THE UNIVERSITY OF WARWICK

DECISION SUPPORT AND STRATEGIC PROJECT MANAGEMENT IN THE UK UPSTREAM OIL AND GAS SECTOR

by

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A thesis submitted in the partial fulfilment of the requirements
for the Degree of Doctor of Philosophy

Operational Research and Systems
Warwick Business School
Warwick University

December 2001

This thesis is dedicated to G'd, my best friend; to my grandparents, who went to Brazil to seek an opportunity for freedom and there seeded their love; to my parents, Anna and Isaac, who unconditionally love me; to my sisters, Clarisse Marcia and Vera z"l, who love me as my second mothers; and to all seekers of a "New World" full of love, respect and equality. I must acknowledge my beloved sister Vera, an enthusiastic and loving person, who left us prematurely just before the end of my PhD.

ACKNOWLEDGEMENTS

First, I would like to thank Petrobras – Petróleo Brasileiro S.A., who generously funded this research and gave me a singular opportunity for professional development.

Next, my gratitude goes to my first supervisor, Prof. Robert G. Dyson, for his enormous assistance and patience, sensible advice and constructive criticism, and my second supervisor, Ms. Maureen Meadows, for her support and commitment.

My thanks are also due to the Institute of Petroleum, notably Dr. Brian Abbott, who provided me with contact names in the UK upstream oil and gas sector.

At Warwick University, I would like to thank Ms. Frances O'Brien for her help in an intermediate stage of my research project; Dr. T. C. Melewar, who provided me with names of scholars outside Warwick; the secretaries of the Doctoral Programme and the Operational Research and Systems Group, for their administrative support; Ms. Sophie Andriopoulou and Dr. Gerard Sharpling, for proof-reading my work; and the doctoral colleagues who shared with me the experience of a PhD.

Outside Warwick, I am particularly indebted to Mr. Carlos Alberto Pereira de Oliveira, from Petrobras, who approved of my doctoral project, and Dr. Charles Cui, from UMIST, who kindly helped me at a crucial moment of my research project. I also would like to thank the staff at Petrobras London Office, and Mr. Fernando Aiube, Ms. Luciana Rachid and Mr. Armando Gonçalves, from Petrobras, for their support.

I am thankful to some Petrobras' colleagues, professionals and experts in UK upstream oil and gas sector, and doctoral students at Warwick Business School, for helping me in my exploratory fieldwork and questionnaire piloting.

I would like to acknowledge the managers in the UK upstream oil and gas sector who anonymously co-operated with the main survey and the assessment sheets.

Finally, I would like to express a big thank-you to Rubem Kicis Torrents Pereira, Carla Bittencourt, Alexandra Aranha-Ward, Marianna Tortell, Jonathan Menuhin, Cláudia Simões, Lorenza Ponzoni and Maureen Stokes, for their love during my stay in England, to the Forest Hermitage Buddhist Temple at Warwickshire for providing me means of discovering a new perspective of life, and to two special friends, Lucia Penna Rosa and Miria de Amorim, who supported me with loving kindness during my PhD.

ABSTRACT

Strategic projects form the core of corporate growth, change and wealth creation, which enable a firm to achieve and sustain long-term success. However, a traditional engineering perspective on project management still seems to dominate.

In general terms, managers are fully aware of some traditional techniques, such as NPV, but these can undervalue a strategic project. They occasionally apply techniques for controlling projects, and often lack a practical understanding of recently developed techniques. The purpose of these recently developed techniques is to create a project's value from the outset, and to drive a firm to superior performance and aspiration.

The current research project aims to explore the role of techniques in facilitating successful strategic project management, and the elements involved in it, as applied to the UK upstream oil and gas sector. At first, the existing literature on successful strategic project management is reviewed, with major emphasis given to the techniques applied to managing projects.

The proposed methodology follows a triangular approach. First, exploratory interviews essentially describe fifty multidisciplinary elements involved in strategic project management. Second, an exploratory deskwork explores the extent to which techniques address, in theory, these elements. Third, a main survey describes the elements managers pay considerable attention to, searches for the elements that are believed to explain a strategic project's success and identifies the techniques that often address each element in practice. Finally, follow-up interviews validate some questionnaire findings. As a result, sets of techniques for successful strategic project management are proposed, and validated through assessment sheets.

The present study represents an embryo for future investigation in the project management field. First, it explores the gap between elements that are believed to explain a project's success and those that managers pay most attention to in managing strategic projects. Finally, it suggests that the convergence of financial, environmental (green) and internal business issues might be a healthy route for the UK upstream oil and gas sector towards successful strategic project management.

Keywords: strategic project management, techniques, upstream oil and gas sector.

DECLARATION

This is to declare that:

- I am responsible for the work submitted in this thesis.
- This work has been written by me.
- All verbatim extracts have been distinguished and the sources specifically acknowledged.
- During the preparation of this thesis a number of papers and presentations were prepared as listed below. The remaining parts of the thesis are unpublished.

1. Asrilhant, B. and Dyson, R. G. (2000). Converging Decision-Support Tools on Successful Strategic Project Management: From Theory to Practice. <u>Proceedings of the 3rd European Project Management Conference,</u> 11-16 June, Jerusalem, Israel: Project Management Institute.

2. Asrilhant, B. (2000). Successful Strategic Project Management in the UK Upstream Petroleum Sector: A Preliminary Study. One of the five finalists of the 2000 Project Management Institute Educational Foundation International Student Paper Award, USA.

3. Asrilhant, B. and Dyson, R. G. (1999). Successful Strategic Project Management in the UK Exploration and Production Sector of the Petroleum Industry. <u>41st Annual Conference of the UK Operational Research Society,</u> 14-16 September, Edinburgh, Scotland.

4. Asrilhant, B. (1999). A Multi-Dimensional Model for Managing Strategic Projects in the UK Petroleum Industry. <u>Oxford-Warwick Forum,</u> 14 May, Oxford, England.

- This work has not previously been submitted within a degree programme at this or any other institution.

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Date: 09.01.02

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Chapter 1

INTRODUCTION

The current research project is entitled *"Decision Support and Strategic Project Management in the UK Upstream Oil and Gas Sector"*. It aims to explore respectively the role of techniques[1] in facilitating successful strategic project management[2], and the elements involved in it, as applied to the UK upstream oil and gas sector[3].

The motivation for carrying out this study was both theoretical and practical. On the one hand, the theoretical support for techniques and their potential applicability as facilitators for project management are controversial and not extensively developed in the literature. On the other hand, the researcher has long-term experience in the management of upstream oil and gas projects, and has detected a realm of problems, limitations and pitfalls related to the management of strategic projects, which are addressed in the course of this study.

The relevance of the current work may be seen in the relationship between the use of techniques and successful strategic project management. However, this is by no means a straightforward task. First, project management is inclined to focus on the

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[1] Techniques applied by decision-makers in managing an individual project or a portfolio of projects to help them *"deal with the complexities of the project process"* (Dawson, 2000: 432). According to Chapman (1997), technique is a generic term that includes models and methods. In this research project, techniques differ from information systems or commercially available software tools *(e.g.* Primavera™, @Risk™, MS Project™*)*, as well as documents, guidelines or communication tools (*e.g.* meetings, reports, peer reviews and electronic mails).

[2] Here, the term Project Management is generic, and refers to the management of an individual project or a portfolio of projects.

[3] The upstream oil and gas sector refers to the research, exploration and production of crude oil and natural gas. The downstream oil and gas sector, in turn, refers to the refining, trading, transportation and distribution of oil and natural gas products.

description of stories of how work is done, or stories of success and failure in the formulation and implementation of corporate change. Second, techniques are associated with antagonistic bodies of theory. While financial techniques often address the outputs, strategic techniques tend to tackle the process. Third, techniques are traditionally associated with the notion of effective and efficient project management. Nevertheless, strategic projects impact a firm's long-term success significantly, and must be conducted within an increasingly uncertain, dynamic and competitive marketplace.

The contemporaneous side of the current work arises from the insufficiency of some traditional techniques, and the need for recently developed techniques, in facilitating successful strategic project management. Strategic project management has become a crucial topic in the information era. Although the number of strategic opportunities has rapidly increased, the most profitable opportunities are associated with intangible, not easily measured issues, namely knowledge and information, more than with land, capital and labour.

The originality of the current work lies in the lack of a substantial previous empirical contribution to the use of techniques in facilitating successful strategic project management. Scholarly attention has been paid to the topic in the last decade. Some techniques seek to refine the measurement of a project's financial value, but have a narrow, rationalistic orientation and often suffer from mathematical complexity. Some others tend to have a broad, multidimensional orientation, although here, attention is paid to the corporate level instead of the project level. There is, therefore, a lack of formal debate on the appropriateness and use of techniques as facilitators for successful strategic project management.

Here, project management is divided into two main stages: evaluation and control. Evaluation involves three phases, the design (*i.e.* drawing up a project after its inception), planning and valuation of a project, which ends at its authorisation. Control, rather, comprises three phases, the management, review and redesign of a project through to its completion. Managers tend to recognise evaluation and control as discrete, independent stages, where control is a natural consequence of the evaluation stage, particularly because managers who assess a project are often different from those who execute it. However, evaluation and control are not sequential, but are, rather, interconnected processes, and control might be conducted from a project's outset.

The traditional engineering approach to project management is associated with the planning of a project's budget, timescale and resources, the estimation of its value in financial terms, the monitoring of eventual variances from plan through its execution, and the achievement of the project's financial results within the estimated time, cost and in accordance with specifications at its completion. Traditional techniques have been developed during the last decades to assist managers in managing projects effectively and efficiently, with a major concern for the short-term financial results. Managers are fully familiar with these techniques, and reasonably use them. This proved to be useful in facilitating the management of operational, everyday projects in particular.

In recent years, the business world has become increasingly complex, uncertain and competitive. Projects come to include strategic, intangible issues, which are not easily or even measurable in financial terms. Strategic projects are major investments that involve high uncertainty, which comprise intangible benefits, and which promise attractive long-term financial outcomes. They are the learning vehicles to realise and implement a vision, and to represent the core of corporate growth, change and value creation. Value creation allows a firm to materialise corporate success.

However, some traditional techniques seem to be insufficient in addressing some of the elements involved in the management of strategic projects. First, uncertainty, flexibility and interdependency are examples of influential elements in evaluating a strategic project. Second, resources deployment, learning and innovation are examples of influential elements in controlling a strategic project. There is, therefore, a need for techniques to address these elements and to facilitate the creation of a project's value, from its early outset and to drive a firm to superior performance and aspiration, as a means of attaining long-term success.

The present research project investigates primarily the role of techniques in facilitating successful strategic project management. It aims to explore the relationship between the use of techniques for managing strategic projects and the success of a strategic project. This relationship is, however, investigated indirectly. First, this study explores a set of elements involved in strategic project management that are believed to explain a strategic project's success (success elements), and then identifies the techniques that tackle these elements.

There are a number of multidisciplinary success elements involved in strategic project management. Managers should pay attention to these elements, as they drive a firm to concentrate on success. However, managers do not appear to pay sufficient attention to all success elements, since they focus attention primarily on financial outputs.

The use of techniques to address the elements involved in successful strategic project management is somewhat restricted in terms of appropriateness. Some of these elements are always quantifiable, and techniques tend to focus on easily quantified aspects. Therefore, techniques appear to be insufficient in managing strategic projects.

A sudden output of techniques has been seen in the last decade for facilitating strategic project management. These techniques promise to address relevant business concerns, and drive a firm to success. However, these techniques tend to be complex and lack scientific evidence of a positive cost-benefit analysis arising from their applicability. Furthermore, managers cannot thoroughly understand the complexity of the business world, resist adopting recently developed techniques and choose the simplest methodologies for pragmatic reasons. Managers are often unfamiliar with (and rarely use) recently developed techniques, which are potential facilitators for successful strategic project management.

There is a gap between what managers want from recently developed techniques and what these techniques are designed to offer. As a consequence, managers use summary measures and add their judgement and intuition. As the gap increases, techniques are excluded and managers tend to make subjective decisions.

The final part of the current study proposes sets of techniques for helping to systematise the successful evaluation and control of strategic projects. These sets combine traditional and recently developed techniques to act as value creation facilitators, which should be in alignment with managerial needs for application.

On the one hand, traditional techniques, reasonably applied by managers, appear to address a certain number of success elements involved in strategic project management. These techniques cannot simply be rejected, as they can be useful instruments if adequately applied. On the other hand, recently developed techniques, which are designed for facilitating a strategic project's success in the first place, seem to address additional success elements. However, these techniques are not always necessary, and cannot simply be imposed, as managers need to develop a practical understanding of these techniques. The application of recently developed techniques appears to be conditional upon the development of friendly procedures.

The current thesis selected a triangular methodology to investigate the role of techniques in assisting successful strategic project management, and the elements involved in that management, as applied to the UK upstream oil and gas sector. This methodology broadly combines interviews, questionnaires and assessment sheets, and it is divided into three parts. First, exploratory interviews were carried out among nine managers holding top and medium positions in a single company. The interviews aimed to give a sense of reality to the research problem, and to motivate the design of the next steps of the proposed research methodology, as well as to support the reviewed literature in formulating the research question and describing the research hypotheses. Some deskwork complemented the exploratory interviews.

Second, a questionnaire was designed and piloted, and fifty-four valid questionnaires were returned from multidisciplinary managers holding top, medium and lower positions in fifteen oil and gas companies of different sizes. The questionnaires aimed to test the research hypotheses, generalise the exploratory findings, consolidate the overall findings and propose sets of techniques for managing strategic projects successfully. Finally, follow-up interviews were carried out among twenty-five respondents to validate the questionnaire findings, and twenty-one assessment sheets returned from respondents in eleven companies of different sizes that were examined to validate the appropriateness of the proposed sets.

This study was applied to the UK upstream oil and gas sector, a stimulating domain of application for two main reasons. First, there is insufficient empirical contribution regarding the application of techniques for managing UK upstream oil and gas projects. Second, the upstream oil and gas sector is placed in a competitive setting, deals with an increasing number of mergers and acquisitions, and is usually governed by strict environmental legislation and prohibitive tax regulation. It also involves a wide range of impacting sources of uncertainty. Furthermore, managers are extremely busy, have high job mobility, and, to some extent, avoid disclosing information.

The current research project is conceived to develop an understanding of (1) the level of awareness and use in general terms of techniques in managing strategic projects; (2) the reasons for using or not using each technique; (3) the level of importance of, and extent of addressing, elements involved in evaluating and controlling strategic projects; (4) the techniques applied to address each element; (5) the degree of success of strategic project management in general terms; and (6) the elements that are believed to explain successful strategic project management in general terms.

The theoretical contribution of this research project is (1) to give a comprehensive understanding of strategic projects and strategic project management; (2) to identify the relevant elements involved in strategic project management and the subset of elements that are believed to explain successful strategic project management; and (3) to determine the role of techniques as facilitators for successful strategic project management.

The practical contribution of this study is (1) to propose sets of techniques for facilitating successful strategic project management; and (2) to elucidate the eventual gap between the elements to which managers often pay considerable attention in managing strategic projects and the elements that are believed to explain successful strategic project management.

Finally, this thesis is exploratory and might contribute to diffuse novel ideas in further studies to be developed in the project management field. The current study is divided into six chapters. Chapter 2 introduces the literature reviewed to support the formulation of the research question and the description of the hypotheses of the current study. Chapter 3 points out different research paradigms and methods of data collection available in the social sciences, and describes the methodological path followed by the current research project, including the methods of data analysis. Chapter 4 presents and discusses the overall results, and revisits the research hypotheses of the current study. Chapter 5 proposes and validates sets of techniques for facilitating successful strategic project management, and revisits and challenges the research question of the current study. Chapter 6 points out the conclusions of the present study and recommends directions for further research.

Chapter 2

LITERATURE REVIEW

2.1 – Introduction

This chapter is a literature review, which is intended to support the formulation of the research question and the description of the hypotheses of the current study. A large part of the chapter is dedicated to a detailed description of the techniques for managing projects. Along with this description, the elements involved in both stages of management (evaluation and control) are fully reviewed. The chapter is also an attempt to discuss recently developed techniques as facilitators for successful strategic project management. The chapter ends by introducing the research question and hypotheses of the current research project.

The chapter is divided into six sections. Section 2.2 presents an overview of strategic project management. Section 2.3 presents the traditional and recently developed techniques for project management. Section 2.4 discusses recently developed techniques as facilitators for successful strategic project management. Section 2.5 presents the research question and hypotheses of the current study. Finally, Section 2.6 provides a summary and introduces the next chapter.

2.2 – An Overview of Strategic Project Management

The aim of this section is to give an overview of strategic project management, and the contribution of the use of techniques in that management. This section is divided into four sub-sections, which aim to (1) define the term "technique"; (2) give an overview of project and project management; (3) discuss strategic project management and the connection between strategic management, capital budgeting and project management; and (4) point out the scholarly contribution to the use of techniques for strategic project management, as presented in the following.

2.2.1 – Definition of Technique

According to Chapman (1997), technique is a generic term, and involves models and methods. Techniques are applied by decision-makers in managing an individual project or a portfolio of projects to help them "*deal with the complexities of the project process*" (Dawson, 2000: 432).

In this research project the term "technique" is defined under the organisational knowledge framework. According to Cook and Brown (1999), knowledge must be used to guide organisational activities and decision-making. Knowledge, defined by Roberts (2000: 429) as "*the application and productive use of information*", is conventionally understood as explicit knowledge, which is rigorous, held in the individuals' minds, and "*acquired, modelled and expressed most accurately in the most objective and explicit terms possible*" (Cook and Brown, *op. cit.*: 384). Implicit knowledge, alternatively, is treated as informal, embryonic, obscure, hidden or even inaccessible for practical purposes, which ideally should be made explicit (Roberts, *op. cit.*).

However, as Cook and Brown (1999) have observed, it is essential to understand four distinct and equally important forms of knowledge, which are crucial for an organisation to solve complex problems and create new knowledge (Cross and Baird, 2000). They consist of (1) individual; (2) group; (3) explicit or codified; and (4) tacit or local, as briefly discussed below.

According to Cross and Baird (2000), while individual knowledge impacts organisational memory, group knowledge "*drives individual performance during interaction with others*" (*op. cit.*: 70). Cook and Brown (1999) associate explicit knowledge with "*spelled out or formalized*" knowledge (*ibid.*: 381), and tacit knowledge with skills or '*know-how*'.

Roberts (2000), meanwhile, defines explicit knowledge as "*recorded or transmitted in the form of symbols (e.g. writing or drawings) or embodied in a tangible form (e.g. machinery or tools)*" (*ibid.*: 431), which is easily transferred and disseminated at low or no marginal cost (*ibid.*). Roberts (*op. cit.*) defines tacit knowledge, as "*acquired via the informal take-up of learning behaviour and procedures*" (*ibid.*: 431), whose transferral is facilitated by mutual understanding and relationship of trust, developed by face-to-face contact, and favoured by the social and cultural context (*ibid.*).

Individual, explicit knowledge is something that "*an individual can know, learn and express explicitly*" (Cook and Brown, 1999: 391), and includes "*concepts, rules and equations, [...] that are typically known and used by individuals*" (*ibid.*: 391). These tools are valuable technologies for the transfer of explicit knowledge (Roberts, 2000).

There is another explicit form of knowledge that it is *"used, expressed, or transferred in a group"* (Cook and Brown, 1999: 391). It includes reports, memos, manuals and other documents that contain lessons to be shared by the members of a group (Cross and Baird, 2000), stories about how work is performed and stories of success and failure, as well as metaphors and phrases that have a meaning within a group (Cook and Brown, *op. cit.*).

Individual, tacit knowledge is *"[...] possessed by individuals, such as a skill in making use of concepts, rules or equations, [...] or the proper use of a tool [...]"* (Cook and Brown, 1999: 391). Tacit knowledge possessed by groups is the most difficult form of knowledge to define. It is associated with organisational genre, *i.e.* organisational common knowledge *vis-à-vis* the meaning of a specific term. As illustrated by Cook and Brown (*op. cit.*), the term *'gathering'* can be understood by an organisation as "where decisions are made", but by another company as "the condition to make political moves".

Individual knowledge, however, is exposed to loss, as employees enter and exit the workplace. Organisations have been continuously making an effort to support organisational memory through structured learning processes. After action reviews are an example of shifting from individual experience to organisational knowledge. Teams, peer reviews and communities of practice (*i.e.* informal groups that exchange systematically work-related challenges) are examples of shifting from personal relationships to organisational *'know-how'* through collaboration, learning and information sharing. Databases and other technologies (*e.g.* KnowledgeSpace, PowerPacks) are examples of learning tools (Cross and Baird, 2000).

According to Roberts (2000), explicit and tacit knowledge are mutually complementary, and, as observed by Cook and Brown (1999), the former cannot be converted into the latter and vice-versa. Explicit knowledge is not sufficient *per se* and cannot substitute tacit knowledge. However, Cook and Brown (*op. cit.*) have added that, on the one hand, the assimilation of explicit knowledge can help appropriate and disseminate tacit knowledge. On the other hand, explicit knowledge is successfully transferred if it is tacitly understood and applied (Roberts, *op. cit.*). Organisations, in an attempt of minimising costs, are escalating their efforts to favour codified knowledge to the detriment of the tacit knowledge dimension. As a result, although firms might be prepared to react to market conditions, they might loose flexibility, creativity, innovation, richness, diversity and complexity. Codified knowledge must be used first and foremost to create and diffuse novel knowledge, but also to increase the tacit knowledge base (*ibid.*).

Nevertheless, part of what people know is not captured by the four forms of knowledge discussed above, but by practice, '*real work*', or ways of knowing – the social interaction between knowledge and the '*real*' world. Knowledge is not simply something to be possessed, but to make action or practice possible. Knowledge must be dynamically generated, transferred and used in organisations. For instance, to use a technique sensibly it is necessary to respect the constraints given by one's actions in using it (Cook and Brown, 1999; Roberts, 2000).

The present work focuses on individual, explicit knowledge and its role in supporting strategic project management. It is embodied in methods and models, and the generic term technique is used throughout the thesis. This thesis does not concentrate, however, on the constraints to one's use of techniques, skills or *'know-how'* (individual, tacit knowledge), memos, reports (group, explicit knowledge), the transferral of individual experience to group knowledge via peer reviews, communities of practice and information systems, as well as the actions of generating, transferring and using knowledge via social interaction between knowledge and the '*real*' world.

