampling methods and the research objectives, this study uses non-random method and the purposive sampling approach. This method is selected because it allows the researcher to ensure that the participants represent the proposed population. This can be achieved by taking several criteria from existing literature prior to selecting the participant, such as their experience of risk management, their project type and the country of origin of their company. On the other hand, by using the purposive sampling approach, the researcher can control and analyse data more easily, because it is revealed by participants from similar backgrounds. Accordingly, this study can be more specific in providing definitions of the manageability and controllability concepts from the perspective of project management practitioners with similar backgrounds and experience.

3.2.1.2. Developing Interview Questions and Pilot Study

Developing the list of question for an interview is just as crucial a process as the participant selection process, because credible research questions ensure a credible outcome of the research. Hence, to produce credible research questions, a pilot study should be conducted. Seidman (2006) states that the main aim of a pilot study is to guide the researcher into the right path before the study conducted. In the interview process, the researcher employs this process for several reasons (Trochim, 2006):

1. to identify incorrect items in the research instrument.

2. to predict possible difficulties that might occur during the interview and seek solutions to minimise these difficulties.
3. to estimate the time required to conduct the interview.
4. to measure the sensitivity of the questions from the participants' point of view.
5. to assess face validity and content validity of the research instrument. Face validity focuses on an informal assessment of question items conducted by a naïve user, whilst content validity is performed by an expert to assess conformity between research objectives and interview questions.

Due to the number of advantages provided, this study applies a pilot study in order to develop credible interview questions and assess the validity of the research question.

For this study, three participants assessed the interview questions separately. Therefore, in total, the interview questions have been revised three times, by three different participants. Two participants are postgraduate research students, who can be categorised as naïve users, and who assessed the face validity, and one participant is a general manager with experience in handling several projects, who assessed the content validity.

A pilot study is conducted by asking and recording the responses to all interview questions. After all interview questions have been asked, all participants are asked about their experience during the interview process. In more detail, eight questions were asked in the pilot study for this research, which were as follows:

1. Are there any unfamiliar terminologies in the list of questions?
2. Are there any questions that are difficult to understand?
3. Do the questions have a good structure?
4. Is the interview too long? Do you think the number of questions is too many?
5. In your opinion, how long is required to complete the interview?
6. Did you find any sensitive questions?
7. In general, are the questions suitable to pursue the research objective?

8. Do you have any comments to enhance the quality of the interview?

This research utilises three iterations of pilot study; the first and second iteration were conducted by the postgraduate research students. According to the first participant (R1), the interview questions could be understood easily. However, R1 provided several pieces of feedback, such as to avoid abbreviation, revise the structure and change several inappropriate terms in interview questions.

After revising the interview question following the first pilot study, the second pilot study was conducted. As a result of the second pilot study, several suggestions were also provided. First, the second participant (R2) suggested adding a range of project budgets and to add another population instead of project management practitioners, in order to avoid sensitivity and bias from participants. Second, R2 also proposed and revised several question forms to make them easier to understand.

The last pilot study was conducted with an expert from the project management field to assess the content validity, following the assessment of face validity in the first and second pilot studies. In the discussion with the last participant (R3), several comments were made. First, R3 stated that utilising various definitions of manageability and controllability can lead to confusion among participants. However, the researcher decided to keep all definitions of these concepts within the study, as the most represented definitions from the existing reference selected by the participant can be utilised to answer the last research question of the study. Second, as R2 and R3 also proposed and revised several question forms to make them easier to understand.

3.2.1.3. Conducting an Interview

There is no particular formula for conducting an effective interview. However, Seidman (2005) states that by listening, engaging, showing interest in the participants’ statements, and being purposive in moving forward is a productive manner in which to conduct an effective interview. By doing so, the researcher must listen and show interest in what people say during the data collection process.

For this study, one hour interviews were conducted with participants following a pilot study and the receipt of ethical approval. The interview process took place in the offices of the participants, or in a public area of Glasgow. The researcher also used a voice recorder to record the interviews to assist with data analysis.

During the interviews, the researcher asked several questions about the manageability and controllability of project risk. Additionally, by using a semi-structured interview, the researcher was able to probe in-depth participants' perspectives of these concepts through developing further questions during the interview. The full list of questions asked is provided in Appendix 1.

3.2.2. Data Analysis

The last main stage of conducting a semi-structured interview is to analyse, interpret and validate the data. Taylor and Bogdan (1998) state that the data analysis process is potentially the most difficult stage of qualitative research, as it is not a mechanical or technical process, such as in quantitative research. In the case of qualitative research, the researcher must apply good reasoning and theorising to the data collected in order to produce a good analysis.

Taylor and Bogdan (1998) advise several processes to analyse qualitative data. The first process is to transcribe the interview data; though this process can be quite time consuming and is potentially costly work, it provides several benefits to the researcher. For instance, it can improve the consistency of the process, encourage the researcher to think through the process and allow them to share their interpretation with readers at a later point. In line with this advice, this data collected in this study was transcribed to produce transcripts of the interviews of each participant, which are useful in analysing the data. These transcriptions are then thoroughly read and re-read by researcher in order to develop an understanding of the concepts of manageability and controllability and begin to interpret the data. The transcription of this study is available upon request.

The second step of the data analysis process is coding and reducing the data. Seidman (2006) states that the aim of this process is to categorise and reduce text into groups with particular codes. The researcher should condense the text and select the important parts inductively rather than deductively. This means the researcher does not address the data with set of hypotheses; instead, they should be open-minded in relation to what emerges as important and interesting within the text.

In this study, the coding and reduction process was conducted using NVIVO software. First, the researcher identified the significant data and grouped it according to six codes. The six codes used were: the concepts of manageability and controllability; project monitoring; the profile of respondent; the project performance; PRM; and improvement. However, to go into more detail, this study also uses sub-codes. For instance, within the 'profile of respondent' code there are four sub-codes: project scale; role in the project management; type of project and work experience.

The third aspect of data analysis is understanding and interpreting the data captured in each code in particular contexts within a piece of research. Seidman (2006) states that this interpretation process can begin with the researcher asking themselves what they have learned from conducting the interviews, studying the transcript, marking and labelling them and organising categories of excerpts. This facilitates the interpretation of data by summarising the entire interview data for each participant based on the codes developed. Afterwards, the researcher can interpret the data by identifying patterns within each code, for all participants, through highlighting similar keywords commonly appearing in each code. The last stage in the data interpretation process is to compare the data that has been interpreted with the existing literature to the manageability and controllability of project risk.