2.2.2 – Overview of Project and Project Management

Having circumscribed the term "technique" through the distinction between individual, group, explicit and tacit knowledge, the terms "project" and "project management" are now thoroughly discussed. According to Dawson (2000), a project is seen as a unique venture, or even a solution to a problem that aims to bring beneficial change to a firm. A project consists of a number of stages through which it progresses until its completion. A project is conducted at different management levels and it is composed of time, cost, quality, scope and resources. Risk is inherent throughout all levels and elements of a project, and it occurs within the project management process.

Project management "*should be capable of improvement, it should be supported by tools, it should be measurable, it should be repeatable*" (Dawson, 2000: 433), and consists of manageable interrelated activities (*ibid.*). Pharro (2000) defines project management as the process by which projects are delivered. For Turner (2000a), project management starts with the conception of a valuable vision. Such a vision is achieved through a journey or mission, which follows a specific strategy. Interim milestones are then identified and a project's progress is monitored and controlled over time until its completion.

Pharro (2000) presents three methods for guiding project management available in the public domain. They include (1) BS6079 ("A Guide to Project Management"); (2) PRINCE2 ("Managing Successful Projects"); and (3) ISO10006 Quality Management ("Guidelines to Quality in Project Management"), as discussed in the following.

The BS6079 is a corporate framework within which projects are managed to ensure that a project's deliveries are both accurate and delivered in time, where corporate management is fully reported. This framework assumes a complete project life cycle, project managers with full control and project sponsors with limited resources. The framework is adequate for large-scale engineering projects (*ibid.*).

The PRINCE2, originally developed for the management of Information Technology (IT) projects, provides a methodology suitable for any project type and size, and for different project managers' skill levels. It recognises the role of a project's sponsors and users in the decision-making process, and links a project into a business management system by distinguishing management, technical and life cycle stages (*ibid.*).

The ISO10006 provides a broad checklist, which focuses on the achievement of required quality standards for the project management process. In this way, the elements of a project must be in line with the corporate management systems and at a suitable level of detail for the project under analysis. However, it does not differentiate simple from complex projects. The three methods, nevertheless, tend to be product-driven and none of them are prescriptive regarding project management techniques (*ibid.*).

In the current work, project management is divided into two main stages, evaluation and control, based on Amram and Kulatilaka's (1999b) taxonomy. Evaluation involves three phases, the design (*i.e.* drawing up a project after its inception), planning and valuation of a project, which ends at the point where it is authorised for execution. Control comprises three phases, the management, review and redesign of a project through to its completion.

Several authors in the project management field classify project management according to "stages" or "processes" in various ways. According to the 1996 Project Management Institute (PMI) Guide to the Project Management Body of Knowledge, stages refer "*to states through which projects progress*", and processes "*represent the series of actions that are performed to bring about a project's result*" (Dawson, 2000: 437). While stages imply a time frame, processes may occur simultaneously throughout a project life cycle (*ibid.*). The following paragraphs discuss the diverse classifications of project management given by the project management field and end up comparing them to the taxonomy adopted by this research project, which is based on Amram and Kulatilaka's (1999b) classification.

According to Ward and Chapman (1995b), project life cycle is often divided into four stages: conceptualisation, planning, execution and termination. These stages vary according to "*the level of resources employed, the degree of definition, the level of conflict, the rate of expenditure, and so on*" (*ibid.*: 145), and they are associated with different levels of risk exposure. Ward and Chapman (*op. cit.*) suggest an eight-stage project life cycle: (1) concept; (2) design; (3) plan; (4) allocation; (5) control; (6) deliver; (7) review; and (8) support. The concept stage refers to the innovation process, identifies the deliverables to be produced and the results obtained from them, as well as crystallising mutually accepted objectives. The design stage gives form to a project's deliverables, develops performance criteria, and refines the objectives. The plan stage develops a base plan, targets and milestones in terms of costs and time. The allocation stage refers to the project organisation, including the identification of suitable participants and the distribution of tasks between them. The control stage is about taking action driven by design changes, adjustments to plan, costs and payments, and revised plans. The deliver stage comprises commissioning and delivery, and refers to actual performance measurement. The review stage encompasses auditing the delivered products and learning from past lessons. The support stage involves the basic maintenance and liability perception of the project completion.

Murray-Webster and Thiry (2000) propose four stages for project management: (1) definition; (2) planning; (3) implementation; and (4) appraisal. The definition stage represents the sense making step of the learning loop, where actors make sense of the required response to a pressure to change. The planning stage consists of strategy planning and project selection. The implementation stage involves the review, alignment, approval process, and change management. The appraisal stage assesses the benefits and the feedback of the lessons learned into the organisation. The use of appraisal by Murray-Webster and Thiry (*op. cit.*) is somewhat problematic, as it is more commonly used as part of evaluation, although appraisal during the control stage is also legitimate.

Turner (2000b) identifies four stages of project management: (1) proposal, initiation and feasibility; (2) definition, appraisal and strategic planning; (3) implementation and control; and (4) finalisation and close-out, testing, commissioning and handover. The first stage refers to describing and providing a value to a vision, as well as identifying several journeys to achieve such a vision. The second refers to designing a strategic plan for a project, identifying its milestones and specifying its value. The third refers to monitoring a project's progress and checking whether its performance is deriving from plan. The fourth refers to testing a project's against its requirements in order to ensure that its benefits were obtained. Lessons learned are also captured as an input for later projects.

Dawson (2000) identifies six project management process groups. They include (1) definition; (2) planning; (3) initiation; (4) control; (5) organisational; and (6) closure. The definition processes seek to "*explore the feasibility of a project, identify a problem to be solved, define a project in terms of goals and objectives, submit a project proposal and obtain a project go-ahead*" (*ibid.*: 438). The planning processes are used to "*prepare workable plans and identify how the project will fulfil these business needs*" (*ibid.*: 438). They broadly involve the estimation and scheduling work of resources and budgeting, as well as planning cash flows and defining standards to be maintained. In the planning processes, techniques such as Gantt charts, activity networks, work breakdown, work breakdown structures, organisational charts, responsibility matrices are actively used.

The initiation processes, as added by Dawson (2000), are related to a project's set-up and start-up. The control processes monitor time, cost, quality and scope as the project progresses according to a project's plans, as well as identifying variances, taking corrective actions when necessary and, as observed by Lock (2000b), identifying current problems and foreseeing and preventing potential risks. Organisational processes pay attention to co-ordinate and organise resources in order to get the work done. Finally, closure processes are related to completion activities.

Finally, project management can be understood as project risk management, as the latter is an integral part of the former. Chapman (1997) proposes a Project Risk Analysis and Management (PRAM) process, a formal risk management process applied to all stages in the project life cycle, in line with the Association for Project Management. The PRAM process is analogous to the UK Ministry of Defence approach, developed in 1991, and to the Synergistic Contingency Evaluation and Response Technique (SCERT) approach, developed by Chapman (1979).

Chapman (1997) developed a nine-stage PRAM process, which includes (1) define; (2) focus; (3) identify; (4) structure; (5) ownership; (6) estimate; (7) evaluate; (8) plan; and (9) manage. The define stage refers to a transparent understanding of relevant aspects of a project by consolidating information. The focus stage refers to a transparent understanding of relevant aspects of the risk management process in order to provide both strategic and operational plans. The identify stage refers to identifying relevant risk sources, as well as classifying opportunities and threats. The structure stage refers to an understanding of simplifying assumptions about relationships between risk, responses and base plan activities. The ownership stage refers to an efficient and effective definition of ownership and management allocations. The estimate stage refers to identifying areas of significant uncertainties and potential significant uncertainties, as well as estimating their likelihood and impact in numerical terms. The evaluate stage synthesises and evaluates the results by ranking risks and comparing base and contingency plans, as well as identifying possible difficulties and providing revised plans. The plan stage designs a risk management plan ready for implementation. The manage stage monitors and controls progress, and develops plans for immediate implementation (*ibid.*).

Table 2.1 is an attempt to compare the different classifications of the stages (or phases) of project management. These classifications appear to match with the classification adopted by the current thesis, in line with Amram and Kulatilaka's (1999b) taxonomy.

TABLE 2.1 – PROJECT MANAGEMENT PHASES ACCORDING TO DIFFERENT SOURCES

Amram and Kulatilaka (1999b)	Ward and Chapman (1995b)	Murray-Webster and Thiry (2000)	Turner (2000b)	Dawson (2000)	Chapman (1997)
Design	Concept Design	Definition	Proposal Initiation Feasibility	Definition Initiation	Define Focus Identify Structure
Planning	Plan Allocation	Planning	Definition Strategic Planning	Planning	Plan Ownership
Valuation		Planning	Appraisal		Estimate Evaluate
Management	Control	Implementation		Control Organisational	Manage
Review	Deliver Review	Implementation Appraisal	Implementation Control	Control	Manage
Redesign	Support	Definition	Finalisation/Close-out Testing/ Commissioning/ Handover	Closure	

Having acclaimed the two management stages (evaluation and control), and their six phases (design, planning, valuation, management, review and redesign), Amram and Kulatilaka (1999b) argue that managers often recognise evaluation and control as discrete, detached stages, and therefore the control stage is considered to be a natural consequence of the evaluation stage. Projects are often optimistically planned

(Kahneman and Lovallo, 1993), rarely go according to plan (Clarke, 1999), and managers who assess a project are generally different from those who execute it (Amram and Kulatilaka, *op. cit.*). However, Simons (1995) observes that evaluation and control are not sequential, but interconnected processes, and control, as Pharro (2000) states, can be carried out from a project's outset.

2.2.3 – Strategic Project Management: The Connection between Strategic Management, Capital Budgeting and Project Management

Having discussed such issues as "project" and "project management", it is time to discuss strategic project management as resulting from the connection between strategic management, capital budgeting and project management. Prior to that, the relationship between traditional project management and strategic projects is presented, as follows.

Traditional project managers pay attention to such criteria as time, cost, performance objectives and functionality (Murray-Webster and Thiry, 2000; Turner, 2000b), and develop planning and control systems to manage these criteria (Turner, 2000a). Kasanen and Trigeorgis (1993) argue that the traditional engineering perspective on project management is related to the operational domain. Traditional project management is usually associated with disciplines such as capital budgeting and financial performance monitoring. It is attached to assessing a project's accounting and short-term financial outcomes, and is inclined to maintain the expected values, to react to eventual negative variances in costs, and tends to overemphasise the shareholders' interests. The management of everyday (operational) projects can be satisfactorily conducted under the traditional project management approach.

Nevertheless, according to Kaplan and Norton (1992) and Partington (2000), the business world has become a highly changeable, uncertain and complex environment. Major changes, as Oyon and Mooraj (1999) observe, have occurred as a result of the overturn of industrialised economies, the advent of privatisation programmes and deregulation trends, as well as the reinforcement of shareholder power and the outburst of new information technologies.

In such a climate, strategic projects are essential, unique, novel and transient long-term investments if a firm wants to achieve, sustain and renew its long-term objectives and prosperity, as claimed by Schoemaker (1992), Faulkner (1996), Andrews (1997), Foss (1997b), Bowman and Moskowitz (1998) and Turner (2000b). As Schoemaker (*op. cit.*: 80) observes, *"[strategic projects] are the vehicles through which a sound vision gets implemented and realized*", and project management is "*a process of converting vision into reality*" (Turner, *op. cit.*: 69).

Buckley (1998) develops this view by stating that strategic projects represent the core of corporate growth, change and wealth creation. They are major investments, often involving high uncertainty, and they comprise intangible benefits and promise attractive long-term financial outcomes. Strategic projects also motivate the creation, acquisition and development of competencies (Foss, 1997a), and comprise a collection of diverse options (Amram and Kulatilaka, 1999b).

On the one hand, as Ward and Grundy (1996) observe, uncertainty, interdependencies and intangibles (*e.g.* quality rate, customer satisfaction, market share, employees' relations and innovation), which are relevant business concerns to be accounted for in managing strategic projects, cloud the decision-making process. On the other hand, some summary measures, which are mastered regularly in the operational domain, do not capture the role of uncertainty, and the value of interdependencies and intangibles in managing strategic projects. First, managers wish to remove uncertainty from future outcomes, instead of coping with it and being adaptive while making decisions (Dyson and Foster, 1983). Second, managers often do not clearly realise the collection of interdependent options embedded in strategic projects, as these options may carry intangible values (Barwise *et al.,* 1989). Third, managers tend to focus on improving the efficiency of tangible assets because these assets are more easily measured (Bontis *et al.,* 1999). As a consequence, managers can make damaging decisions for long-term corporate survival. Good project management addresses uncertainty (Hertz, 1964; Hertz and Thomas, 1983; Dixit and Pindyck, 1994; Chapman and Howden, 1997), interdependencies (Dyson and Berry, 1998) and hard-to-quantify costs and benefits (Barwise *et al., op. cit.*).

The management of strategic projects can draw on the traditional project management approach, but might add strategic dimensions into the analysis, which refine a project's value and introduce new ways of working in organisations via a culture of programme of projects. However, financial and strategic dimensions have experienced theoretical friction. The remaining part of this section discusses the intersection between such disciplines as strategic management, capital budgeting and project management.

Historically, strategic management and capital budgeting are parent disciplines that seem to exist, as Ward and Grundy (1996) state, in a *'schizophrenic'* tension or even in straight opposition. According to Andrews (1997), the former addresses strategy formulation, and discusses such issues as corporate and business strategies, and corporate mission, goals, policies, resources, strengths, weaknesses, opportunities and threats. For Brealey and Myers (1996), the latter discusses the role of financial techniques in appraising a project's financial result.

According to Kester (1984), Bunn and Salo (1993) and Amram and Kulatilaka (1999a), strategic management follows a *'soft'* or *'qualitative'* approach, using judgement, intuition, subjective analysis and undisciplined thinking in the decision-making process. Conversely, capital budgeting follows a *'hard'* or *'quantitative'* approach, using objective analysis, techniques and disciplined thinking in measuring results. Capital budgeting techniques are ways of justifying an investment decision, but they are part of a wider decision-making process (Lock, 2000e).

Barwise *et al.* (1989) and Ward and Grundy (1996) develop this view by stating that while capital budgeting considers the strategic dimensions as informal and subjective, strategic management considers the financial dimension as formal, pragmatic, mechanistic, short-sighted and not taking into account intangibles encompassed in the decision-making process. According to Dyson and Foster (1983), the broad corporate aspects of strategic management conflict with the narrow orientation of corporate finance. For Ward and Grundy (*op. cit.*), while strategic management is continuously enclosing an enlarging range of dimensions, corporate finance keeps strictly attached to a rationalistic standpoint.

Schoemaker (1992) adds that while strategic management is grounded on visioning and idealisation, corporate finance is based on reality and execution. However, as Ward and Grundy (1996) state, these disciplines might be mutually supportive. Strategic vision helps to highlight numbers and numbers give more accuracy to strategic vision. Barwise *et al.* (1989) add that finance provides a common language and framework.

According to Partington (2000), strategic management and modern forms of project management are directly associated, and have been developed in parallel. These modern forms of project management have developed from traditional origins back to large engineering projects in the post-WWII era, through systems development projects to the implementation of organisational change.

Partington (2000) claims that a firm needs to undertake internal programmes of change in order to achieve its business objectives. These programmes, in turn, can be broken into discrete, interrelated projects. The project management approach can be employed to the implementation of strategic change. There is, therefore, a correspondence between strategy planning and implementation, and simple, structured, well-communicated and realistic programmes of projects. This match arises from the connection of the current needs of strategic management with the principles of project management.

Murray-Webster and Thiry (2000) develop this view by extending the term "project management" to "programme management". Programme management is the co-ordinated management of a portfolio of projects in order to implement change effectively and achieve the benefits of strategic importance. Programme management broadly bridges the gap between strategy and projects, by ensuring that strategic needs are effectively implemented and planned benefits are delivered, translating key performance indicators into clear, quantifiable goals, as well as making the most effective use of resources. At each review/approval stage of a project, deliverables against business objectives are reassessed through a learning process. For simplification, programme management and project management are treated similarly in this research project, labelled as project management.

Strategic management, as observed by Partington (2000), can profit from project management principles. First, effective strategy implementation can be associated with a series of flexible, integrated programmes of change. Second, strategy implementation can be related to "*non-routine tasks as project work in temporary team-based structures each with a designated leader*" (*ibid.*: 37). Third, strategies can be founded on co-operation and alliances. Finally, the acquisition, development, accumulation, exploitation and diffusion of knowledge impact the implementation of organisational change.

Schoemaker (1992), Andrews (1997) and Bowman and Moskowitz (1998) reinforce the linkage between strategic management and project management. According to these authors, corporate mission and goals represent a way of explaining a firm's strategic vision in order to allow it to explore and exploit strategic opportunities. Corporate mission and goals allow a firm to build certain desired competencies in order to transform strategic vision into a specific investment programme.

An investment programme is basically a combination of platform and supporting investments. Platform investments are those investments that support other corporate projects, and permeate the organisation in order to allow a firm for acquire, co-opt or develop strategic competencies. Supporting investments, namely training and the redesign of corporate routines, are in charge of sustaining and renewing such competencies (Amram and Kulatilaka, 1999b).

Summarising the above discussion, strategic project management can be seen as the result of the mutual relationship between such disciplines as strategic management, capital budgeting and project management. Strategic management focuses on visioning, idealisation and strategy formulation. Capital budgeting concentrates upon realisation and execution, through the use of techniques for a project's appraisal and the measurement of its results in financial terms. While strategic vision helps to highlight numbers, numbers give more accuracy to strategic vision. Finally, project management links the management of a programme of projects and the implementation of corporate change. Project management ensures that strategic needs are effectively implemented and planned benefits are delivered, translating key performance indicators into clear, quantifiable goals, as well as making the most effective use of resources. Corporate mission and goals allow a firm to build certain desired competencies in order to transform strategic vision into a programme of projects.

2.2.4 - Scholarly Contribution to the Use of Techniques for Strategic Project Management

As previously discussed, strategic project management lies at the crossroads of strategic management, capital budgeting and project management. A question then arises: what has been the theoretical contribution to the use of techniques for the management of strategic projects?

The evaluation of strategic projects is a controversial topic in the literature. Although some theorists aspire to valuing strategic projects, some resist this. Several authors suggest distinct ways of evaluating strategic projects, as seen in the following paragraphs.

Barwise *et al.* (1989) suggest building two scenarios ('*with*' or '*without*' the project), and appraising the differential cash flows, taking into account market trends, comparative advantages, competitive reactions and the impact of internal changes. They highlight such issues as the determination of a strategic project's economic life and salvage value, and the division of a strategic project into a set of independent sub-projects.

Smit and Ankun (1993) recommend integrating option pricing theory with game theory to help capture the role of competition, which includes a firm's market share and position in the industry, and competitor activity. Dixit and Pindyck (1994) suggest estimating a project's value, which is not directly observable in the financial market, through observable proxies. These authors also propose using dynamic programming, in which risk-adjusted discount rates are arbitrarily determined by making restrictions on the investors' (or managers') utility functions. Kasanen (1994) proposes using a market utility function, which incorporates simultaneously financial market (*e.g.* oil price) and technical (*e.g.* geological) uncertainties.

Smith and Nau (1995) argue in favour of merging option pricing theory and decision analysis by dividing the analysis into two steps. In the first step, the option pricing theory captures the financial market risk hedged by trading securities. In the second step, a utility function captures technical uncertainty, by assessing managerial risk preferences, and then assigns a risk premium to the financial market risk obtained in the first step. Smith and Nau (*op. cit.*) also suggest combining decision-tree analysis with utility function. While the former includes the financial market opportunities, the latter captures the time and risk preferences.

Ward and Chapman (1996) combine scenario analysis, forecasting and a probability tree model (semi-Markov process) to identify the cost of inflexibility for scaling up units of power generation in the medium-term planning. Chapman and Howden (1997) propose a parametric and probabilistic analysis process to evaluate large-scale public projects that comprise both considerable time horizons and uncertainty. The analysis process is divided into two phases. The first phase is a parametric discounting approach, used in various forms, such as NPV, IRR and payback period, and sensitivity analysis. The second is a probabilistic approach, which involves risk analysis, decision-tree analysis/Markov process, and scenario analysis.

Chapman *et al.* (2000) propose a simple, applied model to assess cost uncertainty and the probability of winning a bid, assuming a bid as a one-stage project. At first, the model forecasts cost components options and uses a parametric analysis to treat uncertainty of maximum values of cost component options through different scenarios. Risk analysis is then applied to combine cost component options. The estimation of the probability of winning a bid is made explicit from expert perceptions. The optimum bid price is obtained, which is complemented by non-easily modelled qualitative issues. Price refinement is obtained from higher order process optimisation and sensitivity analysis. Finally, feedback from successful bids adjusts and validates the assessment of future bids.

Some authors propose combining quantitative and qualitative appraisals. Kester (1984, 1993) refers to strategic capital budgeting as an adequate tool for evaluating strategic projects, which combines a quantitative framework with managerial judgement. Ward and Grundy (1996) suggest combining prospective vision with a detailed financial quantification of a strategic project's value. Slater *et al.* (1998), meanwhile, seek to combine quantitative and qualitative assessments as an improvement over the strict reliance on financial metrics.

Some authors, however, find it impractical to value strategic projects objectively. Kester (1993) and Slater *et al.* (1998) stress, for instance, that strategic projects are imperfectly traded long-term investments. First, agreements usually involve significant costs, namely legal expenses and monitoring costs. Second, a strategic project's options usually interact with other assets and are dependent on the experience of the firm that possesses it. Strategic projects, therefore, have different values to different firms (Kester, *op. cit.*) and promise biased outcomes (Buckley, 1998). For Barwise *et al.* (1989), strategic projects are vague, depend on a managerial vision of what might happen, and the value of their embedded options is impossible to estimate in practical terms.

Control of strategic projects is not as thoroughly covered by the literature as the evaluation of strategic projects. Insufficient theoretical attention has been paid to project control despite its undeniable importance (Kaplan and Norton, 1992; Kasanen and Trigeorgis, 1993). Furthermore, the core of theoretical work in the use of techniques for facilitating project control has focused on the achievement of targets, at the expense of addressing elements involved in the project control process, namely internal business scanning (corporate alignment), and external environment scanning (financial market, product, market, economic, environmental (green) and political). These issues are covered by such authors as Dixit and Pindyck (1994), Nanda (1996), Foss (1997a), McGrath (1997, 1999), Dyson and Berry (1998), Grant (1998), Brewer *et al.* (1999) and Amram and Kulatilaka (1999b).