3.2.3. Data Validation

The quality of qualitative research can be determined by the drawing of valid conclusion(s) (Silverman, 2005). According to Hammersley (1990, p.57), validity is "*another word of truth interpreted as the extent to which an account accurately represents the social phenomena to which it refers*". In qualitative research, Silverman (2005) states that the validation can be achieved through a process of data triangulation or respondent validation. If using the second validation method, the researcher should return to the participants and ask them about the results of research following the analysis and interpretation process. Then, to obtain the final outcome of the research, the researcher can revise the results according to the participants' comments (Reason & Rowan, 1981). During the validation process, the participant is strongly recommended to agree with, revise, delete or add to the information provided in the tentative results.

In this study, a respondent validation process was carried out in order to yield a valid and credible conclusion. First of all, after analysing and interpreting the data, the researcher produced an interview summary for each participant. Then, these summaries were distributed to the participants via email so that they could review them and provide feedback. Regarding the validation process performed, two of four participants agreed with the interview summary composed by the researcher, whilst the others reviewed and added the interview summary by providing comments and feedback. The validation process used for the study was an iterative process, hence it was conducted continually until the participants agreed with the interview summary and the final research result could be concluded.

4. RESULT AND DISCUSSION

4.1. Introduction

This chapter will present the results and analysis of the in-depth interviews that were conducted. It will discuss the profile of participants, project performance, and the participants' perception of the concepts of manageability and controllability and so on. In addition, this chapter will also discuss the results, elaborating on past studies relating to manageability and controllability.

4.2. The Profile of the Participants

Understanding the profile of participants is an essential element of conducting a research based study, such as one using in-depth interviews and/or surveys, as the results of the study are mostly determined by the participants' perceptions, which are influenced by the experiences they have had in regards to a particular issue (Sproul, 1988).

This study categorises the profiles of the four participants according to four categories, namely work experience, responsibilities, type of projects and project scales. First, in terms of work experience, responsibility and type of projects, participants had different backgrounds. The first participant (P1) is a project sponsor on several different IT projects with approximately 12-13 years' experience of managing projects. P1 also has some experience as a project trainer and a project manager in IT, as well as in policy restructuring projects. The second participant (P2) is a risk manager with four years' of experience in several different thermal projects; they have also worked as a risk manager in general businesses, major capital projects, IT and change management projects for the last fifteen years. The third participant (P3) is currently a project manager in a business improvement project. P3 has been involved in the project for approximately eighteen months, and is responsible for implementing a lean concept using a continuous business improvement in a university. The fourth participant (P4) is a four-year control manager in several different thermal projects who has some experience in the area of project management over the last sixteen years. P4 has been a planner, a control manager, a project manager, a programme manager and a portfolio manager for several projects, such as nuclear, defence, construction and energy projects.

Second, in terms of project scale, most of the participants (P1, P2 and P4) have experience in managing projects of various sizes. According to the Software Education Group (2008), there are five project sizes based on the overall investment provided, namely enhancement projects (under $250,000), small projects ($250,000-$1M), medium projects ($1M-$3M), large projects ($3M-$10M) and very large projects ($10M or more). P1, for instance, has managed enhancement projects with £30,000 of overall investment, as well as very large projects with overall investments of as much as £14M. Unlike P1, P2 and P4 have experience of managing large projects with budgets of £5M, and very large projects worth £1000. Only the other hand, P3 only manages enhancement projects, as the overall investment only covers the project team salaries.

From knowledge of the participants' backgrounds, it is clear that between them they have a lot of experience in working in the project management area. Additionally, they have also managed different projects and held different responsibilities. Thus, even though this study only utilises a small number of participants, the participants' experiences and perceptions regarding the manageability and controllability of project risk can be considered to provide useful information from a number of different perspectives.

4.3. The Project Performance

Typically, the performance of a project can be judged by the project cost, time to complete and the quality of the output that is delivered. However, Taroun (2014) states that time and cost are generally used to measure project performance because they are quantitatively easier to measure than project quality. Therefore, in this study, project performance is described only in terms of budget and time to complete the project.

First, in terms of project duration, three participants (P1, P2, and P3) stated that most of their projects incur some delay. P2, for instance, stated that there are very few projects that finish on time and on budget, for different reasons, the first being that estimations are not realistic at the beginning of the project cycle. On the other hand, in many cases, delays and over spending are caused by a lack of regular reviews of the cost and impact by project team as the project progresses. In agreement with P2, P3 stated that one in four projects experience a month’s delay as a result of improper planning at the beginning of the project. However, unlike P2, P1 stated that for all of the projects they handled that were delayed because a time contingency had not been applied.

Surprisingly, of all the participants, only P4 revealed that their projects can be managed on time and on budget. This is because the project team always add 10% overrunning costs and time contingency to the plan, as well as applying chain control for every project conducted. On the other hand, P4 argued that that the more time is spent on a project, the more budget the project team must consume. Therefore, P4 always attempts to deliver their projects on time, in order to prevent going over-budget.

In summary, according to the participants’ perceptions, there are three underlying issues that must be considered in order to deliver a project on time and within budget, namely producing a realistic estimation at the beginning of project cycle, applying a time and budget contingency plan in every project and undertaking regular reviews of cost and impact as the project progresses.

4.4. The P-I Matrix

According to the interview data, two different perceptions exist from academic and managerial perspectives in relation to the P-I matrix. The first relates to the way managers perceive the usefulness of the P-I matrix, and the second to the way managers perceive the importance of the P-I matrix score.

First, from an academic point of view, at present project risk is always identified and prioritised according to two variables, namely probability and impact (P-I), reflected in a P-I matrix. However, several past researchers have stated that these variables are not useful in representing overall risks. (Williams, 1996; Aven *et al.*, 2007; APM, 2008; Cagno *et al.*, 2007). They point out that there are two issues that emerge when applying the P-I matrix in practice. The first issue is that the categories used in the P-I matrix are quite rough and broad, and so don't represent overall risk. Therefore, it often occurs that a lot of risks get put into the same category. The second issue is that there is no single way of establishing an overall risk level using the P-I matrix, which is quite arbitrary in its ability to determine the level of risk. Specifically, the relative importance of uncertainty and impact may not be correctly represented by the scoring system used.

All of the project management participants expressed different perceptions about the P-I matrix. However, although all participants agreed that the P-I matrix could be improved to assess project risk better, they debated whether the P-I matrix is still effective in identifying and prioritising risk. P2, for instance, stated that the P-I matrix is still used to identify and prioritise risk, as it allows a project team to quickly identify risks that need to be focused on. On the other hand, by adding other categories to represent overall risks in the P-I matrix, P2 argued that the project team will make a lot of assumptions; for instance, when adding the controllability category to the P-I matrix, an assumption regarding whether the risk can be controlled or not should be added. For this reason, P2 still applies the P-I matrix in their system.

Second, although all participants state that they still use the P-I matrix to identify and prioritise risk, they employ different kinds of P-I matrix. There are two different types of P-I matrix used by participants to identify and prioritise risk. The first type is a full five-by-five matrix of probability and impact. Most of the participants (P1, P2, and P4) use this first type of P-I matrix. The second type is a four-by-three matrix of probability and impact, which is only used by P3. As discussed in existing literature (Williams, 1996;

Aven *et al.*, 2007; APM, 2008; Cagno *et al.,* 2007), the different types of P-I matrix might produce different scores for a particular risk, which might incorrectly represent the relative importance of uncertainty and the impact of risk. On the contrary, from a managerial perspective, P1 revealed that the score resulted from the P-I matrix is unimportant in determining the relative importance of uncertainty and the impact of risk. P1 stated that the most important is the way to produce the probability and impact score from the decision makers. For instance, understanding the reasons for decision makers to use the P-I score through a process of communication is the most important point that should be taken into account.

4.5. The Manageability and Controllability of Project Risk

4.5.1. Managers' Perceptions of Manageability of Project Risk

The interviews conducted for this study attempted to illuminate the concept of manageability from a managerial perspective. Participants were asked several questions relating to manageability, such as their degree of familiarity with this concept, their own perceptions of it and any comments they have regarding the academic definition.

First, in terms of familiarity with the concept of manageability, only two participants (P2 and P4) claimed to be familiar with it or to have heard about the manageability of project risk, while the rest of the participants (P1 and P3) were unfamiliar with the concept. P3 stated that they had never heard of manageability because their project team never used academic terms, however, it is possibly that P3 does apply manageability in their projects.

Second, in terms of participants' own perceptions of manageability, most of them (P2, P3 and P4) perceived that manageability can be applied before controllability, stating that the concept of manageability is related to the management process, structure and systems, such as in identifying and understanding project risk, whereas controllability relates to controlling the output of a process by doing something to address risks.

However, an entirely different perception was revealed by P1, who had never heard of this concept. From P1's point of view, the concept of manageability is the process of taking some mitigating action and establishing a contingency plan for the project in order to reduce risk, whereas controllability is the process of classifying whether an event poses a risk or not. Therefore, the project team must use controllability to identify and classify project risk in the first order before they apply manageability. From the perception of P1, manageability can be applied once the project team has failed to execute controllability. Accordingly, if the project team cannot apply manageability, then the project risk can be classified as an unmanageable project risk.

Third, in terms of their comments about the academic definition of manageability, two of the four participants (P1 and P2) stated that Aven *et al.*'s (2007) definition is the closest to their understanding of this concept. They (P1 and P2) agree with Aven *et al.* (2007) that manageability refers to the capability of a project team to reduce risk and increase opportunity within a project by considering human and organisational factors (internal and external) to obtain the desired project objectives. Meanwhile, the others (P3 and P4) claimed that the definitions provided by Leijten (2009), Gao and Jiang (2008) and Ding *et al*. (2010) best reflect their understanding of manageability. P4, for instance, prefers Ding *et al.'s*. (2010) definition because it mentions the concept of transferability. According to P4, transferability is an important concept, one which should be applied in a project to transfer risk to another party in order to manage project risk.

Briefly, according to the interviews conducted with participants, two of the four participants (P2 and P4) are familiar with the concept of manageability, though one (P1) has their own perception of this concept. According to their individual perspectives, most of them (P2, P3 and P4) judged that manageability is related to the management process, structure and systems, such as in identifying and understanding project risk. According to their comments regarding the academic definition of manageability, P1 and P2 agree with the definition provided by Aven *et al.* (2007), whilst P3 and P4 agree with Leijten (2009), Gao and Jiang (2008) and Ding *et al.* (2010), as these definitions reflect their own perspectives.

4.5.2. Managers' Perceptions of Controllability in Project Risk

The interviews conducted also sought to capture the managerial perspectives of controllability. Thus, participants were also asked three main questions in terms of their familiarity with the concept of controllability, their own perception of it, and any comments they had regarding the academic definitions of this concept.

According to the interview data, only one participant (P4) had heard of the concept of controllability in relation to project risk, whilst the others (P1, P2, and P3) were entirely unfamiliar with this concept. Based on the perception of the participant who had heard of controllability (P4), they understood the concept to refer to the procedures and instructions involved in controlling the output of a project risk management process. Additionally, P4 also stated that it is not only what the project team does about a risk, but is also about engaging in effective communication with the other actors involved in a project in order to control the output of PRM.

A different perception was revealed by P1; from this participant's point of view, controllability is a more theoretical concept than manageability. P1 judged controllability to be a binary concept, one that indicates whether an event is categorised as a risk or not. According to P1's perception, if the event cannot be controlled then it can be categorised as a risk, and vice versa.

As well as asking about participants' own perceptions of controllability, this researcher also asked about their perceptions of several academic definitions of the concept. However, of the four participants, only P3 supported an academic definition of controllability. P3 argued that the definitions provided by APM (2008), Miller & Lessard (2001) and Fan *et al.* (2008) are the closest to their own perception, and reflect controllability in a real project context.

The definition of controllability given by Fan *et al.* (2008) is presented as a comparison between the prior and posterior probability of the occurrence of a risk event. Fan *et al.* (2008), Miller and Lessard (2001) also define controllability as the likelihood of changing the probability distribution of the occurrence of an event. On the other hand, APM (2008) states that controllability is the degree to which the risk owner is able to control the risk outcome.

Of the three definitions selected by P3, only the definition provided by APM (2008) explicitly mentions the participants' own perceptions (P2, P3, P4) of controllability, namely controlling the output of the process. By contrast, the controllability definitions provided Miller and Lessard (2001) and by Fan *et al.* (2008) do not explicitly mention controlling the output of the process. However, their definitions can still be utilised as an indicator of whether the output of process is categorised as controllable or not, by comparing the prior and posterior probability of the occurrence of the event.

To summarise, three participants (P1, P2 and P4) disagreed with the controllability definition provided in existing literature; they argued that the academic definitions did not reflect the concept in a real project context. Consequently, participants believed that their own perceptions of controllability better represent the concept in daily project management than the academic perspectives do.

4.5.3. The Managers' Perceptions of Controllability and Manageability in Project Risk

During the interviews, participants were asked about manageability and controllability based on their perceptions of whether these concepts are the same or not. Most participants (P1, P3, and P4) argued that manageability and controllability are two different concepts in PRM. In thermal projects, for instance, P4 stated that the two concepts are different in terms of delivery and activity conducted. P4 further argued that identifying risk is an activity conducted as part of manageability, whereas controlling the output is an activity related to the controllability concept. A similar argument was also given by P3 that manageability is different to controllability in terms of activity performed. P3 also argued that manageability activities involve understanding the risk, whereas controllability activities involve taking mitigating action to reduce the risk.