Control systems were developed in the early 1950s for military reasons as a direct response to the Cold War. Traditional control systems tend to focus on a project's short-term financial results (Ashford *et al.*, 1990; Kaplan and Norton, 1992) and to improve the efficiency of tangible assets (Bontis *et al.*, 1999). According to Dyson and Berry (1998), these procedures are tactical, reactive and passive '*constraining mechanisms*', and, as observed by Kaplan and Norton (*op. cit.*), they overlook the concept of control and impel a control bias.

On the one hand, as noted by Ashford *et al.* (1990), the effect of using traditional control systems can be disastrous for an organisation's performance. "*The problem of commitment to long-term projects emphasizes the need to use many performance measures, which should be more in accord with the long-term goals of the firm*" (*ibid.*: 251). On the other hand, although traditional control systems should be responsible for action and execution, as Oyon and Mooraj (1999) observe, they are usually '*paralysis mechanisms*' that focus systematically on measuring performance and, as a result, tend to prevent change and improvement. According to Brewer *et. al* (1999), these systems considers the risk of novelty to exceed the desired level of future performance.

Nevertheless, according to Foss (1997b), traditional control systems can be useful instruments for a firm, as it will benefit from experiential learning if, as observed by McGrath (1999), deviations from plan would not be simply considered as managerial mistakes. As a result, firms become flexible and adaptive entities in the advent of adverse circumstances (Foss, *op. cit.*).

A realm of techniques has been developed to overcome the limitations of traditional control systems. In the late 1980s the focus was on measuring a firm's long-term financial performance (Stewart, 1994). In the mid 1990s several companies attempted to measure their superior strategic performance (Bontis *et al.*, 1999) through a balanced set of measures (Kaplan and Norton, 1992). "*The financial measurement needs to be at the end of the measurement process as a system of checks and balances, rather than at the beginning of the measurement process as the primary means of assessing performance*" (Brewer *et al.*, 1999: 10). Financial results are a consequence of strategic initiatives, and not in themselves the driving force for superior performance (Mooraj *et al.*, 1999). In the late 1990s the emphasis in measuring a firm's superior performance shifted to seeking a firm's superior aspiration through the control of intangible assets (Bontis *et al., op. cit.*). Major scholarly attention, however, has focused attention on the corporate level instead of the project level.

Murray-Webster and Thiry (2000) propose a pool of techniques for managing programmes of projects. They recommend the use of a technique called Business Excellence Model, which may be combined with the Balanced Scorecard, a technique introduced by Kaplan and Norton (1992) to "*conduct self-assessment of all aspects of its [organisational] operations from leadership and strategy formulation, through management of is people, customers and partners to business results measured in financial and non-financial terms*" (*ibid.*: 58).

The current chapter is not simply organised in chronological terms. It is also composed in themes, as this is a multidisciplinary research topic. The chapter starts by stressing the traditional and recently developed techniques for managing projects. Along with the description of these techniques the elements involved in that management are thoroughly outlined. Finally, the application of recently developed techniques as facilitators for successful strategic project management is indicated.

2.3 – Techniques for Managing Projects

This section aims to explore a range of techniques available for project management, as well as pointing out the elements involved in this. However, some important issues must be outlined prior to the description of these techniques. First, some concepts regarding the evaluation of projects are discussed. These include (1) long- and short-term summary measures; (2) market and accounting approaches; (3) corporate and shareholder's value; (4) rational and behavioural approaches; and (5) individual and portfolio evaluation.

According to Dyson and Berry (1998), a project is a stream of cash flows, usually with an initial outflow followed by a series of inflows, where the latter is considered more uncertain. "*The end product of a financial appraisal is a meaningful summary measure of this stream of financial costs and benefits*" (*ibid.*: 270).

As Dyson and Berry (1998) have observed, it is necessary to distinguish the market approach from the accounting approach. As Stewart (1994) states, the former refers to annual cash flows, and the latter to accounting profits. The market approach and the accounting approach are often associated with, respectively, the long-term and the short-term (Dyson and Berry, *op. cit.*). The accounting approach is considered '*myopic*' (*ibid.*) and accounting-based measures give an equivocal, inappropriate view of the financial attractiveness of an investment opportunity (Ward and Grundy, 1996).

There are two conflicting standpoints for evaluating a project, namely the managerial and shareholder's perspectives. According to Dyson and Berry (1998), while managers are concerned with a project's total risk and conform to a strategy of satisfying its corporate value, shareholders, rather, pay attention to part of a project's risk, *i.e.* the financial market risk, and conform to a strategy of maximising its market value.

Shareholder's value, as observed by Turner (2000c: 217), seeks to increase *"the value of shares to holders of equity in the company"*, and, although being it pre-eminent (Dyson and Berry, 1998), it is often considered a sufficient and superior way of appraisal addressed by financial techniques (Ward and Grundy, 1996). However, the shareholder's perspective does not capture all aspects of a strategic initiative in financial terms (Dyson and Berry, *op. cit.*).

There is a divergence between a shareholder's value and corporate value. A shareholder's value reflects the financial value perceived by the capital market, and drives managers to at least satisfy the returns on the capital market, being based on information accessible to investors. However, shareholder's value over-emphasises external constraints and managers perceive them as a harmful imposition. Corporate value is defined as the present value of expected returns from the association of present business strategies and future investment programmes, based on information accessible to management. Managers have better information about future cash flows than shareholders (Ward and Grundy, 1996).

As Ward and Grundy (1996) and Buckley (1998) note, Simon in 1957 and Mason in 1958 discussed the conflict between rational and behavioural approaches. Organisations might satisfy a balanced group of actors, namely employees, customers, suppliers, rather than merely focusing on the shareholder's perspective. Different actors view a project in different ways (Barwise *et al.*, 1989) and search for different outcomes (Galliers, 1991). Nevertheless, responsibilities and self-interests influence a manager's perception of a project. Buckley (1998: 17) observes that the danger lies in *"managers serving their own ends rather than those of the shareholders"*. For that reason, Ward and Grundy (1996) state that corporate value must not neglect managerial information, but must mirror shareholders' expectations and aspirations. In summary, a project must contribute value to the sponsoring organisation (Turner, 2000c).

According to Dyson and Berry (1998), capital budgeting techniques usually assume that a project can be evaluated in an isolated context. However, isolating a project may not display all the potentialities of a project's value. This research also discusses the evaluation of a project within a portfolio context.

Finally, some important issues regarding the control of projects must be also highlighted prior to the description of the techniques. They include (1) the friction between short- and long-term control targets; (2) the conflict of interest between managers and shareholders; and (3) the conflict of interest between a firm and its employees.

Traditional project control, as Simons (1995) observes, is associated with diagnostic control by measuring periodically and systematically progress against plan. A diagnostic control system generally monitors whether short-term control targets are achieved as intended, measures deviations from the optimal path, and implements immediate corrective action.

As Ashford *et al.* (1990) observe, the managerial focus on short-term targets results from the period of time managers spend in their positions, but it is incompatible with a project's economic life. Managers do not want someone else to take advantage of the long-term benefits generated by their projects. However, as Ward and Grundy (1996) suggest, financial plans require the inclusion of long-term financial targets and a full resource commitment to attain these targets. Simons (1995) proposes an interactive control system, which pays attention to the development of future long-term strategies.

Beyond the conflict between short- and long-term targets, Elrod and Moss (1994) state that according to the agency theory, shareholders are by nature profit maximisers, and their relationship with managers, who have other, sometimes private, interests, might lead to a conflict of interest. A multiple set of measures might mitigate this conflict.

Finally, the relationship between a firm and its employees might result in another conflict of interest related to the ownership of a firm's assets, namely the intangible assets. This conflict can be mitigated, as Nanda (1996) observe, if control was not linked to authority, but to organisational tacit knowledge. *"The more deeply embedded are organisational routines within groups of individuals and the more they are supported by the contributions of other resources, then the greater is the control that the firm's management can exercise"* (*ibid.*: 192). Simons (1995) recommends a boundary control system to establish the limits of legitimate activity for the employees within an organisation.

The following sections discuss the techniques for managing projects, as well as underlying the elements involved in this. Prior to the debate on the techniques, it is relevant to point out the way techniques are understood in the current study. First, techniques differ from information systems or commercially available software tools, as well as documents, guidelines or communication tools such as reports, meetings, peer reviews and electronic mails. Second, this research focuses attention on the critical description of the techniques rather than on the constraints to one's actions, or on the managerial sanction, in using them. Third, techniques discussed here are those used after the inception of a strategic project. Therefore, those techniques associated with the process of conceiving a strategic project did not take part in the present study. Fourth, techniques can be used for both evaluating and controlling projects. However, some of them are more frequently applied either in the evaluation stage or in the control stage. Fifth, techniques are described separately instead of in the context of the project management approach that considers a diverse range of techniques associated with a broader process. Sixth, techniques follow, to some extent, different, but complementary directions. Seventh, techniques are financial (output) oriented or strategic (process) oriented. Eighth, they address both accounting and market measures. Ninth, they address both shareholders' value and corporate value. Tenth, techniques address a project in both individual and portfolio contexts. Eleventh, some techniques, which are used first and foremost for measuring and controlling business performance, are extended to the project level. Finally, techniques are divided into traditional and recently developed techniques. This classification does not imply any negative connotation. It is simply associated with the degree of managerial familiarity with, and use of, techniques.

2.3.1 – Traditional Techniques

This section presents the traditional techniques for managing projects. They include summary measures, sensitivity analysis, techniques that incorporate uncertainty and techniques that deal with some degree of mathematical complexity, as seen in the following sections.

2.3.1.1 – Summary Measures and Sensitivity Analysis

According to Dyson and Berry (1998), it is indispensable to account for two important primary dimensions in project evaluation: the "*time value of money*" and the role of uncertainty. Managers, as observed by Brewer *et al.* (1999), are aware of these two dimensions. Nevertheless, they assume that the future is uncertain and it is preferable to be rewarded now rather than afterwards. Managers tend to recognise right away, at least partially, a project's outlays. However, they do not often recognise the benefits until their realisation. While some summary measures address the time value of money, some techniques address uncertainty.

Summary measures include accounting and financial measures, with which managers are, as observed by Barwise *et al.* (1989) and Buckley and Tse (1996), usually familiar. According to Dyson and Berry (1998), accounting summary measures are based on one-year profits and historic values, and ignore the time value of money and the market (replacement) value. Net income, as observed by Black (1997), is a term used for the surplus of money over the costs (negative or positive) accrued during a particular period (usually one-year) from any source (*e.g.* sales, rentals, investments, gifts, etc). ROI refers to the net profit after taxes-to-investment ratio, and, as Stewart (1994) has added, is often used for assessing corporate financial capability. ROI is also applied as a measure of divisional performance, as discussed in Section 2.3.3.2 ("Economic Value Added").

The project's payback period[1] is the number of years required to return a project's initial investment. A project is accepted if the payback period is inferior to a specified threshold value (Brealey and Myers, 1996). For Lock (2000e), the payback period is also known as breakeven analysis, *i.e.* "*a simple process of discovering how long it is expected to take, under a given set of circumstances, before the cash inflows generated by the project reach and start to exceed the total expenditure*" (*ibid.*: 513).

However, the payback period presents some weaknesses. First, it only accounts for a project's timescale (time to maturity), and neglects the long-term advantages given by most investment opportunities. For that reason, although managers use to pay excessive attention to timescale, they consider the payback period to be a '*myopic*' measure, an '*unsophisticated*' technique, a mere rule of thumb, or even a restriction. Second, the payback period often ignores the time value of money by not applying a discounting procedure. Finally, the threshold value must be correctly specified so as not to constrain a project's selection (Van Horne, 1992; Weston and Copeland, 1992; Brealey and Myers, 1996; Buckley, 1998; Dyson and Berry, 1998; Turner, 2000b).

The discounted cash flow (DCF) procedure is supported by sound rationale, and is widely accepted by managers, as observed by Slater *et al.* (1998). The DCF procedure

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[1] The discounted payback period is a variant of the payback period that considers the time value of money.

usually accounts for a project's durability, as it considers both the size and timing of the expected cash flows during a project's economic life.

According to Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), Buckley (1998), Dyson and Berry (1998) and Lock (2000e), a project's NPV is defined as the sum of its discounted cash flows. A project is accepted if the NPV is positive, as it adds to shareholder's wealth. Nevertheless, as observed by Turner (2000c), the NPV is not definitely correlated to shareholders` wealth creation.

Many financial theorists consider the NPV to be a sufficient and complete long-term measure (Brealey and Myers, 1996). It also allows the comparison and selection of two or more strategies for the same project (Lock, 2000e). However, the NPV presents some weaknesses. First, it is based on single, static projections (Brealey and Myers, *op. cit.*). Second, it does not consider the role of uncertainty (*ibid.*). Third, it is insufficient in accounting for the flexibility of most investment decisions (Buckley, 1998). Fourth, it does not estimate accurately those decisions that involve high initial uncertainty (Bowman, and Moskowitz, 1998). Finally, the application of NPV is independent from the financial ratios of the organisation, and it is in support of parts of the business with high indirect costs and low direct costs (Turner, 2000c).

IRR, as Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), and Dyson and Berry (1998) observe, is the rate of return that results in a null NPV. A project is accepted if the IRR exceeds the discount rate. However, a project's discount rate must be correctly chosen (Lock, 2000e), as it may capture the risk of the project (Brealey and Myers, *op. cit.*).

IRR also has certain pitfalls, as observed by Brealey and Myers (1996). First, a project's IRR assumes that the project reinvests at the IRR instead of at the cost of capital. Second, IRR can be difficult to compute in the case of multiple IRRs[2]. Third, the IRR decision rule is mutable. For debt-financed projects[3], the IRR decision rule is inverted: a project is accepted if the discount rate exceeds the IRR. Fourth, while individual NPVs can be summated[4], IRRs cannot. Finally, in the case of mutually exclusive projects, those ranked by the IRR do not necessarily maximise the shareholders' wealth.

The payback period and IRR are very popular measures among practitioners. First, according to Ashford *et al.* (1990), practitioners consider somewhat surprisingly the payback period as a '*serious*' measure for financial assessment. The reasons include *"[its] simplicity, and robustness for making judgements on possibly optimistic costings and uneasily quantified business risks"* (*ibid.*: 246). Finally, as observed by Chapman *et al.* (1987) and Costa Jr. *et al.* (1994), managers are more familiar with (and may prefer) rates than amounts of money.

According to Buckley and Tse (1996) and Slater *et al.* (1998), in the case of real-world problems, managers do not want to ground important decisions in deterministic, projected measures. As a result, managers use to combine these measures with sensitivity analysis. Sensitivity analysis, as pointed out by Schoemaker (1995), measures the change in one variable at a time, with all other variables being kept constant.

[2] According to the Descartes rule, if the sign of the cash flows changes over time there is more than one single IRR. IRRs are the positive, real roots of the nth-level equation.
[3] Debt-financed projects comprise an inflow followed by outflows, opposite to equity-financed projects that comprise an outflow followed by inflows.
[4] NPV follows the principle of addition.

However, as Lock (2000e) notes, sensitivity analysis does not address uncertainty; it identifies the most risk-sensitive variables, providing managers with answers to a wide range of *'what-if'* questions.

Cost-benefit analysis, as Black (1997) claims, is a measure that usually compares intangible costs with benefits through monetary values. Cost-benefit analysis is traditionally applied to an appraising of the social, environmental or political impacts of projects involving externalities, namely infrastructure and environmental projects. However, as observed by Black (*op. cit.*: 94), *"because non-marketed costs and benefits are difficult to measure and evaluate, the results of cost-benefit analysis can be highly controversial"*.

Organisations have recently become increasingly aware of a project's social impact as an influence on customers due to cultural issues and customers' attitudes. They have also become aware of a project's environmental impact upon the planet's welfare. According to Dixit and Pindyck (1994), although environmental policies seek to mitigate ecological damage, they concurrently impose sunk costs upon society.

Political impact has gradually become an important issue in project management. Taking proactive managerial actions towards key stakeholders, namely the government (Faulkner, 1996), an organisation might affect the *'structure of payoffs'* (McGrath, 1999). The structure of payoffs, as stated by Baumol, in 1993, "*indicate the rewards and sanctions society offers for various kinds of economic activity*" (*ibid.*: 24).

A firm's requirement to raise external funding brings to light another financial measure. According to Brealey and Myers (1996), leveraged NPV is the combination of the equity-financed NPV and debt-financed NPV. On the one hand, traditionalists consider that financial decisions affect investment decisions. On the other hand, Modigliani and Miller (1958) propose that a firm's capital structure does not affect its market value. However, as debt increases the rate of return on investment, it also increases a firm's perceived risk (Brealey and Myers, 1996).

According to Bontis *et al.* (1999), Hermann pioneered, in the 1960s, the debate between accountants and human resource theorists regarding the valuation of human capital. Human Resource Accounting (HRA) models aim only to measure the value of people in financial terms, and are usually developed in service organisations where human capital embraces a significant proportion of the organisational value.

HRA models present some problems. First, it is difficult to anticipate a company's growth, tenure per employee, turnover and salary increases. Second, HRA models suffer from subjectivity, and their measurement cannot be audited with assurance. Finally, to treat people as corporate assets is considered, to some extent, morally unacceptable and easily manipulated (*ibid.*).

As has been previously discussed, summary measures disregard the role of uncertainty (Hertz, 1964; Hertz and Thomas, 1983; Dixit and Pindyck, 1994; Chapman and Howden, 1997). Uncertainty has been considered to be a key issue in project appraisal, and is incorporated by some traditional techniques, namely scenario analysis and risk analysis. "*[...] Value is fundamentally influenced by uncertainty*", as stated by McGrath (1999: 13). There are some other traditional techniques that deal with some degree of mathematical complexity, namely optimisation, capital and manpower rationing, cost management, scheduling and progress measurement.

The next sections discuss a range of techniques that incorporate uncertainty or deal with some degree of mathematical complexity. Prior to this discussion, two important issues must be highlighted. First, techniques incorporate uncertainty through two different perspectives: managerial and shareholder's perspectives. The former focuses on managerial information, while the latter concentrates on shareholder's information. Second, techniques that deal with mathematical complexity are applied for both an individual project and a portfolio of projects.

2.3.1.2 - Techniques that Incorporate Uncertainty

This section presents a wide range of techniques that incorporate uncertainty. They include scenario analysis, forecasting, contingency analysis, simulation, cognitive mapping, risk analysis, mechanisms for generating a project's risk adjusted discount rates (*i.e.* Capital Asset Pricing Model, Arbitrage Pricing Model, Certainty Equivalent Approach and Time State Preference Model) and decision-tree analysis, as seen in the following.

The Rand Corporation introduced scenario analysis in the 1950s (Schnaars, 1990), which was developed by Shell and others and implemented by utilities for long-range planning (Ward and Chapman, 1996). The interest in using scenario analysis comes from the possibility of relying on different possible future environments instead of on a single long-term forecast. As Becker (1983) and Chapman *et al.* (1987) observe, scenario analysis introduces external environment issues, namely economic, social, political, technological and environmental uncertainties and impacts, as well as competition into the analysis. It also examines, as Dyson and Foster (1983) discuss, a firm's competency alignment, *i.e.* fitness with corporate strengths, and a firm's corporate alignment, *i.e.* adherence to corporate mission and goals.

Scenario analysis cannot be misunderstood as a forecasting model. Bunn and Salo (1993: 301) observe that "*Traditional forecasting is an over-deterministic projection of past trends*". Levy (1994: 170) adds that "*Rather than expend large amounts of resources on forecasting, strategic planning needs to take into account a number of possible scenarios*". While long-term forecasting models are techniques for predicting the future through mathematical manipulations of historical data (*e.g.* economic, financial market, political, social and technological uncertainties), scenario analysis expands a single projection by constructing different scenarios grounded in managerial negotiation (Chapman *et al.*, 1987; Schnaars, 1990).

Scenario analysis is, therefore, more than a forecasting technique. According to Schoemaker (1995), scenario analysis is a processual instrument of organisational interaction, learning and adaptability. It associates various forecasts with chronicles of possible future contexts (Bunn and Salo, 1993), and is generated conditional to its intended use, the nature of the organisation and the preferences of the group involved (Vanston Jr. *et al.*, 1977).

According to MacNulty (1977) and Chapman *et al.* (1987), Herman Kahn credited himself with inventing the term scenario, and adopted a stylised narrative, referring to it as '*scenario writing*'. Authors, such as Bright (1972), MacNulty (1977) and Brauers and Weber (1988) define the term '*scenario*' differently. A sound definition of scenario is given by Kahn and Wiener (1967), who describe it as "*A hypothetical sequence of events constructed from a set of specified assumptions for the purpose of focusing attention on* *causal process and decision points*". Becker (1983) and Schnaars (1990) observe that scenarios can be either the evolution from present to future (longitudinal scenarios), or the description of how the future would be (cross-sectional scenarios). The former is preferred to the latter, as it provides cause-and-effect information.

According to Schnaars (1990), companies generally identify a finite number of scenarios (usually three) in order to reduce undesirable future outcomes. Bunn and Salo (1993) and Schoemaker (1995) claim that it is better to build equally probable scenarios than to assign probabilities of occurrence to scenarios. This deters decision-makers from focusing on the most likely scenario at the expense of the others.

For Bunn and Salo (1993) and Schoemaker (1995), scenario analysis is used to encourage decision-makers to early signals, and to generate strategic options which disclose new strategic opportunities and threats. Such analysis also makes it possible to evaluate a strategic option's risk profile, and to assess the robustness and flexibility of various decision-makings. Scenario analysis stimulates critical strategic thinking about possible future changes, reduces the regrets about the past and enhances the quality of the whole decision-making process.

Nevertheless, financial theorists criticise the use of scenario analysis. Leslie and Michaels (1997) argue that scenario analysis depicts discrete snapshots of the future, does not capture the value of flexibility, and offers little managerial direction. Amram and Kulatilaka (1999a,b) observe that scenarios do not quantify the value of flexibility and future options, and managers are inclined to decide subjectively by assigning subjective probabilities to scenarios. Nevertheless, Ward and Chapman (1996) applied scenario analysis, associated with other techniques, to value flexibility. Leslie and

Michaels (*op. cit.*) claim that although scenario analysis recognises the importance of uncertainty and the existence of future options, *"using high, low, or medium scenarios [...] does not help to incorporate in the valuation the variance across the different scenarios"* (*ibid.*: 11).