By contrast, P2 considers the two concepts to be the same, claiming that the definitions of manageability and controllability given in academic literature just use different words to describe the same content. Furthermore, P2 also argued that the two concepts are like two sides of the same coin, in that they have the same structure; they believe that managing the management process is always followed by controlling the output in PRM. Accordingly, the project teams cannot separate these concepts.

As well as capturing participants' perceptions of the differences between the two concepts, they were also asked to explain their perceptions of four different aspects of the two concepts, taken from the existing literature, as depicted in Table 2.1. Of several different aspects of manageability and controllability, from an academic point of view, only P3 chose and agreed with two of these four aspects, namely activity to encounter risk and information used. On the other hand, the others (P1, P2 and P4) disagreed with all the different aspects of the manageability and controllability concepts provided in academic literature. They argued that they were irrelevant and unhelpful in distinguishing between the concepts. Hence, they judged that their own perceptions were better able to distinguish the concepts than an academic perspective.

4.5.4. The Application of Manageability and Controllability in Project Risk Management

All participants agreed that the manageability and controllability of project risk are important elements of a project. However, only two of the four participants (P1 and P4) apply these concepts in their projects. The others (P2 and P3) stated that they never apply these concepts, as they don't label project activities using academic terms. Nevertheless, they engage in activities that are similar to the concepts of manageability and controllability, but without labelling them.

On the other hand, participants have also implemented the concepts differently. This different implementation of the two concepts is due to the participants' different interpretations of these concepts, for instance, where they are used in thermal and IT projects. For thermal projects, P4 interprets manageability as identifying risk, and controllability as controlling the output of the process. Hence, to implement manageability, P4 performs a risk register and uses the P-I matrix, both of which are updated through monthly reviews; P4 utilises the internal project team to control internal risk and an external party to control external risk. On the other hand, in IT projects, controllability is considered to be identifying risk, whilst manageability is considered to be taking mitigating action to manage risk. Therefore, according to P1's perception of the two concepts, controllability is enabled by determining whether or not the event is a risk, through a project team workshop. Afterwards, if the event is judged to represent a risk and cannot be controlled, P1 applies manageability through a risk register, a workshop and meeting with all project teams to produce a mitigation and contingency plan.

On the other hand, the two participants who have never implemented these concepts (P2 and P3) both stated that they do not apply them because they do not refer to their activities in academic terms. However, they do engage in activities that are similar to the concepts of manageability and controllability, based on their own perceptions. They keep the activities of the project as simple as possible, without assigning a particular name to the activities conducted. They also identify and prioritise risk using the risk register and the P-I matrix, though they never consider these activities as relating to manageability.

4.5.5. The Differences and Similarities regarding Controllability of Project Risk from Managerial and Academic Perspectives

According to the interview data and the literature review, of the four aspects identified in past literature, only two aspects distinguish the controllability of project risk from the managerial and academic perspectives, namely activity and the decision making process. Meanwhile, two other aspects are perceived the same way across both academic and managerial perspectives. The different aspects of manageability and controllability from managerial and academic perspectives are depicted in Table 4.1.

Table 4.1. The Different Aspects of Controllability from Managerial and Academic Perspectives

No.	Aspect	Academic Perspective	Managerial Perspective
1.	Activity	Changing risk	Controlling output
2.	Decision making process	Continuous	Discrete

First, from the academic perspective, changing the form of risk is the activity conducted to practise controllability, in order to accomplish the project targets (Ashby, 1961; Wiener, 1948). A project to construct a stadium for the Commonwealth Games, for instance, can illustrate controllability; in this project, the main output is focused on delivering the project on time, as the venue and the date for the event will have been announced. Consequently, project teams must control the risk of delay by hiring more workers to complete the project on time. This activity to control risk might incentivise project teams to change risk from risk of delay to risk of being over budget.

Meanwhile, from the managerial perspectives, most participants (P2, P3 and P4) define controllability activity from different perspectives within the academic point of view, namely controlling the output of the risk management process. According to participants' perceptions (P2, P3 and P4), controlling output can be achieved by utilising the internal project team to control internal risk and an external party to control external risk.

Second, in terms of the decision making process, the academic and managerial perspectives offer different interpretations here, too. According to existing literature, Dobre (2007) and Hill (2011) state that in the practise of controllability, a decision maker views a risk as being related to others in different project stages. Hence, the project teams must decide on a strategy to reduce risk continuously throughout the project cycle (Hill, 2011). They cannot apply a risk prevention strategy separately in each project phase. Accordingly, when a risk emerges in a particular phase, the preventive strategy has been prepared previously, with no need to carry out a regular workshop or meeting in each particular phase.

Unlike with the academic perspectives, none of the participants update the output of risk management process continuously; rather, they just conduct several meetings to compare and update the risk status discretely. They wait to update the risk status, the mitigation actions and the contingency plan in their regular meetings and workshops, conducted weekly or monthly.

The two other aspects listed in Table 4.2, on the other hand, are perceived in the same way from both academic and managerial perspectives. The first of these is the feedback process; according to the academic perspectives about the general concept of a feedback process, fundamentally, a feedback process consists of input, output and standard (Marshal, 1948). It will exist if the output of the process is below standard, where the system will provide feedback to reprocess the current output from the early stages in order to accomplish the agreed standard.

Table 4.2. The Aspects of Controllability that are the same from both Managerial and Academic Perspectives

No.	Aspect	Academic Perspective	Managerial Perspective
1.	Feedback	Closed loop	Closed loop
2.	Advantage of information	Decide sensor and standard	Decide sensor and standard

In line with the general concept of a feedback process, Hill (2011) states that the feedback process that can feature as part of controllability is a closed loop feedback system. When the output of a risk management process is below standard, the system will give feedback as a signal for the decision maker to decide whether the output is acceptable or not. If it is unacceptable, the output of the risk management process should be reprocessed from the beginning of the stages. This process is conducted continuously until the output is agreed upon.

The managerial perspectives also judge that closed loop feedback is also applied by project management practitioners to control the output of the process (P2, P3, and P4). This is because controlling the output of the process also requires sensors and indicators, whether the output of the process fits with the agreed project output or not. If the process fits with the agreed output then the process can continue to later stages of the process. Meanwhile, if the output of the process is unfit for the agreed output then the project team must repeat the process until the agreed output is reached.