Scenario analysis differs from such techniques as contingency analysis and simulation. According to MacNulty (1977), contingency analysis seeks to minimise the consequences of crises. It identifies areas where significant changes may happen, monitors the factors that are precursors to change, and develops plans associated with a new circumstance. Nevertheless, as Schoemaker (1995) notes, contingency analysis examines one source of uncertainty at a time.

Simulations involve continuous scenarios, and measure the combination of simultaneous changes in different technical parameters within a specified worst-to-best range, which results in a probability distribution of the outputs (*e.g.* oil reserves and environmental impact) (Schoemaker, 1995; Lock, 2000e). The values used in the interactions are governed by random number selection, known as Monte Carlo method (Lock, *op. cit.*). However, simulation does not necessarily correspond with monetary values. When using a simulation model, it is hard to handle decisions occurring before the final decision date. Scenario analysis is more than just the output of a simulation model, as it allows the user to include variables that are not easily quantified (Schoemaker, *op. cit.*).

This section presents now a technique for problem thinking. According to Eden (1994) and Bennett *et al.* (1997), cognitive mapping is based on the '*personal construct theory*' introduced by Kelly in 1955. Eden, in the late 1980s, pioneered the use of cognitive mapping as a decision-support technique. Cognitive mapping is a qualitative, subjective, '*soft*' tool, used in the early stages of project formulation. It is a problem-structuring method, which represents a mix of beliefs and value systems. Cognitive mapping deals with complex situations by reconciling multiple perspectives associated with conflicting goals, and helps managers select among divergent actions, as a means of fostering negotiation, commitment and learning.

A cognitive map is a directed graph consisting of several concepts and links to describe the structure of a problem. A cognitive map captures individual knowledge through a network of bipolar constructs that express arguments linked by cause-and-effect arrows and feedback loops. Individual cognitive maps can be gathered into a group (or causal) map (Bennett *et al.*, 1997).

The causal map is an input to building a system dynamics model. A system dynamics model, introduced by Forrester's seminal work in the early 1960s, is broadly a simulation model that consists of a set of equations to explore complex systems in a holistic way. However, system dynamics has increasingly addressed qualitative aspects and, therefore, has more in common with '*soft*' operational research systems. Prior to a system dynamics model, an influence diagram is needed. Influence diagrams involve a system of interacting variables and influences (Bennett *et al.*, 1997). According to Eden (1994), these variables are tentatively and experimentally chosen based on the validated feedback loops embedded in the causal map. Cognitive maps, influence diagrams and system dynamics models sequentially input and feedback to each other as a means of validation and coherent examination.

This section introduces now risk analysis. Prior to introduce it, the concept of monetary risk is introduced. Monetary risk, or simply risk itself, represents an important issue in project management. Risk, as pointed out by Chapman *et al.* (2000), is the objective or subjective quantification of uncertainty, subject to the level of information availability. Several authors addressed the concept of risk. The classical definition of risk, as observed by March and Shapiro (1987), is the variability of possible outcomes. However, as Hertz and Thomas (1983) observe, risk can also be defined as the probability of losses. For March and Shapiro (*op. cit.*), risk is related more to the probability of occurrence and the amount of losses rather than the variability of possible outcomes. Lohmann and Baksh (1993) define risk as the probability of an undesirable outcome.

Hertz (1964) introduced the notion of risk analysis. According to Cooper and Chapman (1987) and Lock (2000e), risk analysis is an appropriate technique for appraising a project's feasibility (*i.e.* difficulty of realisation and implementation) in the early stages of project formulation.

As Dyson and Berry (1998) have observed, risk analysis is the probability distribution of a particular financial summary measure, namely NPV or IRR, and is also called a project's risk profile. To obtain a project's risk profile, the probability distribution of key parameters (*e.g.* financial, political, social, economic, geological, technological and environmental) that affect a project's cash flows are first obtained, and expressed in financial terms. Each periodic cash flow is then designated by a probability distribution, and all cash flow distributions are aggregated into the distribution of a financial summary measure (or project's risk profile). The process follows a random number selection (Monte Carlo method). Environmental impact, social impact and political impact, if they are measured in financial terms, can also be outputs of risk analysis.

Risk analysis presents some advantages, as pointed out by Saavides (1994), Dyson and Berry (1998) and Slater *et al.* (1998). First, it gives an overall picture of a project's risk profile and introduces a number of measures, namely the expected value and the standard deviation. Second, risk analysis reduces the lack of communication between analysts and decision-makers. Third, it improves the quality of results by eliminating conservative, deterministic estimates.

Fourth, risk analysis improves the selection of marginal projects. For instance, projects with both high expected value and probability of losses are extremely risky compared with those having both low expected value and probability of losses. Fifth, decision-makers are able to use their judgement, values and knowledge to appraise a project, and decide on the collection of further information. Sixth, risk analysis recognises the asymmetry of the distributions of key variables and their impacts on a project's risk profile. Finally, risk analysis provides the necessary information for efficient project risk management through a continuous re-examination of the adopted premises and scenarios (*ibid.*).

Risk analysis has certain disadvantages, as pointed out by Saavides (1994), Dyson and Berry (1998) and Amram and Kulatilaka (1999b). First, experts should consult managers in order to determine a credible range of values of each variable. The probability distribution is therefore often estimated by the combination of forecasting models and subjective judgement. Second, changes in input variables may cause more than proportional changes in the outcomes. Third, the interdependencies between variables involved in a specific cash flow, or among cash flows over time, must be taken into account. The specification of conditional probability distributions, however, complicates the use of risk analysis considerably. Fourth, risk analysis does not hold a unique decision rule. The decision-making depends on the trade-off between risk and expected value. When comparing mutually exclusive alternatives, the decision-making is objective only if there is a dominant alternative[5]. If not, the choice is subjective and depends on a decision-maker's attitude toward risk.

Finally, the determination of a correct rate for discounting a project's NPV risk profile, as Brealey and Myers (1996) have observed, remains a crucial topic. Discounting the cash flows at a firm's cost of capital pre-judges a project's risk and makes a redundant consideration of its risk by also using the variance of returns as a measure of risk. Discounting the cash flows at a risk-free interest rate has no practical meaning, as this does not display a project's expected NPV, but its potential expected NPV supposing an ideal, risk-free world. Alternatively, it is possible to use a project's IRR risk profile. Although it is not necessary to discount cash flows, all limitations associated with IRR must be considered.

This section points out now the mechanisms for generating a project's risk adjusted discount rates, which has formed a continual part of the financial agenda in the last decades.

[5] A dominant alternative occurs when its cumulative probability distribution always presents a higher value compared to all other alternatives. In this case, there are no intersection points among the cumulative probability of distributions of the alternatives.

According to Brealey and Myers (1996), a way of objectively computing a project's risk adjusted discount rate is through finding a traded stock in the financial market that replicates the risk associated with the project. However, to find such a replica is a challenge. A feasible alternative is to apply a mechanism that generates share prices. Different mechanisms for generating a project's discount rates, namely the Capital Asset Pricing Model, the Arbitrage Pricing Model, the Certainty Equivalent Approach and the Time Preference Model are discussed in the following.

According to Brealey and Myers (1996) and Dyson and Berry (1998), the Capital Asset Pricing Model (CAPM) is a mechanism for generating market equilibrium prices, and is primarily used for financial assets. The CAPM was developed by Sharpe, Treynor, Lintner and Mossin in the early 1960s. It supposes a positive, linear relationship between the financial market risk and a financial asset's expected rate of return. For the CAPM the relevant part of the financial risk is the systematic risk, as it assumes that shareholders own a well diversified portfolio of financial assets. The risk adjustment is based on the covariance between the returns on a financial asset and the market portfolio, which is given by the financial asset's systematic risk coefficient (or beta).

However, the use of the CAPM to compute the beta of a financial asset is, as Nichols (1993) has observed, a controversial issue in academic circles. The globalisation of financial markets and the existence of powerful financial agents may produce different prices in different markets, although the CAPM estimates a unique equilibrium price.

The CAPM, as observed by Brealey and Myers (1996), can be extended to the appraisal of real assets, namely projects. However, the estimation of a project's beta is a difficult, debatable task, as discussed by authors such as Rosenberg and Rudd (1986), Khan and Fiorino (1992), Van Horne (1992), Weston and Copeland (1992), Brown and Kulkarni (1993), and Asrilhant and Ensslin (1996). Several authors, such as Van Horne (*op. cit.*), Brealey and Myers (*op. cit.*) and Buckley (1998), claim that the use of a project's beta is inadequate for assessing a project's discount rate.

For Buckley (1998), managers do not take for granted, in practice, the risk reduction due to portfolio diversification because they do not have a diversified portfolio of jobs. In reality, managers tend to mirror their own interests in appraising a project, and add a subjective risk premium to a project's discount rate in the case of financially risky projects (Ashford *et al.*, 1990). Kulatilaka and Marcus (1992) and Slater *et al.* (1998) add that subjectively inflating the value of discount rates penalises and undervalues a project.

According to some critics of the CAPM, as observed by Brealey and Myers (1996), multi-index models would better predict the financial market fluctuations, namely the Arbitrage Pricing Model (APM). Ross developed the APM in 1976, and it assumes that returns on securities depend on a certain number of independent indexes.

Buckley (1998) and Dyson and Berry (1998) make an argument a stage further by stating that the APM is a suitable, but relatively new model compared to the CAPM. While the latter is widely used by both academics and practitioners, the former lacks empirical validation in terms of the number and types of indexes. In extending the APM to a project's valuation, as Brealey and Myers (1996) have remarked, it is necessary not only to consider all the weaknesses associated with the CAPM, but also to choose an adequate set of independent indexes.

The Certainty Equivalent (CEQ) approach, as observed by Dyson and Berry (1998), can be used as an alternative way of obtaining a project's risk-adjusted discount rate. Rational decision-makers are able to identify a trade-off between a certain amount (or CEQ) that would be equivalent to an uncertain cash flow. The difference between the uncertain cash flow and CEQ is the risk premium. In order to calculate the CEQ, it is necessary to identify a normal distribution of cash flows with known parameters and a decision-maker's utility function with a constant risk aversion coefficient. However, this is difficult to determine. Ward and Chapman (1995a) applied the CEQ approach for evaluating alternative fixed price incentive contracts. Brealey and Myers (1996) suggest a procedure that combines the CEQ approach with the CAPM to determine a project's risk-adjusted discount rate. In this procedure, however, all weaknesses related to the CEQ approach and the CAPM must be taken into account (*ibid.*).

According to Dyson and Berry (1998), the Time State Preference Model is a framework that considers the existence of mutually exclusive states of nature. For each state of nature, there is an uncertain cash flow associated with a set of cash payoffs and a current market price. The combination of the possible payoffs with the current market prices determines a project's value. The Time State Preference Model can be combined with the CAPM. Given the forecasts of the market returns and the risk-free interest rate[6],

[6] Supposing the existence of pure securities (a pure security pays one monetary unit in one state of nature and zero in all others) in the capital market, it is possible to aggregate the time-state prices discounting them at the risk-free interest rate. Time state prices are considered certainty equivalents.

the CAPM calculates time-state prices. However, the identification of states of nature and their probabilities of occurrence is subjective (*ibid.*).

As has previously been discussed, an objectively computed project's risk-adjusted rate is the rate at which a project's risk adjusted NPV is calculated. The risk-adjusted NPV, however, can also be defined as the expected NPV. The expected NPV results from the combination of NPVs associated with continuous or discrete scenarios, and is the final product of risk analysis and decision-tree analysis. The remaining part of this section presents decision-tree analysis.

According to Brealey and Myers (1996), a decision tree is a sequence of decision problems where dependent events are interrelated with investment decisions. A decision tree consists of decision nodes that involve mutually exclusive (*'to do or not to do'*) decisions, and probability nodes that involve events associated with probabilities of occurrence. Each node is related to a pair of payoffs. A strategy consists of a path that involves a set of nodes that leads to a final outcome. In order to obtain the optimal strategy that maximises a project's value, it is necessary to move backwards from the final nodes of the tree. In the petroleum industry, decision-tree analysis is usually used to tackle both the financial market and technical uncertainties via the probability of occurrence of the events.

Decision-tree analysis is a technique that allows for an explicit examination of possible future events and decisions (*ibid.*). "*Decision trees force the underlying strategy into the open*" (*ibid.*: 227), and add managerial flexibility to the single NPV in the event of unexpected changes. By linking present and future decisions, decision-makers are able to maximise NPV (*ibid.*). As Kester (1984: 157) states, "*Decision-tree* *analysis works in principle because managers are forced to map out all future decision points, contingencies and probabilities".*

There are, however, some weaknesses associated with decision-tree analysis. First, real life decision trees are extremely complex. Kester (1984: 157) notes, for instance, that *"[...] decision-tree analysis can be unwieldy and impossibly complicated for companies with even a modest number of projects to consider".* According to Buckley (1998: 21), *"Human mind is limited in its comprehension of problems. Decisions rarely involve the full process of mapping out all possible paths on a complete decision tree".*

Second, decision-tree analysis usually does not account for discounted values in calculating a project's value. When considering discount rates, monetary values are regularly discounted at a firm's cost of capital (Brealey and Myers, 1996). As Amram and Kulatilaka (1999b: 39) observe, *"Decision-tree analysis [...] relies on subjective assessments of probabilities, subjective discount rates, and preferences about the objective".*

Finally, according to Brealey and Myers (1996), the main weakness of decision-tree analysis is that it does not allow a project's embedded options to be explicitly valued. As Brealey and Myers (*ibid.*: 228) state, *"[...] decision trees don't tell us how to value options at all; they are just a convenient way to summarize cash flow consequences".*

2.3.1.3 – Techniques that Deal with Mathematical Complexity

This section introduces techniques that deal with some degree of mathematical complexity. These techniques are associated with resource deployment, improved knowledge of costs (Mooraj *et al.*, 1999) and strategy implementation (Simons, 1995).

They include (1) optimisation; (2) capital and manpower rationing; (3) cost management; (4) scheduling; and (5) progress measurement, which are briefly discussed as follows.

According to Dyson and Berry (1998), capital budgeting techniques are usually applied within an individual project context. Optimisation is applied for portfolio selection, and refers to the most effective interdependent use of resources, which confers the best outcome.

Optimisation uses mathematical programming techniques, namely linear or integer, in order to characterise the portfolio problem (Dyson and Berry, 1998). Linear programming, which was proposed by Weingartner (1963) and implemented by Chambers (1967), is a multi-periodic model that seeks the maximisation or minimisation of an objective-function (profit, cost or value) subject to constraints applied to each time period. In the case of project indivisibility, integer programming is requested (Dyson and Berry, *op. cit.*). However, as Black (1997) observes, decision-makers are generally inclined to use rules of thumb to help choose the best solution. Chapman *et al.* (1987) add that decision-makers usually seek to find the solution that achieves the minimum level of satisfaction, at the expense of attaining the optimal solution.

The assessment of a project in isolation does not account for some sources of interdependency among projects, or between projects and ongoing activities. It is not consistent with the incorporation of tax systems, where profits from a specific project can be compensated by other projects. The potential expansion of market shares by a competitor can lead to a strong competitive reaction, and therefore affect a project's cash flows (Dyson and Berry, 1998).

According to Weingartner (1963), rationing motivates behaviour in the direction of economising, *i.e.* controlling quantities through constraints in order to encourage and discourage project formulation. Capital rationing, as noted by Chapman *et al.* (1987), is applied to rank the execution of attractive projects if the capital available is scarce in the current and future periods.

Mathematical programming, namely linear and integer, is applied in capital rationing problems, as is discussed by Dyson and Berry (1998), usually at a corporate level. In the case of capital rationing, such programming is subject to budgetary constraints (*ibid.*). Manpower rationing is related to the shortage of people available to work (Miller, 1963), and can also be added to the set of budgetary constraints.

Some authors, however, claim that capital rationing is illusory because funding is available in the financial market. However, "*In practice firms do not have access to unlimited funds*" (Chapman *et al.*, 1987: 146). As Ashford *et al.* (1990) and Dyson and Berry (1998) add, it is useful to explore different levels of capital availability and identify the premium rate of interest per unit of additional capital borrowed.

As Lebas (1999) observes, between the end of WWII and the end of the 1970s, cost allocation was simplistic, and allocated overhead costs on a basis of direct labour costs. The traditional costing logic encouraged the minimisation of costs, and considered costs as an organisational imposition and a means of consuming resources.

At that time, US labour costs were rarely considered as fixed costs and the economic environment was less demanding as a result of little automation, large batches, large volumes, little diversity and long product life. Control of direct costs was, therefore, effective in bringing profitability. Conversely, European costing practice considered labour costs as fixed due to a strict labour legislation. By then European markets were relatively small and, to some extent, protected (*ibid.*).

Automation, short product life and product diversity led firms to develop a cost management system. Activity-Based Costing (ABC) considers that costs are not allocated to responsibility centres, as in the traditional cost allocation systems, but to '*transfunctional*' activities or processes. ABC is a '*constructivist*' approach that considers costs to be a result of processes. ABC is also contemporaneous to the value-chain techniques, and considers that a business should attend to customers effectively and efficiently by a set of co-ordinated processes. However, ABC does not pay sufficient attention to the causes of cost allocation, because cost allocation remains product-driven (*ibid.*).

According to Lock (2000b), scheduling is a key technique for managing a project's progress. There are several methods for managing a project's schedule by meeting a project's deadlines in cost and time. They include (1) Gantt Chart; (2) critical path networks; and (3) resource scheduling, as described in the following paragraphs.

The Gantt chart, as discussed by Lock (2000d), was the main used scheduling technique during the first half of the 20th century, and it continues to be popular today as a technique "*to communicate the schedule to the people working on a project*" (*ibid.*: 323). The Gantt chart is a bar chart developed by Henry Gantt for production scheduling in a munitions factory during the WWI. Gantt charts, as observed by Dawson (2000), are a useful means of managing and controlling time and resources. However, Gantt Charts have restricted applicability in managing the interrelationships and sequencing of a project's activities. Linked bar charts address activity interdependencies (or constraints), which are difficult to be shown in practice. The notation provided by linked bar charts is inadequate, or at least restricted, even for small projects.

In the 1950s, as introduced by Lock (2000d), critical path networks were developed to overcome the limitation of activity interdependencies, and they were used successfully in military projects. Critical path networks include arrow and precedence networks. The main difference between them is that in the latter nodes represent activities instead of events and, therefore, arrows with zero duration are unnecessary. Arrow networks are ideal techniques for developing plans emerged from brainstorming sessions. However, they do not allow for the representation of complex activity interrelationships. In this case, precedence networks are required and fully covered by most modern software packages. Managers generally find precedence networks easier to understand than arrow networks, as they are similar to process flow diagrams. However, managers tend to use bar charts rather than critical path networks.

The Project Evaluation and Review Technique–Critical Path Method (PERT-CPM), as observed by Dawson (2000), usually denotes critical path networks. According to Miller (1963), the PERT-CPM was introduced in 1958. A time-oriented version was introduced during 1961-2, and this included manpower and cost elements. In 1963, PERT-CPM was associated with systems engineering, linking product performance, costs and schedules. PERT-CPM identifies and schedules a project's activities, determines the sequence, interrelations, duration and cost of its activities, ranks the activities, and measures, monitors and reviews any cost overrun or time slippage as events occur.

According to Dawson (2000), Gantt charts and PERT-CPM can be either deterministic or probabilistic. In the deterministic structure, activity durations are single estimates. In the probabilistic structure, activity durations are represented by probability distributions and Monte Carlo simulation is applied. Three discrete scenarios are alternatively used instead of continuous distributions. However, Gantt charts and PERT-CPM commonly follow the deterministic structure.

Generalised Activity Networks (GANs) were developed in 1962 to take scheduling techniques a step further by coping with uncertainty as well as redefining the task input and output characteristics. The most common form, the Graphical Evaluation and Review Technique (GERT), was developed in the early 1970s. The Venture Evaluation and Review Technique (VERT) was developed in the 1980s and 1990s. GANs can be either deterministic or probabilistic, have the ability to manage loops, as well as allowing for feedback from activities to input initial stages of a project (*ibid.*).

Time and resources limits are two major dimensions in scheduling a project. The above scheduling techniques broadly address the time dimension. Nevertheless, it is essential to balance the durations of the activities with the number and type of resources required. Resource scheduling, as observed by Lock (2000d), is a separate task performed after the time analysis. According to Lock (2000c), limited resources, namely people with particular skills, might be scheduled. A simple way of scheduling limited resources is by adding resources with no respect to their availability. Critical path networks can also be used to determine the priorities of the activities if they are disputing for scare resources. Parallel scheduling (*i.e.* limited resources and indefinite time of completion) or serial scheduling (*i.e.* indefinite resources and limited time of completion) are alternative approaches for optimising a project's resources. The latter is more popular than the former, as it splits activities less than the parallel approach and uses less computational memory per activity.

Multiproject scheduling is used for ranking a portfolio of projects. There are two ways of assigning priorities to projects. The first uses target project completion dates. In this case, projects are of the same importance and activities of different projects equally compete for resources to be completed. The second is called residual scheduling. In this case, a project with the highest priority is scheduled before any of the second priority project (*ibid.*).

Finally, there is a number of progress measurement techniques used for assessing a project's performance over its life cycle through to its completion. They include (1) time-scaled budget graph; (2) milestone analysis; (3) earned value analysis; and (4) financial performance monitoring, as discussed in the following.

According to Lock (2000a), the time-scaled budget graph (or "S" curve) of a project assesses its cost performance by measuring deviations between budgeted and actual costs. The milestone analysis (or milestone monitoring) is one of the simplest methods of comparing a project's actual costs and progress with its budget and schedule of work. It is an improvement over the "S" curve, as it not only monitors cost performance but also examines whether a project's milestones are achieved at a planned time. The milestone analysis is a suitable method when a project's plan and work breakdown structure are not available in detail. However, it presents some disadvantages. First, quantities tend to be coarse, measured at intervals somewhat too occasional. Second, the milestones analysis is not predictive and sometimes too late for effective action to be taken. Finally, it does not consider properly (or even does not consider at all) work in progress.

The earned value analysis (or achievement analysis) is an analytical, predictive method for comparing actual performance against planned performance in significant degree of detail and showing trends early in the project life cycle. Earned value analysis links historical cost reports to active cost management, and provides a cost performance index. This index can be used to forecast the remaining costs to completion over a project's life cycle, supposing that the cost performance achieved by the review date will remain unchanged up to the conclusion of the project. However, the earned value analysis presents some disadvantages. First, it is difficult to appraise precisely the amount of work associated with different sorts of activities. Such difficulty is greater if activities have already been started. Second, it is hard to gain co-operation for getting accurate and complete data at the review dates in order to maintain the database and perform the calculations. Finally, the use of software packages can be useful but dissociate decision-makers from consistent, valid results, such as, for instance, when the cost performance index reverts to zero (*ibid.*).

According to Kaplan and Norton (1992), financial performance monitoring is more regularly applied to the control of business performance at a corporate level than to projects. It looks at the past, aims to maintain expected financial targets, determines corrective actions to minimise eventual negative deviations, and tries to control behaviour. However, corrective actions are not invariably effective, as changes can be extreme and irreversible. As Kaplan and Norton (*ibid.*: 75) state, *"These [reactive] measurement systems fit with the engineering mentality of the Industrial Age"*. A measurement system must be a responsive information system to avoid being the Achilles' heel of performance measurement.

2.3.2 – Recently Developed Techniques

As has been discussed in the previous sections, summary measures are broadly deterministic, financially oriented techniques that passively appraise a project's value in financial terms. These techniques do not seek to add extra value to the project. Some techniques incorporate the role of uncertainty, and consist of two types: static and dynamic. Static techniques address uncertainty in discrete terms, to support the estimation of a project's financial value. Dynamic techniques, rather, tackle uncertainty in continuous terms to compute a project's financial value. Finally, techniques that deal with some degree of mathematical complexity are broadly deterministic, financially oriented techniques that reactively review a project, particularly in a portfolio context.

Recently developed techniques, as discussed by Ward and Grundy (1996) and McGrath (1999), aim to quantify, in a rigorous way, the effects of business concerns, namely uncertainties, interdependencies and intangibles. These techniques are committed to the future track and, as suggested by Leslie and Michaels (1997), Amram and Kulatilaka (1999b) and Brewer *et al.* (1999), proactively seek a project's value creation from its outset through to its completion in order to drive a firm to superior performance (Kaplan and Norton, 1992) and aspiration (Bontis *et al.*, 1999). According to Buckley (1998), value creation materialises corporate success. The following sections present some of these recently developed techniques, which include Real Options, Economic Value Added, Balanced Scorecard and Intellectual Capital.

2.3.2.1 – Real Options

According to Faulkner (1996), the valuation of financial options started at the beginning of the 20th century. In 1973, as discussed by Brealey and Myers (1996), Faulkner (1996) and Amram and Kulatilaka (1999b), Black and Scholes developed a continuous-time option pricing formula, which gave a significant impulse to the use of the option pricing theory.

Managerial awareness of the new and more sophisticated financial instruments has become more crucial in the information era, as has their applicability to industry. Real options, as Smith and Nau (1995), Brealey and Myers (1996) and Buckley and Tse (1996) observe, are a natural expansion of decision-tree analysis used to value the options embedded in real assets. Trigeorgis (1993) and Buckley and Tse (*op. cit.*) have reviewed the literature relating to the use of real options to quantify a wide range of investment decisions in different industries and for different topics. Kasanen (1993) has investigated the impact of interdependency among a wide range of options embedded in a project, which include, according to Amram and Kulatilaka (1999a,b), operating, waiting-to-invest, flexibility, exit, learning, growth and staging options.

The real options approach, as observed by Leslie and Michaels (1997), provides a systematic framework to recognise the managerial flexibility involved in an option's valuation. According to Evans (1991), flexibility is "*the ability to do something other than that which was originally intended*" (Ward and Chapman, 1996: 129). Ward and

Chapman (*op. cit.*) remark that flexibility is occasionally confused with diversification. In fact, diversification may lead to flexibility. Flexibility "*[...] leaves available a larger set of future positions, allows the attainment of new positions in a shorter period of time, and requires less additional cost to move to another position*" (*ibid.*: 129). Flexibility is a multidimensional concept that comprises a trade off between timing, costs and benefits to reach other positions (*ibid.*).

For Ashford *et al.* (1990), Kulatilaka and Marcus (1992), Kemna (1993), Buckley and Tse (1996) and Kogut and Kulatilaka (1998), the value of flexibility (or the opportunity cost of flexibility) associated with a project's embedded options increases a project's value. Cash flows often do not occur as expected and managers are flexible regarding changing course (to continue or stop) if conditions alter, in order to take advantage of favourable opportunities, to mitigate future losses and create value. Nevertheless, Ward and Chapman (1996) claim that a flexible posture must be clearly appreciated, as flexibility is not necessarily desirable. "*Flexibility is valuable in so far as it is able to reduce the cost of inflexibility*" (*ibid.*: 135).

According to Faulkner (1996), uncertainty is viewed positively by the real options approach. On the one hand, there is a limit to the downside risk[7] to which the option holder is exposed, given by the price of purchasing the option. On the other hand, there is no limitation to the upside gains. Uncertainty affects directly and positively an option's value, and is reduced as new information arrives.

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[7] Downside risk is the expected loss associated with a probability distribution on monetary outcomes (Morris *et al.*, 1991: 36).

According to Morris *et al.* (1991), Dixit and Pindyck (1994), Chi and Nystrom (1995), Faulkner (1996) and McGrath (1999), the real options approach addresses the role of learning. As Chi and Nystrom (*ibid.*: 306) have observed, *"A more uncertain project is economically more valuable if its higher uncertainty also implies a greater chance for learning in its development process"*. The real options approach also tackles the role of growth. Traditional financial techniques fail to account for opportunities for growth (Buckley and Tse, 1996). As Amram and Kulatilaka (1999b: 24) observe, *"A real options analysis is needed [...] when the value seems to be captured in possibilities for future growth options rather than current cash flow"*.

However, the use of financial options techniques to value real options is somewhat restricted, as projects involve technical uncertainty and the real market is imperfect. Some authors suggest the combination of the real options approach with utility functions and game theory to overcome such an obstacle, as discussed in the following paragraphs.

As pointed out by Kasanen (1994) and Smith and Nau (1995), there are some theoretical and practical limitations in using utility functions. First, a utility function must aggregate the agents' preferences or identify a representative agent. Second, the utility function must belong to a linear risk tolerance (LRT)[8] class and suppose the existence of homogeneous agents' beliefs and preferences. Third, an empirical estimation of the form of the utility function is required to ensure that the right form was

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[8] Examples of LRT utility functions are the negative exponential, quadratic, generalised logarithmic and power.

chosen. Finally, in the case of a market utility function, a continuous empirical re-calibration is needed to ensure consistency.

According to Smit and Ankun (1993), Kulatilaka and Perotti (1998) and Amram and Kulatilaka (1999a), financial and real options are identical if they are both exclusive (or proprietary) rights of the owner. If a project is not an exclusive right, competition may corrode the value of a project. A possibility for addressing the impact of competition on a project's value, as observed by Smit and Ankun (*op. cit.*), is to use game theory. However, linking game theory to real options is somewhat problematic, both in theoretical and practical terms.

Finally, the real options approach presents some weaknesses. First, real options cannot simply be understood as a straightforward extension of financial options, as observed by Van Horne (1992), Brealey and Myers (1996) and Slater e*t. al* (1998), because projects are much more complex than financial assets. Second, real options use the financial market as a benchmark, which poses constraints on firms to receive normal rents, unless a firm has developed singular abilities to cope with the financial market. Normal rents are associated with static equilibrium, complete markets and homogeneous information. Nevertheless, as observed by Foss (1997a,b), firms aim at appropriating superior rents due to their idiosyncrasies, incomplete markets and asymmetric information.

Third, as Faulkner (1996: 56) states, "*[...] projects develop an inertia of their own and can be difficult to stop*". Fourth, the real options approach is occasionally misused to justify a project's approval (*ibid.*). Fifth, as stressed by Buckley and Tse (1996), there are specific situations involving strategic issues, namely competition, in which exercising an option becomes necessary. Sixth, as Buckley (1998) observes, the real options approach cannot be indiscriminately used. In some cases, traditional DCF techniques, such as NPV, cannot simply be rejected. In others, the combination of decision-tree analysis with sensitivity analysis gives good approximations to a project's value.

Real options are considered by practitioners a complex technique and are rarely applied. Between the early 1980s and the end of first half of the 1990s, scholarly contribution has concentrated on the refinement of project valuation, as compared to the value given by the NPV. However, mathematical complexity has amplified rapidly. From the second half of the 1990s, theoretical work focused on the qualitative dissemination of the ideas involved in the real options approach. Real options has been treated as a strategic technique and applied in a broader scope, as an alternative, or a complement, to scenario analysis.

2.3.2.2 – Economic Value Added

According to Slater *et al.*, (1998), during the last decade some techniques have been developed to create a firm's value, namely the Shareholder Value Analysis (SVA), the Market Value Added (MVA) and, the most popular technique, the Economic Value Added (EVA).

SVA, as introduced by Turner (2000c), broadly estimates a company's value as the net present value of future dividends or free cash flows, *i.e.* free from taxes and capital reinvested in the business. The shareholder value is, therefore, the NPV net of new debt required to fund a project. SVA is based on value drivers, which are, in turn, based on financial ratios commonly used to predict the NPV. SVA is a suitable technique for controlling the impact of a project's decisions on the shareholder's value creation. It can be also combined with risk analysis to illustrate the risk associated with high fixed costs.

Stern Stewart & Company developed the EVA in the late 1980s, to assess, measure and control corporate performance (Stewart, 1994). As Brewer *et al.* (1999) observe, the EVA came as a response to the inadequacy of, for instance, accounting summary measures, namely ROI. DuPont developed ROI at the outset of the 20^{th} century to compare divisional performances. The appeal of ROI was to control size differences across different areas of a company. However, ROI encourages managers to invest in divisions where they have private interests, at the expense of the firm's overall interests. ROI, therefore, favours *'dysfunctional'* decision making.

Other measures are also used for measuring divisional performance, namely the residual income. Accountants have developed the residual income, and it is the remaining value after all providers of capital have been compensated. Companies, such as General Electric, have developed during the 1950s and 1960s a similar measure, the residual value (Brewer *et al.*, 1999).

Although the concept of EVA is not a complete novelty, it is currently benefiting from widespread acceptance in the financial arena as a measure of value creation. EVA develops appropriate metrics that account for different ways of adding (or losing) corporate value and seeks to align divisional goals with a firm's overall goals. Broadly, it measures the difference between the capital invested since a company's start-up and the capital currently obtained from selling its shares, including the contribution of future projects by comparing a company's after-tax operating profits to its cost of capital (Stewart, 1994; Bontis *et al.*, 1999; Brewer *et al.*, 1999; Simister, 2000).

The MVA was another measure created to respond to the anomalies of traditional accounting measures, as observed by Simister (*op. cit.*: 238), to quantify "*how the executives running a company have fared with the capital under their control since the company was established*". If either EVA or MVA are positive, value is being created for shareholders. The fundamental difference between them is that the EVA accounts for the value of future opportunities (*ibid.*).

Some adjustments to the original EVA calculation have been suggested to address important business concerns, in order to overcome the limitations of the conventional accounting practice. Companies that use EVA usually limit the number of adjustments to five. Some companies, however, do not introduce any adjustment in order to avoid complicating the procedure (Stewart, 1994).

There are a few disadvantages in using EVA. First, it uses book values based on historic costs, which give little indication of the market (or replacement) value. There are two reasons for choosing book values: (1) market values and their volatility must be constantly updated, and this would impose large costs on the measurement system; and (2) the subjective estimation of future market values reduces the objectivity of EVA (*ibid.*). Second, EVA overemphasises short-term results, which acts as a disincentive to managers to invest in new products, technologies or processes. Third, EVA relies on accounting methods of revenue realisation and expenditure recognition, which can be easily manipulated and negatively affect customer satisfaction, product quality and employee development (Brewer *et al.*, 1999).

Finally, and most importantly, EVA tends to fulfil exclusively shareholders' interests at the expense of other stakeholders, as observed by Bontis *et al.* (1999) and Brewer *et al.* (1999). According to Oyon and Mooraj (1999), recently developed techniques, despite seeking to eliminate the short-term bias, should also overcome the strict reliance on financial targets. Environmental targets and market position are examples of targets that are not easily measured in financial terms. Brewer *et al.* (1999: 9) claim that *"EVA and other financial measures should play a role in performance measurement, but they should be accompanied by a balanced assortment of measures that encompass all the performance attributes critical to long-term success"*.

2.3.2.3 – Balanced Scorecard

Kaplan and Norton introduced the Balanced Scorecard in 1992. The Balanced Scorecard is a technique for setting and calibrating corporate goals and measures in order to allow a firm to achieve superior performance and long-term success. It looks at multiple, long-term measures in order to eliminate the short-term bias and overcome any reliance on solely financial measures (Kaplan and Norton, 1992). *"The scorecard forces managers to focus on the handful of measures that are more critical"* (*ibid.*: 73), instead of launching a proliferation of measures. According to Mooraj *et al.* (1999), while European organisations have been using the Balanced Scorecard as a planning technique, American organisations have been using it as a control technique.

Companies traditionally measure their performance in terms of short-term financial targets. However, financial targets have well-documented inadequacies, a backward-looking focus, and an inability to reflect value-creating actions. For this reason, while some researchers and practitioners are focused on financial targets, others try to forget them (Kaplan and Norton, 1992).

There is no single measure that can fully and clearly express a performance target or focus attention on the critical activities of a business. The Balanced Scorecard links success factors to performance measures distributed within four different perspectives: financial, customer, internal business, and learning and innovation (*ibid.*).

According to Kaplan and Norton (1992) and Bontis *et al.* (1999), the Balanced Scorecard has its own merits. First, it is flexibly built according to each company's peculiarities. Second, it gives a comprehensive view of the business by incorporating the organisational impact into the analysis and promoting corporate alignment, organisational communication and managerial interaction. The Balanced Scorecard assists managers in making the corporate vision clear to all parties within the organisation, communicating and aligning strategies with the corporate objectives, planning the business, and learning. The Balanced Scorecard also brings together the external environment and internal competitive advantages as sources of generating superior rents for the firm, as discussed in the following paragraphs.

Porter (1980), as observed by Foss (1997a), has introduced the five competitive forces and analysed different types of competitive strategies (low-cost and differentiation) to allow a firm to reach supremacy. Porter (1985) has linked corporate resources to the external environment by combining value-chain concepts (*e.g.* customer satisfaction) with competitive strategies.

According to Nanda (1996), Foss (1997a), Grant (1998) and Kogut and Kulatilaka (1998), the Resource-Based View (RBV) of the firm was introduced by Penrose's (1959) seminal work. The RBV of the firm re-emerged in the early 1980s as a response to the external environment-biased approach. Although the RBV of the firm is commonly used in strategy formulation (Grant, *op. cit.*), its concepts can be extended to project management. The RBV of the firm is a normative theory based on neo-classical economics (Foss, *op. cit.*; Buckley, 1998).

In terms of the RBV of the firm, firms should be learning organisations, *i.e.* flexible, proactive, adaptive and generative entities, to create, sustain and renew competencies in order to appropriate superior rents (Nanda, 1996; Grant, 1998). Core competencies must be durable, scarce, heterogeneous, specialised, costly to imitate and substitute, imperfectly transferable and traded, and valuable assets (*ibid.*). These core competencies should evolve dynamically to produce optimal decision rules on the development of resources and maximise a firm's rent over time (Nanda, *op. cit.*).

Foss (1997a) develops this view by stating that new options are usually acquired in a firm's areas of competence, as firms are able to learn more and better in their areas of competence. However, learning is costly and firms resist changing their current paths of development. As Nanda (1996) and Grant (1998) argue, a firm must be prepared to face incremental or radical technological changes. According to Foss (*op. cit.*) and Kogut and Kulatilaka (1998), incremental changes imply technological costs, but a firm remains in its learning domain. Radical changes imply technological and redesign costs, and a firm benefits from innovation.

In the view of Kogut and Kulatilaka (1998), technologies and organisation are dynamically correlated and organisational knowledge is accumulated in terms of a firm's ability to use technologies. However, a rigid organisational system is a '*competence trap*', as firms continue to perform well on tasks that are no longer profitable. Firms must proactively and increasingly develop and diffuse new technologies and change routines. According to Andrews (1997), innovation allows firms to either enhance or eradicate competencies in order to continuously seek new opportunities.

The RBV of the firm introduced different sources of internal competitive advantage, namely resources deployment, learning, organisational adaptability and innovative routines. Total Quality Management (TQM), Business Process Reengineering (BPR) and learning organisations, which were implemented into some organisations particularly during the 1980s and early 1990s, introduced other sources of competitive advantage, such as product quality. As Turner (2000b) has observed, BPR highlighted the role of cultural issues in project management in contrast to the technical/technological emphasis given to such a process between the 1940s and mid 1980s.

Having discussed different sources of competitive advantage, Bontis *et al.* (1999) have criticised the Balanced Scorecard despite its merits. First, it searches for critical success factors associated with each perspective. Some of the factors, however, have a simultaneous impact on different perspectives. This is not a major problem, as managers can select the key factors on each perspective. The danger lies in managers focusing only on the most relevant perspectives and the key success factors associated with these perspectives. Second, the customer's perspective is, to some extent, limiting. A better label would be the external environment perspective, as the former does not account for suppliers, alliance partners, among others.

Finally, and most importantly, the Balanced Scorecard persistently seeks to measure success, and tends to neglect knowledge-based issues, which are hardly measurable. The Balanced Scorecard considers employees together with information systems as part of the learning and innovation perspective. Innovation, which is a result of learning and action, is part of the internal business perspective. For the Balanced Scorecard, innovation is something a company can get without people or, at least, independently from them. The Balanced Scorecard seems to underestimate the management of people and knowledge, and treats them simplistically as other physical assets. The Balanced Scorecard appears to reinforce some companies' disposition to believe that information systems are sufficient to manage knowledge (*ibid.*).

2.3.2.4 – Intellectual Capital

According to Nanda (1996) and Bontis *et al.* (1999), the value of a company comes from two different sources. The first refers to physical and monetary resources, namely financial capital. The second refers to intangible resources, *i.e.* strategic resources that contribute to value creation, namely intellectual capital.

Intellectual capital refers to the stock and the flow of intangible resources, and is a combination of human capital and structural capital. Human capital is embedded in the members of the organisation, namely competencies (skills and knowledge), attitude (motivation and leadership) and intellectual agility (innovation, adaptability and enterpreneurship). Structural capital is divided into organisational knowledge and boundary assets. Organisational knowledge, also called organisational culture, is firm specific, and is embedded in the organisational routines. Boundary assets (*e.g.* loyalty, brand capital and public trust) are relatively specific assets because although a firm accumulates them, they belong to external constituencies. For this reason, organisational knowledge is considered more strategic than boundary assets (Nanda, 1996; Bontis *et al.*, 1999).

Intellectual capital is a widely used concept in the knowledge management literature, and an interest to develop a tool to address it formally has recently emerged from companies who believe that many existing techniques lack the ability to address all of the intangible issues they face. Scholarly contribution on the potential use of Intellectual Capital as a technique to manage intangible assets, however, has recently occurred, yet in an insignificant proportion (Bontis *et al.*, 1999).

Intellectual Capital, unlike the Balanced Scorecard, divides success factors into performance measures and value-creating indicators. While the former is general key success measures, the latter is not necessarily measurable and challenges a firm's future performance (*ibid.*). As Mooraj *et al.* (1999: 488) have observed, *"[...] it is important to add that what cannot be measured is still relevant. [...]. Changes occur and must be taken on board if an organisation is to remain alert and proactive"*.

Intellectual Capital, however, remains a technique with restricted applicability. First, it is a context specific technique that includes factors particular to a company. Second, it has difficulty in conforming to the accounting and financial domains. Third, it neglects the dynamics of knowledge. Finally, it lacks metrics development and comparability (Bontis *et al.,* 1999).

2.4 – Recently Developed Techniques as Facilitators for Successful Strategic Project Management

As has previously been discussed, there is a wide range of techniques for managing projects and a range of elements involved in strategic project management. Managers are generally familiar with traditional techniques for effectively planning and controlling a project's goals and results, and delivering it efficiently on time, within budget and in accordance with specifications. Turner (2000a) and Lock (2000b) have argued that to complete a project on time, within budget and to quality implies a project's success. McGrath (1999) adds that a project fails if, at its completion, its expected performance is below a specific threshold, or it does not attain its planned goals.

Turner (2000 a,b) develops this view by saying that successful projects are those which provide value for the sponsor and are planned, monitored and controlled to achieve a specific, widely known objective by a certain time. To finish a project at or near time and cost are necessary but not sufficient conditions to provide value for the sponsor. Although managers can determine whether a project has finished on time and within budget at its completion, they may not be able to determine whether a project had provided value for the sponsor until several years after its completion.

Recently developed techniques, which managers are often unfamiliar with (Slater *et al.*, 1998), are linked to create (or provide) a project's value for the sponsors (Leslie and Michaels, 1997; Amram and Kulatilaka, 1999a; Brewer *et al.,* 1999; Turner, 2000a), and drive a firm to superior performance (Kaplan and Norton, 1992) and aspiration (Bontis *et al.*, 1999). These techniques are directly associated with corporate success, and seem to be potential facilitators for successful strategic project management.

At first, it is important to explore the elements involved in successful strategic project management. Rockart (1979) has introduced the term critical success factor, which increases (decreases) the probability of success (failure). Rockart (*op. cit.*) has divided critical success factors into all-encompassing industry-based factors and firm-specific factors. "*Critical success factors [...] should receive constant and careful attention from management*" (*ibid.*: 85), because they drive the organisation to focus attention on success.

Kaplan and Norton (1992) use the concept of critical success factor to develop the Balanced Scorecard. Turner (2000a) suggests a balanced set of potential key project success criteria, which increase the chance of a project to be successful. These success criteria must be agreed with the stakeholders at a project's outset, and the understanding on these criteria must be refined along with a project's implementation to ensure its delivery. The project success criteria include (1) make profits for the sponsors and a project's team; (2) meet needs of the sponsors and team; (3) deliver the prestated objectives; (4) meet a project's functionality and quality; and (5) deliver a project at an appropriate time and cost.

According to Clarke (1999), the management of big projects involves the "*planning, organisation and control of a large number of complex factors, activities and their interrelationships*" (*ibid.*: 139). According to the Pareto Rule, which separates "*the* *important few from the trivial many"* (*ibid.*: 139), if attention is paid to sets of critical elements and their interactions, success is more likely (*ibid.*).