To run a feedback process for controllability properly, communication among project teams is key. Communication is designed to generate and distribute information during the process to reach the agreed output (Wiener, 1948). From managerial perspectives P4 also stated that communication is required to enable the controllability of project risk. Controllability, according to P4's perception, is not only what the project team does about risk but is about communication with others. Furthermore, P4 also argued that communication is significant to the controllability of project risk because it is the root cause of all risks associated with a project. Therefore, if project teams desire to control project risk successfully, they must take into account the communication process within the project.

Lastly, another aspect also perceived by academic and managerial perspectives is the benefit of information utilised by the decision maker. According to control theory and the concept of cybernetics, information is used to update the latest standard (sensor) to obtain the agreed output. Similarly to these theories, all participants stated that information obtained by project stakeholders is used to define the latest standard to control risk regularly.

4.5.6. Differences and Similarities in Manageability of Project Risk from Managerial and Academic Perspectives

Unlike controllability, manageability can be distinguished in relation to two aspects, namely the activities and the advantages of information, as depicted in Table 4.3. The first differing aspect is the activity conducted to apply manageability. According to the previous literature, the activity conducted to enable manageability is reducing risk through mitigating action. However, from the managerial perspectives, most of the project management participants (P2, P3 and P4) argued that the key activity of manageability is identifying risk. If the event is manageable, then it cannot be categorised as risk any more, and vice versa.

Table 4.3. The Different Aspects of Manageability from Managerial and Academic Perspectives

No.	Aspect	Academic Perspectives	Managerial Perspectives
1.	Activity	Reducing risk	Identifying risk
2.	The advantage of information	Predict the expected output	Define risk

The second different aspect is the benefit of information. In previous research, Aven and Kristensen (2005) state that information is used to ensure manageability by predicting the output of the risk reduction process, reflected in the expected value. Conversely, the managerial perspectives (P2, P3, and P4) argue that information is used to define and identify the risks of project.

Besides these two different aspects of manageability, the managerial and academic perspectives also agree on some aspects, as depicted in Table 4.4., namely the decision making process and feedback.

Table 4.4. Aspects of Manageability that are the same from both Managerial and Academic Perspectives

No.	Aspect	Academic Perspectives	Managerial Perspectives
1.	Decision making process	Discrete	Discrete
2.	Feedback	No feedback (open loop/linear)	No feedback (open loop/linear

The first similar aspect relates to the decision making process. Past literature states that the decision maker only defines the strategy to manage risk once in each project phase, and usually do not make decisions continuously because, they argue, the risks involved in each project phase are not related to other risks throughout the project. Consequently, the decision maker only makes a decision once in each stage of a project. As in the academic perspective, the participants do not conduct a continual risk identification process, instead they identify project risk at the beginning of the project.

The second identical aspect relates to the feedback system. The manageability concept does not apply closed loop feedback, as controllability does. Unlike the concept of controllability, which uses a closed loop feedback system, Saynisch (2010) states that manageability is achieved through a linear process. In the linear process, the project team does not reprocess the output from the beginning of project, even if it is below standard.

As with the academic point of view, the managerial perspectives (P2, P3 and P4) also followed the linear process. They argued that the identification process is the process of distinguishing whether an event represents a risk or not. Accordingly, when an event is not categorised as a risk, project management participants are not required to reprocess the first stage until the event can be categorised as a risk. When an event is not categorised as a risk they do not need to do anything, and must proceed with the controllability process if an event is categorised as a risk. Table 4.5 summarises the differences between the manageability and controllability of project risk from the managerial point of view.

Table 4.5. The Differences between Manageability and Controllability of Project Risk from a Managerial Point of View

No.	Aspect	Manageability	Controllability
1.	Activity	Identify risk	Control output
2.	Feedback	No feedback (open loop/linear	Closed loop
3.	Advantage of information	Define risk	Decide sensor and standard

4.5.7. Recommendation of a Useful Definition for Manageability and Controllability of Project Risk

In terms of academic definition, various definitions are given for manageability and controllability. In summary, there are 11 definitions of controllability and 8 definitions of manageability, provided by different authors in the existing literature. However, those definitions lack agreement among authors' interpretation of these concepts. Accordingly, they can be difficult to implement in practice.

On the other hand, according to the managerial perspectives of the participants, they have different interpretations of manageability and controllability. According to the four participants' perceptions, three (P2, P3, and P4) share a similar understanding of these concepts. They (P2, P3 and P4) perceive that manageability is about identifying and understanding risk whilst controllability is about controlling the output of the risk management process.

Participants were not only asked to provide their own perceptions of these concepts, but they were also asked about their perceptions and comments of the academic definitions of those concepts. Based on the managerial perspectives, two of four participants (P1 and P2) agree with Aven *et al.*'s (2007) definition of manageability. The others (P3 and P4) claimed that the definitions provided by Leijten (2009), Gao and Jiang (2008) and Ding et al. (2010) reflects their perceptions about the manageability concept. Meanwhile, in the controllability concept, only definitions from APM (2008), Miller and Lessard (2001) and Fan et al. (2008) are agreed by one participant (P3).The others (P1, P2, and P4) argue that their own perceptions are more reflecting this concept in practice. Table 4.6 and 4.7 depict the academic definitions of the manageability and controllability concepts agreed by participant and the own definition of manageability addressed by participants.

Table 4.6. Manageability Definitions from Academic and Managerial Perspectives

No.	**Author**	**Definition**
1.	Aven *et al.* (2007)	Manageability is the capability of the project team to reduce risk and increase opportunity in a project by considering human and organisational factors (internal and external) to obtain the desired project objectives.
2.	Leijten (2009)	Manageability is related to information needed to decide upon the risk response.
3.	Gao and Jiang (2008)	Manageability is the ability to assign risk to a participant who can best manage best reduce the risk
4.	Peng-cheng *et al*. (2005) in Ding *et al*. (2010)	Manageability = controllability + transferability
5.	Participants' own	1. Manageability is how to mitigate, deliver and control risk by collecting important

	perceptions	information to manage project risk. Manageability is linked with the management process, structure and systems, such as in identifying and understanding project risk. (P4) 2. Manageability is related to the process of identifying whether an event can be considered a risk or not. (P3) 3. How effective the level of control is within the project environment. (P2)

According to all definitions presented in Table 4.6, in a nutshell, the objective of manageability within a project is to reduce risk and increase opportunity. In order to address the project objectives, therefore, several underlying elements must be in place, namely collaboration among actors, information to be utilised and the activity performed.