At this point it is important to verify the role of techniques in facilitating successful strategic project management. First, according to Dyson and Foster (1980), Bontis *et al.* (1999) and Mooraj *et al.* (1999), there seems to be restricted appropriateness and use of techniques to address elements involved in strategic project management. For Becker (1983), most elements involved in strategic project management are multidisciplinary and not always quantifiable. As Schnaars (1990) noted, quantitative techniques tend to focus on aspects that are easily quantified.

Second, according to Slater *et al.* (1998), managers have been increasingly exposed to recently developed techniques to assist them in managing projects successfully. As firms adopt these techniques for managing their businesses, as Brewer *et al.* (1999) observe, managers are forced to develop a practical understanding of each technique. Although techniques are beneficial, not of all them are really necessary (*ibid.*). For a number of reasons recently developed techniques are often not implemented. First, managers resist adopting new procedures (Foss, 1997b). Second, recently developed techniques are often complex (Slater *et al., op. cit.*). Finally, there is no scientific evidence of a positive cost-benefit analysis arising from their application (Oyon and Mooraj, 1999).

Managers, as argued by Slater *et al.* (1998), tend to simplify their assumptions regarding business problems according to their mental models. The reason is that managers cannot thoroughly understand the complexity of the business world. Decision-makers tend to choose the simplest methodology for pragmatic reasons (Godfrey and

Hill, 1995) and use simple heuristics (Bowman and Moskowitz, 1998). The managerial use of recently developed or complex techniques appears to be conditional to the development of friendly procedures (Slater *et al., op. cit.*).

Amram and Kulatilaka (1999b) comment on the gap between what managers want from recently developed techniques and what these techniques are designed to offer. Managers recognise the limitations of quantitative analysis, use techniques such as NPV as a mere *'organisational ritual'* (Slater *et al.*, 1998), and add their judgement and intuition (Ward and Grundy, 1996; Buckley, 1998; Amram and Kulatilaka, *op. cit.*).

As the gap widens, techniques are excluded, and managers make subjective decisions (Amram and Kulatilaka, 1999b), sometimes as *"an excuse for retreat into untested intuition or 'acts of faith'"* (Ward and Grundy, 1996: 326). As a result, managers associate a project's success with their superior ability and a project's failure with bad luck (McGrath, 1999). Finally, Bontis *et al.* (1999) summarises the above discussion by saying,

> *How can [managers] use [...] tools developed 500 years ago to help merchants in the feudal era, to make the key success factors of the information age visible? Once the need for new tools is recognised, how do you choose among the many alternatives suggested by different sources? How do they stop jumping on the band-wagon of the latest faddish instrument that promises success and competitive dominance?* (p.392).

2.5 – Research Question and Hypotheses

This section sets out the research question and hypotheses of this study based on the reviewed literature. The exploratory investigation, which is the first part of the research methodology, will consolidate the research hypotheses. The remaining part of the research methodology will revisit the research hypotheses, along with the research findings. The research question will be revisited and challenged in the chapter that proposes sets of techniques for successful strategic project management.

According to Buckley (1998) and Amram and Kulatilaka (1999b), as strategic project management is a complex, value-creating process to assure long-term corporate success, there is a need for techniques to act as value creation facilitators, which should be in alignment with managerial needs for application. As a result, the research question of the current study is *"**What is the role of techniques in facilitating successful strategic project management and the elements involved in that management?**"* Here, strategic projects are managed successfully if they are successfully completed, are financially successful and are successful for strategic (*i.e.* non-financial) reasons.

Table 2.2 introduces the following hypotheses for the research in progress. These hypotheses illustrate, support and lead towards the resolution of the research question.

TABLE 2.2 – RESEARCH HYPOTHESES AND CONCEPTUAL SOURCE

Hypothesis		Conceptual Source
I	Managers are invariably familiar with and always use some traditional techniques (*e.g.* NPV), and are unfamiliar with recently developed techniques for managing strategic projects	Barwise *et al.* (1989); Stewart (1994); Buckley and Tse (1996); Slater *et al.* (1998)
II	There is a set of critical elements that explains a strategic project's success	Rockart (1979); Kaplan and Norton (1992); Bontis *et al.* (1999); Clarke (1999); Turner (2000a)
III	There is restricted appropriateness and use of techniques to address the elements involved in managing strategic projects	Dyson and Foster (1980); Bontis *et al.* (1999); Mooraj *et al.* (1999)
IV	Planning and control are interconnected processes	Simons (1995)

2.6 – Concluding Remarks

This chapter has presented a literature review to support the research question and hypotheses of the current study. The core of the chapter was dedicated to a thorough description of a realm of techniques used for facilitating strategic project management and a number of elements involved in it. The chapter also discussed the application of recently developed techniques as potential facilitators for successful strategic project management. The chapter ended by introducing the research question and hypotheses.

The following chapter aims to discuss the research methodology of the current study. It provides an overview of different research paradigms and methods of data collection available in the social sciences. It also describes the methodological path followed by the current research project, including a proposal of data analysis. Finally, it consolidates the research hypotheses of the current study based on the exploratory investigation undertaken.

Chapter 3

RESEARCH METHODOLOGY

3.1 – Introduction

This chapter introduces different research paradigms and methods of data collection in the social sciences, and describes the methodological path followed by the current research project. The methods of data analysis are also discussed. The chapter ends with bringing to light the limitations of this study and ethical issues.

The chapter is divided into seven sections. Section 3.2 presents an overview of the existing research paradigms in the social sciences and suggests *'a paradigm of choices'* (Patton, 1986) for the research project. Section 3.3 gives a description of the methods of data collection, according to different research families, approaches and techniques, and ends with an emphasis on a mixed-method research design. Section 3.4 introduces the research methodology design, which is divided into three stages: exploratory investigation, core investigation and confirmatory investigation. The exploratory investigation involves two phases: exploratory fieldwork and exploratory deskwork. The former consists of interviews and the latter consists of a theoretical analysis. At the end of the exploratory investigation, the research hypotheses are illustrated. The core investigation involves a questionnaire design, a proposal of statistical analysis and a questionnaire administration. The confirmatory investigation involves follow-up interviews and an assessment sheet. Section 3.5 outlines the limitations of the current study. Section 3.6 introduces certain ethical issues. Section 3.7 provides a summary to the chapter and introduces the next chapter.

3.2 – Research Paradigms in the Social Sciences

This section starts by addressing the notion of knowledge building. According to Rudestam and Newton (1992), scientific inquiry refers to the application of rationally justified procedures as a means of building reliable and valid knowledge. Knowledge construction, as Clarke and Dawson (1999b) observe, is directly associated with the collection and processing of information.

There are four elements responsible for building knowledge. The first is method. Methods are the applied research techniques for collecting data. The second is methodology. Methodology is related to a general logic of inquiry and the principles that support the methods. Finally, the last two elements are ontology and epistemology. The former is concerned with the being and the nature of reality, while the latter refers to the nature and limits of knowledge (*ibid.*).

The process of building knowledge is closely associated with the paradigm selected. Kuhn (1962) defines paradigm as a view of the real world based on untestable beliefs and assumptions in order to guide researchers in their research projects. A paradigm proposes a set of assumptions for the real world and supplies a researcher with a framework to investigate such a world.

According to Clarke and Dawson (1999b), there are two major divergent paradigms, namely the quantitative and qualitative paradigms. Quantitative and qualitative paradigms adopt different ontological positions. The quantitative paradigm supposes that social reality is a unique, objectively measured entity, which exists independently from human understanding. Rigorous investigation is applied in order to find regularities and relationships and establish the causes of social phenomena in order to prove the truth.

Conversely, the qualitative paradigm supposes the existence of multiple, divergent and interrelated phenomenological versions of the social reality, according to different individuals or groups of individuals. Qualitative researchers do not aim to identify which version corresponds to the truth, but to guarantee that different versions are taken into account and well documented (*ibid.*). However, from the researcher's point of view, the quantitative paradigm can also have multiple perspectives on social reality. The strict ontological separation between the quantitative and qualitative paradigm is, to some extent, inopportune (*ibid.*).

Quantitative and qualitative paradigms also adopt differing epistemological stances. The quantitative paradigm assumes that the researcher and the phenomenon under analysis are detached from each other. Conversely, researchers following a qualitative approach become involved with the data collected (*ibid.*). From the researcher's point of view, qualitative data can be collected *'objectively'*, although the observer and the observed cannot be completely detached from each other, as can happen when compiling quantitative data. The rigid epistemological separation between quantitative and qualitative paradigms is somewhat disadvantageous (*ibid.*).

The ontological and epistemological differences between the two paradigms lead to the availability of two different methodological positions. On the one hand, the quantitative research process starts with a body of theory and a set of interrelated conceptual propositions. The researcher then formulates *a priori* hypotheses and collects data in order to confirm or falsify the hypotheses, which remain unchanged during the research exercise. The researcher designs a programme in advance in order to successfully measure the research outcomes (*ibid.*).

On the other hand, the qualitative methodology follows an inductive approach, and seeks to determine a broad generalisation from the observed data. The researcher builds, revises and reformulates the research programme along with the participants' experiences, and harmonises the outcomes as the research process progresses (*ibid.*).

An integration of both paradigms, as stressed by Clarke and Dawson (1999b), is usually rejected in theoretical terms. Patton (1986) suggests a *'paradigm of choices'*, and argues for methodological quality instead of methodological rigidity. The *'paradigm of choices'* allows for the combination of diverse methods in a single research project (Clarke and Dawson, 1999b). The combination of different methodologies in the management sciences is broadly discussed by Mingers (1997), and is referred to as the multimethodology approach. The combination of different methodologies is presented later in Section 3.3.2 ("Methodological Triangulation").

3.3 – Methods of Data Collection

This section pays particular attention to the repertoire of methods of data collection available to investigate different phenomena in the social sciences, and it also introduces the concept of methodological triangulation.

3.3.1 – Categorisation of Methods of Data Collection

Different methods are often used in various research projects, and aim to gather valuable data to entitle a researcher to draw reliable conclusions. The methods of data collection are divided, according to Blaxter *et al.*'s (1996) taxonomy, into three levels: (1) research families; (2) research approaches; and (3) research techniques. The following paragraphs discuss these three levels.

Research families, *i.e.* *"general strategies for doing research"* (Blaxter *et al.*, 1996: 59), are divided into two groups: quantitative or qualitative research, and deskwork or fieldwork (*ibid.*). As quantitative and qualitative research were previously discussed, the following paragraph discusses deskwork and fieldwork.

While fieldwork is conventionally defined as going out to gather empirical data, deskwork refers to the work executed at a desk. The traditional definition of fieldwork, however, does not correspond with the current fast technological evolution. For instance, telephone interviews and postal (or e-mailed) questionnaires are carried out at a desk, but take the researcher virtually into the field. The fieldwork-deskwork polarisation does not occur in most research projects, as is also the case with the current study (*ibid.*).

According to Blaxter *et al.* (1996), there are four research approaches: (1) experiments; (2) surveys; (3) action research; and (4) case studies. The following paragraphs briefly discuss these research approaches.

In the social sciences there are two research traditions: the experimental and the non-experimental. The former originates from the natural sciences, conventionally assumed as scientific, and widely used in a number of research projects in the social sciences (*ibid.*).

The true (or random) experiment, as noted by Rudestam and Newton (1992) and Blaxter *et al.* (1996), basically creates a simulated situation, tests the impact on the dependent variable(s) due to changes in the independent variable(s), and controls the influence of extraneous variables. However, according to Rudestam and Newton (1992) and Clarke and Dawson (1999a), true experiments are not necessarily a successful research approach in the social sciences, as the social sciences deal with human subjects. The main reasons for this are that control is not fully exercised and ethical issues are not always considered. In this research project the independent variables could not be controlled. Therefore, the current study applied a non-experimental research approach.

Surveys, as Blaxter *et al.* (1996) indicate, are a research approach that collects data by asking pre-established questions in a specific order to a group of individuals who are representative of a targeted population. There are two types of survey: descriptive and analytical. The former aims to depict the features of individuals, situations or groups. The latter refers to testing the relationships between variables in order to elucidate a phenomenon. In both types, the subject of inquiry is generally an object, rather than a group of people. This research project applies different types of survey, such as structured interviews and questionnaires.

Elliot (1991) defines action research as *"the study of a social situation with a view to improving the quality of action within it"* (Blaxter *et al.*, 1996: 64). Action research is based on fieldwork, and views participants as members of social groups. It is especially useful for studies conducted in the education, health and social care fields, which deal with development and engagement problems (*ibid.*). The current research project did not fit with an action research approach.

Finally, according to Blaxter *et al.* (1996), case studies involve multiple research techniques, such as observations, interviews and documentary sources, and cannot be separated from their context of analysis. Case studies are particularly appropriate for studies in the sociological area, as they originally recall someone's life story.

Yin (1993) categorises case studies according to the number of cases (single or multiple), and to the aims of the research (exploratory, descriptive or explanatory). Case studies are small-scale research projects that are concerned with in-depth analysis. These research projects usually comprise one to three cases, and focus on different units of analysis, such as an organisation, teamwork or individual (Blaxter *et al.*, 1996). The current research project did not adopt the case study approach.

According to Blaxter *et al.* (1996), there are four research techniques: (1) questionnaires; (2) interviews; (3) observations; and (4) documents. The following paragraphs briefly discuss these research techniques.

Questionnaires, as observed by Blaxter *et al.* (1996) and Clarke and Dawson (1999a), are one of the most commonly used research techniques in the social sciences. They are mainly used for collecting primary data, whether they are quantitative or qualitative.

Questionnaires are usually posted, but they can also be administered by telephone, e-mail or face-to-face (*ibid.*). According to Clarke and Dawson (1999a), questionnaires must involve properly framed questions, so that the respondents can clearly and unequivocally understand them. A researcher must also test and amend a questionnaire before its administration.

There are two formats of questions: closed and open-ended. A type of closed question is the forced-choice question. This allows the respondents to select one or more responses from an exhaustive and mutually exclusive list of alternatives. The other type of closed question uses a response options format. Finally, open-ended questions allow for free answers (*ibid.*).

Interviews represent an extensively applied method of investigating the participants' experiences, perspectives and understandings in some depth. Although interviewing is a qualitative method, researchers who use primarily quantitative methods can also benefit from interviewing. In the early stages of the research process, interviews represent an essential step in preparing the research design (*ibid.*).

For Blaxter *et al.* (1996) and Clarke and Dawson (1999a), meanwhile, interviews usually deal with a direct interviewer-interviewee relationship. They can be held face-to-face or by telephone. Interviewers can tape-record the interviews, or take notes of them. The former is, however, conditional to authorisation.

Interviews are categorised into different interview formats, such as structured, semi-structured or unstructured. A structured interview is a formal instrument based on an interview schedule. It comprehends a set of clear instructions, and questions are asked in a specific order. The semi-structured interview is less formal, including open-ended questions. Questions are not posed in a rigid order, and can be re-worded for a specific interview. Unstructured interviews do no impose clear rules. They are based on an interview agenda where open-ended questions are developed during the interviews (Clarke and Dawson, 1999a).

Systematic observations, as noted by Galton (1988), usually involve the recording, coding and analysis of observed events. They can be, as pointed out by Blaxter *et al.*

(1996) and Clarke and Dawson (1999a), secret or open, and involve participant or non-participant observers. They can be recorded at its event or subsequently, and aim to gather primary qualitative data, whether structured or unstructured. The observer is the primary instrument of data collection. According to Clarke and Dawson (*op.cit.*), the observer can play different roles, ranging from a complete participant to a complete observer. In choosing the role to be followed, ethical issues must be taken into account.

Finally, documents are usually decoded through content analysis, disclosing different opinions and giving rise to retrospective studies (*ibid.*). As Blaxter *et al.* (1996) note, researchers usually use secondary, previously analysed data. However, in some situations such as those where there is insufficient or incomplete documents, a researcher may produce primarily written documents.

3.3.2 – Methodological Triangulation

Despite the polarisation of quantitative and qualitative paradigms at a conceptual level, in recent years the friction between quantitative and qualitative methods within social scientists has progressively diminished. Research methods, whether quantitative or qualitative, have been considered neutral, and a combination of them has been increasingly applied by a large number of researchers. This route denotes not only that research methods are not inevitably associated with a specific research paradigm, but it also acknowledges the increasing importance of qualitative methods (Clarke and Dawson, 1999a).

In the social sciences, the strategy of bridging different research methods is the traditional definition for triangulation. Triangulation is a terminology originating from surveying or navigation (*ibid.*). It aims to measure precisely a position from different perspectives to *"[...] enable greater accuracy of measurement"* (*ibid.*: 86). Triangulation aims to enhance the validity of a research project, displaying a more comprehensive portrait of a problem and fitting a research project with its informational needs (*ibid.*).

The definition of triangulation has wide scope. There are four types of triangulation in the social sciences, these being (1) data; (2) investigators; (3) theory; and (4) methodology. Data triangulation consists of collecting different sorts of data in different contexts at different moments. It may be executed by using the same method at diverse times or different methods on different occasions. Investigator triangulation refers to different researchers examining the same circumstance. This kind of triangulation allows for the engagement of different perspectives on a subject, which avoids the effect of individual preferences and orientations. Theory triangulation refers to the application of different bodies of theory in the data analysis (*ibid.*).

Finally, there are two main types of methodological triangulation: the within-method approach and the between-methods approach. The former refers to using the same method at different times, or using the same method through different measurement techniques. The latter refers to combining different methods. Methodological triangulation allows a researcher to become more positive regarding the research findings. The weaknesses of one method may be counterbalanced with the strengths of the other(s), so that the measurement error is minimised and bias is avoided. Nevertheless, triangulation does not necessarily guarantee validity, as it may generate incompatible results (*ibid.*).

3.4 – Research Methodology

The previous sections focused attention on the existing research paradigms and the research methods for data collection available in the social sciences. The discussion ended with an emphasis on methodological triangulation. The research methodology to be proposed here suggests the combination of multiple research methods.

The proposed research methodology is divided into three phases: the exploratory investigation, the core investigation and the confirmatory investigation. The methodology began with a qualitative approach. A set of semi-structured, preliminary face-to-face recorded interviews was carried out to give a sense of reality to the research problem, to motivate the design of the next steps of the proposed research methodology and to support the reviewed literature to describe the research hypotheses.

The exploratory investigation was followed by a quantitative approach. A questionnaire, which was the main source of data in the current study, tested the research hypotheses, generalised the exploratory findings, consolidated the overall findings, and supported the proposal of sets of techniques for managing strategic projects successfully. Finally, a mixed approach combined structured telephone interviews with assessment sheets to validate, respectively, some questionnaire findings and the proposed sets of techniques. In this research project, interviews were carried out not only to investigate the relevant issues that would be explored in the questionnaire, but also to obtain more details regarding the issues investigated by the questionnaire. Table 3.1 summarises overleaf the phases of the proposed research methodology.

TABLE 3.1 – PHASES OF THE RESEARCH METHODOLOGY

Phase		Research Technique(s)	Objectives	Period(s) of Realisation
Number	Denomination			
I	Exploratory Investigation	Semi-Structured Preliminary Face-to-Face Recorded Interviews and Conceptual Analysis	To give a sense of reality to the research problem, motivate the design of the next steps of the proposed methodology, and support the reviewed literature to describe the research hypotheses	July – October 1998 (first version), September and October 1999 (revision)
II	Core Investigation	Postal and E-Mailed Questionnaires and Statistical Analysis	To test the research hypotheses, generalise the exploratory findings, consolidate the overall findings and support the proposal of sets of techniques for successful strategic project management	June 1999 – February 2000
III	Confirmatory Investigation	Structured Telephone Interviews and Postal and E-mailed Assessment Sheets	To validate the questionnaire findings and the proposed sets of techniques	March 2000 and February 2001

3.4.1 – Exploratory Investigation

The exploratory investigation was the first phase of the proposed research methodology, running from July to October 1998. During the pilot testing of the questionnaire, in September and October 1999, the results of the exploratory investigation were revisited.

The exploratory investigation represented a turning point in this research project. First, it allowed for the transition from theory to method by linking the literature review to the research methodology. Second, it attempted to harmonise theory with practice. Third, it was considered a pilot, or even a prototype, of the core investigation, and motivated the design of the next phases of the current research methodology. Finally, it complemented the literature review to outline the hypotheses of the current study.

The exploratory investigation consisted of two stages: exploratory fieldwork and exploratory deskwork. The former aimed to provide a general picture of corporate strategies, strategic opportunities and strategic projects, to understand the evaluation and control of strategic projects, and to describe a set of elements involved in it. The latter aimed to search for a correspondence between the elements obtained from practice and theory, to place these elements within a conceptual framework, and to investigate the role of techniques in addressing, in theoretical terms, such elements. Table 3.2 summarises the stages of the exploratory investigation.

TABLE 3.2 – STAGES OF THE EXPLORATORY INVESTIGATION

Stage		Research Technique	Objectives	Period(s) of Realisation
Number	**Denomination**			
I.1	Exploratory Fieldwork	Semi-Structured Face-to-Face Recorded Interviews	To give a general picture of corporate strategies, strategic opportunities and strategic projects, understand the evaluation and control of strategic projects, and describe a set of elements involved in it	July 1998 (First version). September and October 1999 (Revision)
I.2	Exploratory Deskwork	Conceptual Analysis	To search for a correspondence between the elements obtained from practice and theory, place these elements within a conceptual framework, and investigate the role of techniques in addressing, in theoretical terms, such elements	August – October 1998

3.4.1.1 – Exploratory Fieldwork

This section discusses the exploratory fieldwork. This part of this research was conducted in a single upstream oil and gas sector company[1]. The upstream oil and gas sector was selected for the exploratory investigation because it was also the domain of application for the core investigation. The reasons for interviewing only a single

[1] The name of the company was not disclosed for ethical reasons.

company included (1) the opportunity of free access; (2) time and cost constraints; and (3) the exploratory characteristics of the phase under investigation.

The upstream oil and gas sector is a capital-intensive, technology-oriented and infrastructure-based business. The sector has no tradition of dealing directly with customers at the very end of the productive chain. Geophysicists, geologists and engineers manage the sector, which is placed in a competitive setting, and is usually governed by strict environmental legislation and prohibitive tax regulation. The upstream oil and gas business involves a high level of technical (*e.g.* geological) uncertainty, and copes with volatile financial market (*e.g.* oil price) uncertainty.

The exploratory fieldwork, carried out in July 1998, consisted of nine semi-structured face-to-face recorded interviews (see Appendix I for the interview schedule) with a diverse group of managers holding top and medium positions. Each interview lasted, on average, one hour. The group comprised three general superintendents, a production general manager, an exploration general manager, a reservoir general manager, a development manager, a new ventures manager and a strategic planning manager.

Ultimately the most important aim of the exploratory fieldwork was to identify and define a set of relevant elements involved in strategic project management. These elements decompose the strategic project management process, and as Dyson and Foster (1983) observe, they are a means of detecting the weaknesses involved in a specific process. However, should one investigate elements from the business world instead of simply searching for elements in the literature? The following paragraphs attempt to answer this question.

According to Godfrey and Hill (1995), from a positivist viewpoint, theories that contain unobservables or purely theoretical entities have no correspondence with reality. According to the positivists, *"there is no value added to knowledge by the inclusion of purely theoretical elements - one that cannot be verified by empirical observation – in determining the truth."* (*ibid.*: 523).

As Ward and Grundy (1996: 322) stated, *"In some areas [...] we find that theory needs to catch up with practice, and in other cases vice versa. Theory and practice are thus out of step, providing an opportunity to generate fruitful debate"*. As Ward and Grundy (*op. cit.*) added, theory and practice have the ability to inform in a mutual way, and as Eisenhardt (1989) stated, theory should mirror reality.

According to Buckley (1998), preliminary observations represent a positive way of designing a model or a process from the examination of the real-world behaviour. These observations, as noted by Alher (1998), are carried out to give a practical support to a process and verify its importance in a real context.

For Dyson and Foster (1980, 1983), the effectiveness of a process is attained in terms of choosing a sufficient set of elements. However, it is difficult to determine such a level of sufficiency. An alternative would be to identify a necessary set of elements. A necessary set of elements is a collection of relevant elements that represent the sufficient set of elements. Nevertheless, as MacNulty (1977) observed, despite decision-makers intuitively listing elements they believe to be important in a specific process, it is by no means a complete or exhaustive procedure.

Furthermore, Dyson and Foster (1980, 1983) argue that in order to generate a necessary set of elements it is advantageous to examine the level of importance of each element so that non-pertinent elements are excluded and the key ones are kept. Elements must be thoroughly examined in order to assess the extent to which they are included, and whether any element should be combined, eliminated or restated, along with the examination of potential interrelationships amongst them. The argument for reducing a number of elements to a necessary set of relevant elements is extensively addressed in the scenario analysis technique, as discussed by authors such as Linneman and Kennell (1977), Vanston Jr. *et al.* (1977), Becker (1983) and Schnaars (1990).

The exploratory interviews conducted in the upstream oil and gas company covered two main topics. In the first, each interviewee presented his/her viewpoint on different topics, such as corporate strategies, strategic opportunities, strategic projects and evaluation and control of strategic projects. They not only described and defined the above topics, but also recommended new approaches to deal with them. A synopsis of their ideas was produced, and is presented in the next chapter ("Research Findings"). In the second, each interviewee suggested a number of relevant elements involved in strategic project management. An aggregated list of the relevant elements and their operational definitions was produced, based on the ranking of the most important elements. These elements are presented in the next chapter. In the development of the aggregated list of relevant elements, a few elements were eliminated, and a few more were restated or combined. The possible interrelationships amongst the elements were also examined.

A second round of face-to-face recorded interviews was conducted during the pilot testing of the questionnaire between September and October 1999. These interviews supported the re-examination of the proposed set of elements, which helped the design of the final version of the questionnaire.

The main purpose of the exploratory fieldwork was to identify and define the elements involved in the management of strategic projects. These elements emerged from the business world and the characteristics of the upstream oil and gas sector exerted some influence on the selection of such elements. Therefore, it was important to examine whether these elements are supported theoretically and the extent to which they are general and comprehensive. This examination occurred during the final stage of the exploratory investigation, as presented in the following section.

3.4.1.2 – Exploratory Deskwork

The exploratory deskwork took place between August and October 1998, which basically broadened, strengthened and developed the ideas brought to light by the exploratory fieldwork. The exploratory deskwork was divided into three steps: (1) correspondence between the elements obtained from practice and theory; (2) conceptual framework to support these elements; and (3) the role of techniques in addressing, in theoretical terms, such elements.

The first step of the exploratory deskwork was to search for a correspondence between the elements obtained from practice and theory. The following paragraphs discuss the argument for this search.

According to Eisenhardt (1989) and Buckley (1998), elements obtained from practice (that is, empirical elements) reflect the business-world behaviour. Nevertheless, as Carmines and Zeller (1979) argue, it is necessary to close the loop between theory and practice. Empirical elements must correspond with theory. A first question is then addressed: is the proposed set of elements supported by the literature?

The empirical elements must be researched in the literature to ensure their completeness and credibility, as suggested by Vanston Jr. *et al.* (1977), in order to be both effective and acceptable. If a body of theory circumscribes the empirical elements, then these elements can be used to evaluate the applicability of theoretical concepts (Carmines and Zeller, 1979), because *"if theoretical concepts have no empirical referents, then the empirical tenability of the theory must remain unknown" (ibid.*: 11*)*.

However, a mere conformity of elements obtained from the business world with theory is not sufficient *per se*. According to Eisenhardt (1989), a powerful linkage between empirical elements and multiple theoretical paradigms results in a more internally valid, coherent and widely generalisable framework that attains a richer conceptual level. Therefore, evaluation and control elements might have a correspondence with several, sometimes dichotomous, bodies of theory. This correspondence is presented in the next chapter.

A further question is then addressed, as suggested by Linneman and Kennell (1977), Vanston Jr. *et al.* (1977) and Becker (1983): are the examined elements multidimensional? Ward and Chapman (1995b) develop this view by stressing the importance of multidimensional project management. The next paragraphs propose to place the elements involved in managing strategic projects comprehensively within a conceptual framework, in order to examine their degree of multidimensionality.

First, the proposed elements were distributed through the four perspectives (financial, external environment, internal business, and learning and innovation) proposed by the Balanced Scorecard (Kaplan and Norton, 1992), and later criticised by Bontis *et al.* (1999). The rationale behind the Balanced Scorecard refers to a balanced set of multi-perspective measures (or outputs) which drives a firm to superior performance. In this study, the notion of *'balance'* is transferred from the Balanced Scorecard to a balanced set of elements involved in strategic project management. These ideas are is in line with Turner's (2000a) "Seven Forces Model". This model introduces seven forces to determine a strategy for the implementation of a project's objectives and success criteria. There are two forces external to the organisation (financial sponsorship and external environment), two forces internal to the organisation but external to the project (a project's definition and attitudes of people), and three drivers from within the organisation (people, management systems and organisation of a project).

Finally, the balanced sets of elements were divided into three main categories, which are discussed by two distinct bodies of theory. While the first two categories focus on the description of a specific process and its interrelationships with context and content, the third focuses broadly on the achievement of results.

The three categories of elements are context elements and content elements, as discussed by Pettigrew and Whipp (1991) and Pettigrew (1997), and outputs, discussed by Dyson and O'Brien (1998). Context and content elements are part of the strategic project management process. Here, they are called, for simplification, process elements.

In accordance with the 1996 PMI Guide to the Project Management Body of Knowledge, process elements are the influential elements that affect the achievement of a strategic project's outputs. Outputs represent the ultimate results of a specific process.

The concept of balanced outputs suggested by the Balanced Scorecard was, therefore, not only associated with the outputs of strategic project management, but was also carried over to the process elements involved in such a management. The notion of *'balance'* was used as a background for formulating a suitable framework for investigating the extent to which the proposed elements are multidimensional. The distribution of the elements within the discussed conceptual framework is presented in the next chapter.

The final step of the exploratory deskwork sought to examine the extent to which techniques address, in theoretical terms, the proposed set of elements. The following paragraphs discuss this procedure.

Techniques, extensively discussed in Chapter 2 ("Literature Review") and examined during the pilot testing of the questionnaire to validate the pertinence of the chosen terminology, were connected to the set of elements involved in strategic project management. This connection revealed the extent to which techniques facilitate, in theoretical terms, strategic project management. The results are presented in the next chapter.

It is important to emphasise that this was a preliminary, conceptual examination of the role of techniques in addressing the proposed set of elements involved in managing strategic projects. Two important issues must be outlined. First, the reviewed literature was extensive, but possibly not complete. Second, the techniques were *a priori* segregated into evaluation and control techniques, for the purposes of simplification. This segregation was tested during the core investigation. These issues are further discussed in the following chapters.

Nevertheless, analogous with what Clarke and Dawson (1999a) defined as an effective evaluation programme, it is insufficient to identify and define a set of relevant elements involved in strategic project management and verify the extent to which techniques tackle these elements in theoretical terms. Rather, it is essential to check the subset of elements involved in successful strategic project management and the extent to which techniques are applied effectively in practice, as discussed in the following.

3.4.1.3 – Motivation of the Remaining Part of the Research Methodology and Research Hypotheses

Three questions emerge to motivate the design of the remaining part of the current methodology. The first question to be addressed is as follows: Among the relevant elements examined in this exploratory investigation, what are the success elements, *i.e.* the elements that are believed to explain successful strategic project management? The implication here is that the notion of success is, therefore, added to the current debate.

As has been presented in the literature review, Rockart (1979) introduced the term critical success factor, which increases (decreases) the probability of success (failure). *"Critical success factors [...] should receive constant and careful attention from management" (ibid.*: 85), because they drive the organisation to focus attention on success. According to the Pareto Rule, which separates *"the important few from the* *trivial many*" (Clarke, 1999: 139), if attention is paid to sets of critical elements and their interactions, success is more likely (*ibid.*). A second question is then posed: Are the success elements those that receive constant and careful attention from management?

The third question asks what the techniques are that address, in practice, the elements involved in strategic project management, and which techniques that address the success elements. The three questions are answered in the core investigation.

Finally, based on the examined theoretical background introduced in Chapter 2, and the exploratory investigation previously discussed in this chapter, Table 3.3 revisits Table 2.2, by including the practical sources for the research hypotheses.

TABLE 3.3 – RESEARCH HYPOTHESES, AND CONCEPTUAL AND PRACTICAL SOURCES

	Hypothesis	Conceptual Source	Practical Source
I	Managers are invariably familiar with and always use some traditional techniques (*e.g.* NPV), and are unfamiliar with recently developed techniques for managing strategic projects	Barwise *et al.* (1989); Stewart (1994); Buckley and Tse (1996); Slater *et al.* (1998)	Exploratory Fieldwork
II	There is a set of critical elements that explains a strategic project's success	Rockart (1979); Kaplan and Norton (1992); Bontis *et al.* (1999); Clarke (1999); Turner (2000a)	Exploratory Fieldwork and Exploratory Deskwork
III	There is restricted appropriateness and use of techniques to address the elements involved in managing strategic projects	Dyson and Foster (1980); Bontis *et al.* (1999); Mooraj *et al.* (1999)	Exploratory Deskwork
IV	Planning and control are interconnected processes	Simons (1995)	Exploratory Fieldwork

3.4.2 – Core Investigation

The core investigation consisted of the development (design and administration) of a questionnaire, and a proposal of statistical analysis, which took place between June 1999 and February 2000. It aimed to produce a questionnaire able to address the research question, test the research hypotheses, justify and generalise the exploratory findings, and support the proposal of sets of techniques for assisting successful strategic project management.

The questionnaire aimed to identify (1) the role of techniques in managing strategic projects; (2) the elements to which managers pay considerable attention in managing strategic projects; (3) the success elements involved in strategic project management; and (4) the eventual gap between those elements to which managers pay great attention and those that are believed to explain a strategic project's success.

The core investigation comprised three stages. The first stage was the questionnaire design, which consisted of four steps: (1) sampling procedure; (2) questionnaire structure; (3) measurement scales and operational definition of the research variables[2]; and (4) questionnaire's reliability and validity. The second stage referred to the proposal of statistical techniques of data analysis. The third stage was the questionnaire administration, which consisted of three steps: (1) institutional support and primary access; (2) pilot testing; and (3) main survey.

Table 3.4 summarises overleaf the steps of the core investigation, where steps II.1 to II.4 refer to the questionnaire design, step II.5 refers to the proposal of statistical techniques of data analysis, and steps II.6 to II.8 refer to the questionnaire administration.

[2] In this study, variables are called items of measurement up to employing factor analysis. In the factor analysis, items of measurement are grouped into factors. These factors are the input variables of the multiple regression models.

TABLE 3.4 – STEPS OF THE CORE INVESTIGATION

Steps		Research Technique(s)/ Courses of Action	Objective(s)	Period of Realisation
Number	Denomination			
II.1	Sampling Procedure	Documents and Judgmental Sampling	To identify the unit of analysis, sample size, sample frame, and sample design	June – August 1999
II.2	Questionnaire Structure	Deskwork	To frame the questionnaire	June – November 1999
II.3	Measurement Scales and Operational Definition for the Research Items of Measurement	Deskwork	To determine the measurement scales and the need of operational definitions for the research items of measurement	September 1999
II.4	Questionnaire's Reliability and Validity	Deskwork	To check the questionnaire's reliability and validity	September – November 1999
II.5	Statistical Techniques of Data Analysis	Deskwork	To propose a set of statistical techniques to fit with the questionnaire purposes	September 1999
II.6	Institutional Support and Primary Access	Presentations, Letters, E-mails, and Telephone Calls	To get institutional support to facilitate the primary access to companies and negotiate such access with them	September – November 1999
II.7	Pilot Testing	Structured Face-to-Face Recorded Interviews and Feedback Discussions	To implement amendments before sending out the final version of the questionnaire	November 1999
II.8	Main Survey	Postal and E-Mailed Questionnaires, Letters, E-mails and Telephone Calls	To send out the questionnaires to the respondents	November 1999 – February 2000

3.4.2.1 – Questionnaire Design

This section discusses the main steps of the questionnaire design. The first part of this section describes the sampling procedure. Sampling, as observed by Chou (1998), refers to the selection of a subject from a population of interest. The sampling procedure is divided into four areas of consideration: (1) unit of analysis; (2) sample size; (3) sample frame; and (4) sample design, as discussed in the following.

The unit of analysis is "*the major entity analysed in the [sic] study*" (Chou, 1998: 90). According to Rudestam and Newton (1992), units of analysis (or subjects) can involve informants or participants, organisations, events, documents or even an entire society, and must be in accordance with the research question and hypotheses. This research project aims to investigate the role of techniques in facilitating successful strategic project management and the elements involved in that management. The strategic project was, therefore, the chosen unit of analysis for the current questionnaire.

An important issue must, however, be discussed here. There was no objection in the current study to analysing non-completed strategic projects up to the administration of the questionnaire. In the case of non-completed strategic projects, only part of the data associated with strategic project management in general terms was used. The unit of analysis of the questionnaire is further discussed in the following chapter.

The identification of the appropriate sample size is an important step in the sampling procedure. Appropriate samples are a requirement for the application of statistical tests and the inference of sound conclusions (Rudestam and Newton, 1992).

The assumption of normality is, according to Hair *et al.* (1997), an influential constraint in dealing with basic statistics. The characteristics of the distribution (*e.g.* mean and standard deviation) and t- and F-tests are generally based on the premise of a normal distribution. According to the Central Limit Theorem, a sample size of at least thirty observations is necessary to take normality for granted. Samples with less than thirty observations are considered small and require special tests, such as the chi-square test, to determine statistically significant findings.

A sample size of at least thirty observations is also necessary to assume normality in some of the multivariate techniques, as indicated by Hair *et al.* (1997). Rudestam and Newton (1992) add that it is also necessary to identify the type of statistical tests to be applied and the level of significance of the study. Here, the sample consists of fifty-four valid observations.

The sample frame refers to the identification and description of the targeted population. The focal population of this research project is the UK upstream oil and gas sector. The focus on a specific sector avoids any cross sectional influences, as observed by Chou (1998). The sample design, in turn, discusses the sampling procedures to determine the population under inquiry, as seen in the following.

According to the 1999 Dun & Bradstreet Database of Key British Enterprises, the upstream oil and gas sector is part of the mining industry. The population under inquiry refers to the crude petroleum and natural gas extraction companies. These companies include upstream, downstream and integrated (upstream and downstream). The targeted population was drawn from the upstream oil and gas companies, and from the upstream department of integrated companies.

The selection of the representative companies of the population was based on two complementary criteria: (1) corporate financial performance and size; and (2) judgmental (expert) sampling. The corporate financial performance and size criterion was based on the numbers shown in the 1999 Dun & Bradstreet Database of Key British Enterprises. In a preliminary stage, companies with a turnover exceeding fifty million sterling pounds were selected. The reason for choosing such a cut-off point is based on the researcher's practical experience in the upstream oil and gas sector. Strategic projects are major long-term investments, which usually involve extremely high amounts of funds. Hence, fifty million sterling pounds seems to be an acceptable cut-off point for corporate turnover. A higher cut-off point, however, would lead to a drastic reduction in the potential population.

Judgmental sampling complemented the previous procedure. An expert from the Institute of Petroleum provided the researcher with a list of companies considered representative of the population. As a result, thirty-one leading UK upstream oil and gas companies, including UK-resident affiliates, comprised the targeted population.

The resultant population was, nevertheless, extremely small. If the unit of analysis were a company, there would be a great likelihood of having a small sample (less than thirty observations). As the strategic project is the unit of analysis, observations could be multiples of the same company, which increase the number of potential observations. Nevertheless, all observations must be independent, *i.e.* observations in the same company must be related to different strategic projects. Details on the implementation of the sample frame and design are given in Section 3.4.2.3 ("Questionnaire Administration").

The second part of this section describes the structure of the questionnaire and the purpose of each of its sections. Rudestam and Newton (1992) recommend the modification of existing questionnaires or, at least, the combination of existing ones with a new questionnaire. However, as there were no existing questionnaires available for the purposes of the current research project, a self-designed questionnaire (see Appendix II) was developed. Instrument development is claimed to be *"[...] a valuable enterprise"* (*ibid.*: 69).

The current questionnaire was an exploratory and descriptive instrument. It was developed, as suggested by Shoham (1998), to be based on a thorough literature review and preliminary interviews held among practitioners, as has been previously discussed in the exploratory investigation. The questionnaire developed by Chou (1998) in his doctoral project served partially as a reference for the design of this questionnaire.

The ten-page questionnaire was introduced by a covering letter (see Appendix III), which included guidance for completing the questionnaire, five sections of questions and, at the end, the respondents' and firms' profiles. The top of the front page included the title of the research project and mentioned the sponsorship of the Warwick Business School in collaboration with the Institute of Petroleum. A statement relating to the confidential handling of the data collected and the contact name, telephone number, fax number and e-mail address were also provided.

The guidance for completing the questionnaire included the aims of the research, the importance of managing strategic projects, and the definitions of strategic project and strategic project management. The bottom of the front page included a note informing the respondents that they only needed to answer sections relevant to them, and, if they had not been involved in any strategic project, then they could forward the questionnaire to someone who had been involved at a managerial level.

The first section of the questionnaire referred to the management of the respondent's last completed strategic project. The purpose of this section was to describe and assess the management of the respondent's last completed strategic project. This introductory section was intended to refresh the respondents' memory, and build up an interaction with them. The first part referred to the category(ies) to which their last strategic project belonged. The second referred to the investment climate during the management of the last strategic project. The third referred to the extent to which the respondent's last strategic project was successfully completed, financially successful and successful for strategic (*i.e.* non-financial) reasons. The last asked about the main reasons for (and barriers to, if applicable) the last strategic project's successful completion.

The second section referred to techniques available for managing strategic projects. The purpose of this section was to assess the respondent's degree of awareness and application of a list of techniques, both in general terms and in the last strategic project, and identify the reasons for using or not using them.

The third and fourth sections had a similar format. The purpose of these sections was to assess, in general terms, the degree of relevance of each element and to what extent each element is addressed in practice, and link each element to the list of techniques pointed out in the second section of the questionnaire.

The fifth section aimed to understand and assess strategic project management in general terms. The first part referred to the extent to which strategic projects are successfully completed, financially successful and successful for strategic reasons. The second part referred to some statements on strategic project management in general terms. Demographic questions about the respondents' and firms' profiles were posed at the end of the questionnaire. Finally, respondents were invited to request a summary report of the questionnaire findings.

The third part of this section discusses the measurement scales and operational definitions of the research variables. As mentioned by Blalock (1982), measurement scales and operational definitions usually work together in a questionnaire.

Stevens (1951) defines measurement as *"the assignment of numbers to objects or events according to rules"* (Carmines and Zeller, 1979: 9). Effective measurement is directly associated both with choosing appropriate operational definitions and suitable measurement scales for the variables (*ibid.*). For Kerlinger (1986), an operational definition specifies the activities or operations needed to measure a concept. The following paragraphs discuss the types of measurement scales.

According to Hair *et al.* (1997), the understanding of different categories of measurement scales is essential for two reasons. First, the researcher must not misuse measurement scales with different types of data. Second, the degree of complexity of a scale determines what kinds of mathematical manipulations and statistical tests are admissible.

The categories of measurement scale include nominal, ordinal, interval and ratio. This study basically uses nominal and ordinal scales, which are briefly discussed in the following. The nominal scale, as observed by Hair *et al.* (1997), is the basic one. It solely supplies the frequency of a variable. The ordinal scale is the next higher category of scale. Variables can be ordered in relation to the quantity of the attribute contained and subclasses can be compared to one another in relative terms, such as "greater than" or "less than" (*ibid.*).

According to DeVellis (1991), there are some extensively used option formats for the scale items, such as the binary, the Likert and the semantic differential, which are applied in this study and briefly discussed in the following.

The binary scale involves a "yes-no" format or a list of items from which a respondent checks off some items that are considered pertinent. The Likert scale is one of the most popular formats, and is used for measuring opinions, beliefs and attitudes. It involves a statement and several possible response options, ranging, for instance, from strong disagreement to strong agreement. The semantic differential scale is associated with the research conducted by Osgood and his colleagues in the mid 1950s. Such a scale refers to target stimuli, which are given by a list of pairs of antonyms. Several points represent options for a respondent's stimulus (*ibid.*). To assist the respondents in filling in the questionnaire, Likert and semantic differential scales adopt the same number (five) of response options.

Table 3.5 summarises overleaf for every section (or part of the section) of the questionnaire, the type of question, the measurement scale, the objective, and the need for operational definition.