First, in terms of collaboration among actors, Aven *et al.* (2007), state that an internal and external project team should collaborate to reduce risk. In more detail, Ding *et al.* (2010) applies the concept of transferability concept; this means that risk can be assigned to the internal and external actors who can best manage and reduce the risk. Second, in terms of the information utilised, Leijten (2009) and one of the participants (P4) agree that information in relation to manageability should be employed to manage the process, structure and system, and to carry out mitigating actions. The last element to be addressed in pursuit of the project objectives is the activity conducted. Most participants (P2, P3 and P4) perceived that the activity that should be conducted in applying manageability is identifying and understanding project risk. They agree that manageability is a binary concept that determines whether or not the event can be classified as a risk. Therefore, according to academic and managerial perspectives, manageability can be defined as the capability of the internal and external project team to select and utilise important information for identifying and understanding project risk in order to reduce risk and increase opportunity within a project.

Table 4.7. Controllability Definitions from Academic and Managerial Perspectives

No.	Author	Definition
1.	APM (2008)	Controllability is the degree to which the risk owner is able to control the risk outcome.
2.	Miller and Lessard (2001)	Controllability of a risk event refers to the likelihood of changing the probability distribution of the occurrence of the event.
3.	Fan *et al.* (2008)	Controllability is defined as the comparison between the prior and posterior probability of the occurrence of the risk event.
4.	Participants' own perceptions	1. Controllability is about the procedures and instructions required to control the output of the risk management process. 2. Controllability is not only what the project team does about risk, but it is also about utilising effective communication with other actors involved in a project to control the output of PRM. (P4)

Unlike manageability, according to Table 4.7, controllability is perceived differently. The aim of this concept, from academic and managerial perspectives, is to control the outcome of the mitigation action conducted. Therefore, to address the aim, three essential elements must be emphasised, namely the activity conducted, the skill required and the parameter used to measure controllability performance.

The first element is the activity conducted to apply manageability. According to APM (2008) and participants' own perceptions, controlling and monitoring the output of risk management is the activity conducted by project management practitioners to achieve controllability. To control and monitor the output of risk, therefore, P2 states that the project team can apply mitigating actions, regular workshops, insurances, procurements, legal and financial instruments and so forth.

The second element is the skill required by the project teams to apply controllability, namely the communication skills of the project teams. P4 believes that controllability is not only about the activity performed by the team, but is more about utilising effective communication with other actors involved in a project to control the output of PRM. This is in line with the academic understanding presented by Wiener (1948), who explains that communication skills are intended to generate information in control theory, in order to reach the agreed output.

The last element to address in terms of the aims of controllability is the parameter used. In general, a parameter is used to judge whether the process is under control or not. It is important that this is considered when applying controllability because the parameter is used to ensure that the controllability concept is properly applied. According to the academic definitions agreed by the participants, Miller and Lessard (2001) and Fan *et al.* (2008) present a parameter of controllability, namely the differences in probability of occurrences. They explain that controllability can be reflected in a comparison between the prior and posterior probability of occurrence after the mitigating action is performed. Therefore, if the probability of risk after the mitigating action (output) is more than the probability of risk before the mitigating action (input), then the project team does not properly apply the controllability concept, and vice versa.

In brief, from the objectives and three elements embedded in this concept, controllability can be defined as the ability of a project team to monitor and control the output of the project risk management process by utilising effective communication. In monitoring and controlling output it is common for project teams to deploy a parameter that enables them to distinguish the probability of occurrence before and after the project risk management process is conducted.

Table 4.8. Recommendation of Controllability and Manageability Definition from Academic and Managerial Perspectives

Manageability is the capability of the internal and external project team to select and utilise important information for identifying and understanding project risk in order to reduce risk and increase opportunity within a project.
Controllability is the ability of a project team to monitor and control the output of the project risk management process by utilising effective communication

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

This final chapter concludes the summary of two concepts, namely manageability and controllability. It will describe briefly the differences between them and recommend useful definitions of the two concepts from academic and managerial perspectives. Additionally, some recommendations for further research will also be presented in this chapter. According to the in-depth interviews and the analysis process conducted, three conclusions can be drawn to answer the research questions of this study, to be explained in the following sub chapters.

5.1.1.The Managerial Perception of Manageability and Controllability

Regarding the managerial perspectives, only P4 was familiar with both concepts, whereas the others were not familiar with them. However, the others (P1, P2, and P3) did state that they do apply these concepts, just under a different name.

Most of the participants (P2, P3 and P4) perceived manageability to be related to the management process, structure and systems, such as in identifying and understanding project risk, whereas controllability relates to controlling the output of a process by doing something to address risk. Thus, in the application of these concepts, manageability is practised by creating a risk register and P-I matrix, which are updated in workshops and monthly reviews, whereas controllability is practised by employing a project team to control and mitigate risk throughout the project. The internal project team controls and mitigates internal project risk, whilst the external project team controls and mitigates external project risk, which cannot be handled by the internal project team.

5.1.2. The Distinction between Manageability and Controllability of Project Risk from Academic and Managerial Perspectives

The second conclusion of this study relates to the different perceptions of manageability and controllability of project risk from academic and managerial perspectives. There are two different aspects of controllability from academic and managerial perspectives, namely the activity conducted and the decision making process. From the academic perspective, the activity required to apply controllability is changing risk, and the decision making process is performed continuously. By contrast, from the managerial perspective, the activity conducted is controlling output and a discrete decision making process is performed. Meanwhile, the similarities are located in the closed-loop feedback system that is used, and the advantage of information to decide the sensor and standard.

In terms of manageability, the differences between managerial and academic perspectives are located in the activity conducted and the advantage of information. From an academic perspective, the activity is reducing risk and the advantage of information is in predicting the expected output. By contrast, from the managerial perspective, the activity conducted is identifying risk and the advantage of information is to define that risk. Meanwhile, similarities are found in terms of the discrete decision making process and the fact that feedback is not utilised.

5.1.3. Definitions of Manageability and Controllability of Project Risk

The third conclusion provides a useful definition of manageability and controllability, which are recommended based on both the academic and managerial perspectives. Drawing on the literature review and interviews conducted for this study, manageability is defined as the capability of internal and external project teams to select and utilise important information for identifying and understanding project risk in order to reduce risk and increase opportunity within a project. On the other hand, controllability is defined as the ability of a project team to monitor and control the output of a project risk management process by utilising effective communication.

5.2. Recommendations

This study provides several findings and insights, particularly reflecting on the manageability and controllability of project risk from managerial and academic perspectives. However, this study far from perfectly describes manageability and controllability in a real project context. This can be improved upon through several recommendations for obtaining more sophisticated results in further studies.

The first recommendation is to increase the number of interview participants across several project types. This study only employs four participants from three different projects, namely IT, energy and business improvement projects, in a particular location. Hence, the results of this study only reflect the perceptions of manageability and controllability from those particular project types within a particular location. In other words, their perception may not represent more general managerial perspectives of manageability and controllability. Participants from different project types might have different perceptions of those concepts. For this reason, increasing the number participants from various project types and various locations could enhance further research.

The second recommendation is to verify the recommended definitions of manageability and controllability given in this study using other project management practitioners. The recommended definitions of these concepts given in this study have not yet been verified by other project management practitioners; they are only verified by participants as to whether the results of this study are consistent with their perceptions or not. Verification by other participants is required to confirm a definition that is more credible and useful in the PRM context.

The third recommendation of this study is to build a framework for the concepts of manageability and controllability. This framework can be driven by the definition recommended by this study and subsequently developed according to the guidelines of project management practitioners in order to apply these concepts in practice.

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APPENDIX

Appendix 1. List of Questions

No.	Classification	Question	Objective
1.	**Profile of Respondent**	1. How long have you been working in project management?	To identify the experience of respondent in order to obtain the reliable data. PMI (2008) stated that minimum experience is five years to claim that the person is expert in project management.
		2. What roles have you played in project management?	To identify the experience of respondents' responsibility in project. It will be useful to enrich the analysis about different perspective towards those concepts based on their responsibility.
2.	**Profile of Project**	3. What type of project have you been involved with?	To identify the project type that they have been involved. It will be useful to enrich the analysis about the different project type in applying those concepts.
		4. Can you indicate the range of project budgets for your projects?	To identify the size of project based on the project budget. It will be useful to enrich the analysis about comparison the perspective of those concepts based on the

No.	Classification	Question	Objective
			project size.
		5. Among the project you have been involved with, roughly what proportion have had a. overspent and delay? b. overspent but on time? c. on budget but delay? d. cancel before finish?	To identify the performance of their project. It will be useful to analyse the correlation between applying those concepts and project performance.
3.	**Definition of Risk**	6. What approach or method have you used to define and prioritize risk in project?	To capture their perception about risk in general concept.
		7. How useful have they been?	
		8. Do you consider probability of occurance and impact to define and prioritize risk? Why?	This question is prepared if the interviewee does not mention the probability and impact (formal definition of risk).
		9. Is it sufficient to define and prioritize project risk only by probability and impact?	To understand their perception about P-I model.
		10. What other criteria do you consider to be important in defining project risk?	To understand their critics about P-I model.
		11. What kind of risk you can encounter in a project? How do you deal with this? Do you utilize any particular method to manage and control risk?	To capture PRM method application in practice.
		12. Do you think that the particular method used by you or your company is an effective method to manage and control risk? Why?	To capture their perception about the effectiveness of current PRM method used.

No.	Classification	Question	Objective
4.	**Definition of Manageability and Controllability of Project Risk (before provided references)**	13. Have you heard about manageability in project risk? I f yes, what do you think about manageability in project risk? If no, what do you think this concept means?	To capture their perception about manageability and controllability concepts before influenced by references.
		14. Have you heard about controllability in project risk? If yes, what do you think about controllability in project risk? If no, what do you think this concept means?	
		15. Do you think manageability and controllability are different concepts? Why?	
		16. Do you think those concepts are important to mitigate risk? Why?	
5.	**Definition of Manageability and Controllability of Project Risk (after provided references)**	17. Of these definitions, which do you find useful, and why? Or given your own definition if they are no useful definition from references.	To capture their perception about manageability and controllability concepts after influenced by references
		18. In the light of the definitions given, do you think that manageability and controllability are different concepts? Why? (If no, ask directly Q20, Q22 and Q23)	
		19. Do you already use the concept of manageability and controllability in practise? If so, when are they used and when not used? If no, why you do not consider those concepts?	To capture their application of those concepts and to understand when those concepts are suitable to be applied and when those concepts are not suitable to be applied.

No.	Classification	Question	Objective
6.	**Improving Manageability and Controllability Method**	20. Using a definition you identified under Q17, how would you treat manageable and unmanageable risk? For example, if risk A is considered manageable and risk B is considered unmanageable, how would you treat them differently?	To capture manageability and controllability method in practice.
		21. Using a definition you identified under Q17, how would you treat controllable and uncontrollable risk? For example, if risk A is considered controllable and risk B is considered uncontrollable, how would you treat them differently?	
		22. Using a definition you identified under Q17, how would you treat the combination between two criteria, for example, if risk A is manageable but uncontrollable and if risk B is controllable but unmanageable, how would you treat them differently?	
		23. Do you think that your particular way to distinguish manageable/controllable and unmanageable/uncontrollable project risk is effective to mitigate risk? If so, why? If no, any suggestion to improve the method?	To capture the current method to apply those concepts in practice in order to improve manageability and controllability method that can be more useful in practice.

Appendix 2. Academic Definitions of Manageability and Controllability Concepts

Controllability

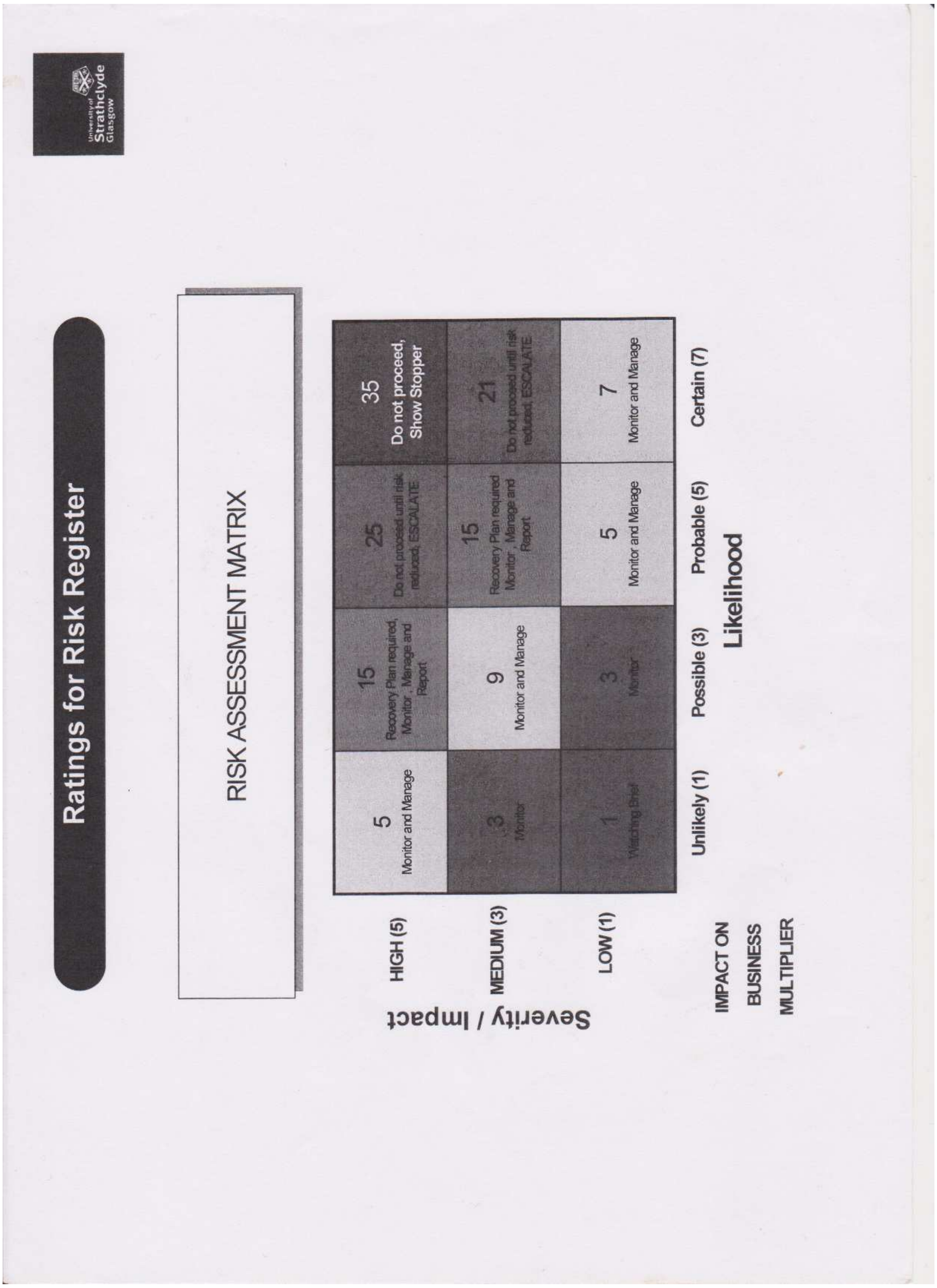
No.	Author	Definition
1.	Jin Tian and Tingdhi Zhao (2012)	Controllability is comparison between time margin and time required towards mishap.
2.	Cagno et al. (2007)	Controllability is the ratio between expected value of losses resulted by risk after and before mitigation.
3.	APM (2008)	Controllability is the degree to which the risk owner is able to control the risk's outcome.
4.	Peng-cheng et al.(2005) in Ding et al. (2010)	Controllability means the ability to adopt a certain technology or management practices before the risk event occurs to reduce the probability of losses
5.	Kuvaas (2002)	Controllability associated with the internal problem (threat and opportunity) in project.
6.	K.C. Lam et al. (2007)	Controllability is the ability of party to conduct best control on minimising or avoiding the materialisation of the risk.
7.	Gao and Jiang (2008)	Controllability is the ability and experience to avoid, minimise, monitor, and control risk.
8.	Control theory and cybernetics	Controllability of project risk is the capability of decision maker to generate valid information to take a decision for manipulating dynamically the risk behaviour to obtain the agreed (stable) output in the project.
9.	Miller and Lessard (2001)	Controllability of risk event refers to the likelihood of changing the probability distribution of the occurrence of the event
10	Fan et al. (2008)	Controllability is defined as the comparison

		between the prior and posterior probability of the occurrence of the risk event.
11.	Giraud et al. (2008)	Controllability principle is a condition of fairness, which leads to managers' satisfaction and motivation, in turn leading to performance.

Manageability

No.	Author	Definition
1.	Aven et al. (2007)	Manageability is the capability of project team to reduce risk and increase opportunity in project by considering human and organisational factors (internal and external) to obtain the desired project objectives.
2.	Leijten (2009)	Manageability is related to information to decide the conduct risk response.
3.	APM (2008)	Manageability is a function of controllability and response effectiveness". Response effectiveness is "the degree to which current risk responses can be expected to influence risk's outcome.
4.	Peng-cheng et al.(2005) in Ding et al. (2010)	Manageability = controllability + transferrability
5.	Kuvaas (2002)	Manageability is associated with the ability of top management to deal with internal and external problem.
6.	Ginsberg & Venkatraman (1995)	Manageability describes the perception that the means for resolving the issue are available and accessible.
7.	K.C. Lam et al. (2007)	Manageability is the ability of project manager to select the party who is best able to manage risk in order to minimize the severity, extra cost and delay once the risk occurs.
8.	Gao and Jiang (2008)	Manageability is the ability to assign risk to the participant who can manage best and reduce the risk

Appendix 3. The Example of P-I matrix from Participant



Appendix 4. The Example of Risk Register from Participant

Monthly Highlight Report for ISC Projects

Project Name: Website Transformation Programme	**Project Manager:** Nicola Smith		**Legend:**
Project Sponsor: Hugh Hall	**Status Date:** 31st July 2014		■ Complete
Project Status: ◆	**Budget Status:** ◆	**Initial Budget: £770,000**	◆ On Track
Project Start: March 2013	**Scope Status:** ◆	**Progress Percentage Indicator: 70%**	△ At Risk
Original End Date: June 2014	**Delivery Status:** ◆	**Anticipated End Date: October 2014**	● Late/Out
Project Code: 00069			⊘ On Hold

Milestones	**Status**	**Baseline**	**Forecast**
July, August, September, October 2014			
1. Complete UG course pages (phase 1)	■	31/07/14	31/07/14
2. Complete PGT course pages (phase 1)	■	31/07/14	31/07/14
3. Complete PGR pages (phase 1)	■	31/07/14	31/07/14
4. Homepage, menu and footer	◆	31/08/14	31/08/14
5. Knowledge exchange and research pages	◆	31/08/14	31/08/14
6. Complete UG course pages (phase2)	◆	30/09/14	31/09/14
7. Complete PGT course pages (phase 2)	◆	30/09/14	31/09/14
8. Feedback and tidy up	◆	30/09/14	31/09/14
9. Transfer completed beta site pages to the live site.	◆	31/10/14	31/10/14
10.			
11.			
12.			
13.			
14.			

Achievements Since the Last Report of 30/06/2014

- Populated undergraduate, PGT and PGR course pages with information gathered from the prospectus and made available on the beta site.
- Received the majority of undergraduate proformas from our departmental contacts and have provided the PGT proforma for completion by the end of August.
- Progress report sent to Deans.

Active and/or New Issues

- Due to the time of year there is an increase of annual leave taken by the project team and by departmental staff which has required us to work with departments in a more fragmented way.

Active and/or New Risks

- Departmental content will be dependent on departments having resources available to gather and produce the content.

Key Decisions and Change Requests	**Responsibility:**
	•

Next Steps for the Project (e.g. for the next month)

- Complete Homepage, Header and Footer sprints
- Integrate knowledge exchange into the research pages.

Page 1 of 1