TABLE 3.5 - TYPE OF QUESTION, MEASUREMENT SCALE, OBJECTIVE AND NEED FOR OPERATIONAL DEFINITION

Section or Part	Type of Question	Measurement Scale	Objective	Need for Operational Definition
Section 1, Part 1	Closed (Forced-choice)	No scale	To identify to what category(ies) the last completed strategic project belong	No – there is no measurement
Section 1, Part 2	Closed	Semantic Differential	To assess the investment climate during the last strategic project management	No – the items of measurement are common knowledge
Section 1, Part 3	Closed	Likert	To assess a respondent's opinion about the level of success of their last completed strategic project	Yes
Section 1, Part 4	Open-ended	No scale	To explore the reasons for, and barriers to, successful strategic project completion	No – there is no measurement
Section 2	Closed	Binary	To assess a respondent's degree of awareness and use of each technique in general terms and in the last strategic project	Yes
	Open-ended	No scale	To explore the reasons for using or not using each technique	No – there is no measurement
Sections 3 and 4	Closed	Semantic Differential	To assess a respondent's opinion about an element's level of relevance and the extent of addressing it in practice	Yes
	Open-ended	No scale	To explore the linkage between elements and techniques available	No – there is no measurement
Section 5, Part 1	Closed	Likert	To assess a respondent's opinion about the level of success of strategic project in general terms	Yes
Section 5, Part 2	Closed	Likert	To assess a respondent's opinion about several statements on strategic project management in general terms	No – each statement is self-explicative

As has been previously discussed, a questionnaire must meet a desired level of objectivity (Rudestam and Newton, 1992). Objectivity includes a pleasant layout, precise wording, appropriately selected measurement scales and well-defined items of measurement. Nevertheless, objectivity is necessary, but not sufficient in itself for producing an effective questionnaire. A desired level of quality *i.e.* findings and conclusions inferred from these findings that bring about a reliable and valid piece of knowledge, must also be achieved. The last part of this section examines the questionnaire's reliability and validity.

Reliability is *"[...] the ability of a measure to produce consistent results"* (Carmines and Zeller, 1979: 66), or *"the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials"* (*ibid.*: 11). Reliability is divided into reliability of measures and instruments, but this study focuses on the reliability of instruments.

According to Carmines and Zeller (1979), the most popular method for assessing an instrument's reliability is the internal consistency. It measures the internal consistency of an entire group through a single reliability index. The most popular one was introduced by Cronbach in the early 1950s, and is called Cronbach Alpha. It must exceed 0.70 or, in the case of exploratory research, 0.60.

As observed by Kerlinger (1986), to pilot testing helps in practical terms increase the reliability of a questionnaire. It adjusts the questions to be more easily answered and logically followed by the respondents. The current questionnaire had, in general terms, sound reliability. Cronbach Alpha also assesses the consistency of groups of items of measurement when applying factor analysis (Hair *et al.*, 1997).

Although reliability is a necessary condition for validity (DeVellis, 1991), reliable measures can be invalid ones (Carmines and Zeller, 1979). It is also crucial, therefore, to examine the validity of a questionnaire.

Validity, as defined by Carmines and Zeller (1979: 17), is " *[...] the extent to which any measuring instrument measures what it is intended to measure*". There are three ways of testing the validity of an instrument or specific measurement items: content, criterion-related and construct validity (*ibid.*).

Content (or face) validity depends on "*the extent to which an empirical measurement reflects a specific domain of content*" (Carmines and Zeller, 1979: 20). There are no formal ways of assessing content validity. The content validity of this questionnaire was evaluated based on Shoham (1998). On the one hand, the elements involved in, and the list of techniques for, managing strategic projects had a correspondence with distinct bodies of theory. On the other hand, interviews during the exploratory fieldwork and the pilot testing of the questionnaire with experienced managers, experts and scholars contributed to checking the questionnaire's content validity. The current questionnaire is believed to have sound content validity.

Criterion-related validity of an instrument is tested by the extent to which it properly estimates how well the criteria are exercised in practice (Carmines and Zeller, 1979). In the present study, the literature review and the exploratory fieldwork defined both the elements involved in strategic project management and the concept of successful strategic project management. The criterion-related validity of this questionnaire was checked during its pilot testing by examining the extent to which respondents considered the criteria to be precisely represented by the measures. According to the research findings, the current questionnaire is believed to have sound criterion-related validity.

Construct validity examines whether the constructs are systematically connected in theoretical terms and are well represented by their measures (Carmines and Zeller, 1979). In the exploratory deskwork, prior to administering the questionnaire, the construct validity was accounted for, in theoretical terms, by placing the elements within a conceptual framework to check the extent to which they were multidisciplinary and belonged to different constructs (also called concepts or dimensions).

After administrating the questionnaire, factor analysis was employed to test the construct validity of each factor, as factors are practical representations of the conceptual dimensions. Factor analysis ultimately tested the appropriateness of the proposed conceptual framework. This questionnaire had, in general terms, acceptable construct validity.

*3.4.2.2 – **Statistical Analysis***

This section sets out those statistical techniques that will be employed in the data analysis, a process which, according to Rudestam and Newton (1992) is highly recommended before administrating the questionnaire. The data analysis of this questionnaire was divided into three parts: (1) univariate and bivariate analyses; (2) multivariate analysis; and (3) qualitative analysis.

The statistical package SPSS version 8.0 was applied for univariate, bivariate and multivariate analyses (Bryman and Cramer, 1997; Cramer, 1998). Qualitative analysis was drawn from the open-ended questions, for which no statistical techniques were applied. The remaining part of this section discusses the test of normality, and univariate, bivariate and multivariate analyses.

The test of normality is an essential assumption prior to applying univariate, bivariate and multivariate analyses. According to Hair *et al.* (1997), the first and simplest test of normality is a visual examination of the distribution. The statistic values (z) for the skewness value and for the kurtosis value must also not exceed a critical value. This critical value is obtained from a z distribution, based on a specific significance level. A common critical value is 1.96, which corresponds to a 5% error level. The modification of the Kolmogorov-Smirnov (or Lilliefors) test is a common test to check the degree of departure from normality. The Lilliefors test value must be less than the table value (*ibid.*).

In the present study, univariate and bivariate analyses were applied for the original sample and sub-samples. For the original sample, which involved more than thirty observations, the univariate analysis included the characteristics of the sample such as percentages (for the binary scale), means and standard deviations (for the Likert and semantic differential scales) and confidence intervals. A confidence interval is indicative of the extent to which a sample represents the population. In the case of skewed items of measurement, medians and ranges are also needed. For the small sub-samples, univariate analysis was based on the chi-square test (Hair *et al.*, 1997).

Bivariate analysis complements the univariate analysis. Here, it broadly involves difference of means (t-test) and correlation analysis. A t-test identifies whether a difference of means is statistically significant for a specific level of significance (Hair *et al.*, 1997). Correlation analysis is, as described by Hair *et al.* (*op. cit.*), a technique for investigating the relationship between two variables. This relationship is represented by a correlation index, which indicates the strength of relationship between the variables, ranging between –1 and 1. The most common correlation index is the Pearson's correlation index. The Spearman's correlation is a non-parametric version of the Pearson's correlation index, which is suitable for ordinal or interval data with any shape of distribution.

According to Hair *et al.* (1997), multivariate analysis includes a wide range of techniques, but this study focuses on factor analysis and multiple regression analysis. Before going further, it is important to note that multivariate analysis requires continuous variables. However, the current study uses ordinal (discrete) scales for multivariate analysis. Nevertheless, as observed by DeVellis (1991: 68), "*[...] Likert scales form a continuum from strong disagreement to strong agreement*", and the pair of antonyms in semantic differential scales represent "*opposite ends of a continuum*" (*ibid.*: 70). The use of ordinal scales in multivariate analysis is a common practice among marketing researchers. Smith (1999) uses a wide range of multivariate techniques, such as factor analysis, ANOVA and multiple regression analysis to test different Likert scales.

According to Overall and Klett (1972), factor analysis is a multivariate technique that usually defines factor variates as linear transformations of the original correlated items of measurement. In order to employ factor analysis, the number of observations must be at least fifty, and the number of observations-to-independent items of measurement ratio must exceed five (Hair *et al.*, 1997). The last condition was, however, not met by the sample size of this research project. There were twenty-five items of measurement respectively for evaluation and control of strategic projects, and fifty-four valid observations.

In the first instance, factor analysis could not be employed in this study. However, as multiple regression analysis would potentially bring to light some interesting insights in the management of strategic projects and possibly recommend future research directions, it appeared to be important to seek a way of feasibly overcoming this practical obstacle.

A viable way of overcoming such an obstacle could be to use the sub-groups of items of measurement previously established in the questionnaire as a starting point for employing factor analysis. The literature review and the exploratory investigation justified these sub-groups of elements. For each sub-group of items of measurement, the number of observations-to-independent items of measurement ratio exceeded five. As a result, regression analysis could also be employed, as each factor would be an independent variable in the regression models.

Prior to employing factor analysis, it is necessary to check some assumptions for the appropriateness of using it, as observed by Stewart (1981), Tabachnick and Fidell (1989) and Hair *et al.* (1997). First, the proportion of statistically significant correlation indexes between each two items of measurement must be substantial. Second, the correlation between items of measurement when the effect of other items of measurement is taken into account must be small. Third, the Bartlett test of sphericity checks the presence of correlations among the items of measurement by giving the probability of the correlation matrix having significant correlation indexes among, at least, some of the items of measurement.

Finally, as observed by Stewart (1981), the Keiser-Meyer-Olkin measure of sampling adequacy (MSA) is considered to be the best procedure for testing construct validity. MSA assesses the extent to which items of measurement can be grouped together. It must exceed 0.50 to be acceptable, but it must desirably exceed 0.60. In the present study, if more than one item of measurement has MSA lower than 0.50, the items are removed in a case-by-case strategy, starting with the item with the lowest MSA. Complementarily, Cronbach Alpha is used to test the reliability of the factors.

According to Hair *et al.* (1997), there are two models for obtaining factor solutions: the common factor analysis and the principal component analysis (PCA). PCA considers the total variance (shared variance plus specific variance) and determines the factors that minimise the proportion of specific variance. It is usually preferred to common factor analysis (*ibid.*), and it is employed in this study.

There are some stopping criteria to extract the number of factors. The latent root (or eigenvalue) criterion is the most widely used technique. It states that any factor should explain the variance of at least a single item of measurement if it is kept for interpretation. Factors that present an eigenvalue above one are considered representative. The *a priori* criterion is applied when the researcher knows in advance the number of factors to extract. The percentage of variance criterion aims to ensure that at least a specific amount of variance (usually circa 0.60) is given by the extracted factors. The scree test criterion identifies the optimum number of factors to be extracted before the amount of specific variance dominates the shared variance (*ibid.*). In this study, the scree test is used to confirm the latent root solution, and the *a priori* criterion is applied only if the latent root solution has no practical significance.

The number of extracted factors is crucial. There are two solutions for extracting factors: unrotated and rotated. The latter is commonly applied, as it often simplifies the factor structure. There are two groups of rotation: orthogonal and oblique. Oblique rotation is usually used in the case of seeking meaningful factors in theoretical terms, which is not the case of the present study. Among the methods of orthogonal rotation, VARIMAX allows for a distinguishing separation of factors. It is preferably used (*ibid.*) and, therefore, applied in this study.

After extracting the factors, it is necessary to interpret them by identifying the highest significant factor loading for each item of measurement on each factor. Factor loadings must be greater than 0.30, desirably exceeding 0.50, and the percentage of communality for each factor loading must exceed 0.50 (*ibid.*).

The next step refers to labelling the factors. In this study the framework proposed by the exploratory fieldwork is a reference for labelling the factors. The labelled factors, however, are not validated. The reason is that the sample size of this research project is not sufficient to employ confirmatory factor analysis, as observed by Hair *et al.* (1997) and Shoham (1998), which requires at least one hundred observations.

In this research project factor analysis aimed to create a reduced set of appropriate variables to be used in regression models. There are different ways of reducing the number of variables, namely summated scales and factor scores.

Summated scales use a composite measure (or an equally weighted linear combination, as suggested by Hair *et al.*, 1997, p.129) as a replacement variable. While summated scales combine the selected items of measurement that highly load on a factor, factor scores combine all items of measurement on a factor. While factor scores make the interpretation more difficult, summated scales are not necessarily orthogonal.

However, factors can be applied together for other multivariate techniques even if orthogonality among them is not guaranteed (*ibid.*). *"If summated scales are a well-constructed, valid, and reliable instrument, then it is probably the best alternative"* (Hair *et al.*, 1997: 120). As far as possible this study used summated scales. If it was not possible to achieve an acceptable level of reliability and validity for the summated scale, a surrogate variable was chosen instead (*ibid.*). A surrogate variable is an alternative to summated scales. It is a simple procedure that chooses an item of measurement that best represents a group of items of measurement.

The remaining part of this section discusses multiple regression. It refers to a regression model in which the fitted value of the dependent variable is a function of several predictors (Hair *et al.*, 1997).

According to Hair *et al.* (*op. cit.*), regression analysis follows a four-step procedure: (1) identification of the purpose of the regression analysis; (2) search for any violation of assumptions; (3) estimation of the regression model and assessment of the overall fit; and (4) interpretation of the regression. Each step is discussed in the following paragraphs.

There are two main purposes for employing regression analysis. Regression analysis can be predictive or explanatory. Predictive models aim to appraise the maximum predictive power of a set of independent variables. Explanatory models assess the relative contribution of each independent variable, so as to predict the dependent variable. In the present research project, regression models were employed for explanatory reasons only (*ibid.*).

Before running the regression model, it is necessary to search for any violation of assumptions. First, it is necessary to check whether each independent variable is normally distributed. In the case of skewed variables, tentative transformation (power, logarithm, square root, etc) of these variables is recommended. Second, it is advisable to verify the linear relationship between each two independent variables. Partial regression plots between each two independent variables must be employed (*ibid.*).

After running the regression model, it is necessary to seek out any violation of some assumptions. First, the linearity of the phenomenon measured (or predicted value) must be met. The studentised residuals plot against the predicted value must be employed. This plot, however, examines the combined effect of all independent variables against the predicted value. It is also necessary to complement the analysis by plotting the studentised residuals against each independent variable of the regression model (*ibid.*).

The procedure for checking the normality of the error term distribution has already been discussed (see page 120). The homoscedasticity of the error term distribution can be explored by analysing the studentised residuals plot against the predicted value. The dependence of the error term distribution basically occurs in time series problems, which is not the type of data handled in this study (*ibid.*). Therefore, this assumption did not need to be tested.

After seeking any violations of the assumptions, it is necessary to estimate the regression model and assess its overall fit. For that purpose, it is necessary (1) to select a method for introducing/removing variables into/from the regression model; (2) to evaluate the statistical significance and the goodness-of-fit of the model; and (3) to examine the occurrence of influential observations.

There are different methods for introducing/removing the variables into/from the regression model, such as the enter method, which introduces the entire set of independent variables, or the backward or stepwise elimination methods, which involve a sequential search of variables. The stepwise method is the most robust. The sequence of variables is not relevant, due to the recursive approximation of the method (Hair *et al.*, 1997). As far as possible, the stepwise method was applied in the current study. If it was not possible to apply it, the enter method was applied instead. For the confirmatory specification of the model, the enter method was applied.

The statistical significance of the overall fit of the model is given by the F statistic, which is obtained from the analysis of variance. If the regression model fits the data well, the error of the residual square-error of the regression square ratio is distributed as an F statistic (*ibid.*).

The goodness-of-fit of the model is assessed through the coefficient of determination (R^2) and the adjusted coefficient of determination (adjusted R^2). While the former considers the proportion of the variance of the dependent variable that is explained by the regression model, the latter is useful for comparing regression models with different number of predictors and/or different sample sizes (*ibid.*).

Influential points are outliers and leverage points. Outliers are observations with standardised residuals beyond two standard deviations from the mean. Extreme observations are special cases of outliers, where the standardised residuals are beyond three standard deviations from the mean. The outliers that are not representative of the population must be removed (*ibid.*). As it is difficult to identify when outliers are representative of the population, they are, for simplification, removed.

Leverage points are those observations where the residuals are not necessarily beyond two standard deviations from the mean, but they differ from the others in one or more predictors. They influence the relationship between the predictors and the predicted value in their direction (*ibid.*). There are several measures used for identifying leverage points, as discussed in the following paragraphs.

The leverage value measures the combined effect of all predictors for each observation. In the case of big samples, the applied threshold is 2p/n, where p is the number of predictors including the constant, and n is the sample size. In the case of small samples, the threshold 3p/n is used (*ibid.*).

There are some measures that refer to the influence on the overall fit or the overall influence. The Cook's distance is considered to be the most comprehensive measure. It accounts for changes in the predicted value if the observation is excluded, and the leverage of a single observation in relation to the others. The threshold is usually one, but for big or small samples the threshold 4/(n-k-1) is used, where n is the sample size and k is the number of independent variables in the regression model. One recommends using the Cook's distance combined with the leverage value (*ibid.*). In this study, they are applied together, and the adopted thresholds are, respectively, 3p/n and 4/(n-k-1).

The adopted procedure for removing influential points is the following. Outliers and leverage points are initially identified. The first candidates for deletion are the outliers that are also leverage points. In the case of mutually exclusive sets of outliers and leverage points, the outliers are firstly removed, those with a higher standardised residual first, and the leverage points are then removed, those with a higher Cook's distance first. The removal of influential points follows a case-by-case strategy until there is no more influential points left. When this occurs, observations with studentised residuals beyond two standard deviations, if they occur, are also removed, as recommended by Hair *et al.* (1997). In the case of samples with a reduced number of observations, the removal of influential points might stop short of the above. This happens because the sample may become too small and have a negative impact on the results (*ibid.*).

Finally, the interpretation of the regression model includes analysing the regression coefficient (B) or the standardised regression coefficient (ß) and the degree of multicollinearity.

The regression coefficient, as observed by Chou (1998), is used to calculate the predicted value for each observation, and measures the change in the dependent variable per unit of change in the independent variables. The standardised regression coefficient is the slope of the regression model, and denotes the relative importance of each predictor in the regression model.

Predictors usually have some degree of multicollinearity. The tolerance and the variance inflation factor (VIF) are commonly used for measuring multicollinearity. The latter is the inverse of the former. Tolerance is the amount of variability of an input variable that is not explained through other input variables. A small tolerance denotes high collinearity. In practical terms, tolerance and VIF must be, respectively, higher than 0.1 or less than 10 (Hair *et al.*, 1997).

Some final remarks must be made. The regression power, *i.e.* "*the probability of detecting as statistically significant a specific level of R^2 or a regression coefficient at a* *specified significance level for a specific sample size"* (*ibid.*: 165) must be, at least 80% for a significance level of 5%. The observations-to-independent variables ratio must exceed five. These two rules of thumb directly affect the generalisability of the regression model (*ibid.*).

Data sets are generally incomplete, but regression models require complete observations. In order to accommodate the data set, missing values are usually replaced by mean series, as the mean substitution is one of the most used methods. The average of the valid responses is used to calculate the replacement value. This method maintains the size of the data set, provides all cases with complete information, internally generates the replacement value, and does not change the sample's overall mean. In order to apply the mean substitution method, missing data must be random (*ibid.*). In the current study no specific pattern for the missing data can be observed, and missing data are, therefore, considered to be random. This is further discussed in the following chapter.

3.4.2.3 – Questionnaire Administration

This section focuses attention on the questionnaire administration. It is divided into three parts: (1) institutional support and primary access; (2) pilot testing; and (3) main survey. The first two were carried out before sending the questionnaire out to the respondents, in order to increase the questionnaire's response rate and test its reliability and validity.

The first part of this section discusses the process of facilitating and negotiating primary access. On the one hand, facilitating primary access is possible by getting support from an institution to get key contacts in the companies. On the other hand, negotiating primary access consists of approaching and gaining co-operation from the key contacts. Gaining and sustaining the co-operation of the potential participants is, however, discussed at the end of this section.

A critical issue in the current study was to obtain a significant number of potential respondents who would be willing to answer the questionnaire. There were three ways in which this could be done. The first was to identify the UK upstream oil and gas companies listed in the 1999 Dun & Bradstreet Database and send the questionnaires out for the attention of staff holding targeted positions. The second was to gain access to a database of an institution in the petroleum industry and to send out the questionnaire randomly to its associates. The third was to ask an institution in the petroleum industry for a list of key contact names in the companies who would indicate names of potential respondents.

There were five relevant issues that affected the choice of the most effective alternative to be followed. First, the selected population of UK upstream oil and gas companies was not large (thirty-one companies). Second, the targeted group of respondents was very specific, and this limited the applicability of the institution's database. They were preferentially senior, non-operational and multidisciplinary managers holding a medium management level, and were directly involved in managing strategic projects. Third, managers in the UK upstream oil and gas sector were extremely busy, especially due to reduced staffing levels in the companies. Fourth, the questionnaire was too long to be answered by managers who would not be willing to respond it. Finally, the upstream and oil and gas sector is a competitive environment in itself and the respondents could be sceptical (or even downright unwilling) about disclosing information. Based on these five issues, the third alternative was selected, *i.e.* to ask an institution in the petroleum industry for a list of key contact names in the companies who would nominate potential respondents.

The sample framing strategy followed by this study is based on Shoham's (1998, 1999) methodologies. In his studies, a list of companies was first identified, and then a specific group of managers was contacted by telephone and asked to participate in the survey. Nominated questionnaires were sent to a sample framed by convenience of managers who were willing to participate. In the first study, the sample framed by convenience resulted in a much higher response rate than the previous studies (*ibid.*), and as observed by White (2000), samples framed by convenience give a large scope.

In the current study, the Institution of Petroleum was contacted and agreed to collaborate with this research project. The Institution offered a list of twenty-seven primary contacts. They included twenty-five names in UK upstream oil and gas companies and two names in UK petroleum institutions. These names would be approached both for piloting the questionnaire and designating names of potential respondents. A second list of nine contact names replaced part of the original list. Six companies, although not included on the list provided, were also contacted, as they were part of the selected thirty-one leading UK upstream oil and gas companies.

A primary contact letter was sent out both to the list of twenty-five contacts and the six additional companies. This letter aimed to get informed consent and a list of nominated participants from each company. Some of the companies asked for a sample of the questionnaire prior to nominating the participants.

As a result of sending out the primary contact letters, eight companies refused to participate in the survey. Three of them gave reasons for not taking part in the survey, such as corporate restructuring, merging and limited staffing levels, and one of them ignored the contact letter. Twenty-three companies (74% of the targeted population) responded positively to the primary contact letter. Among them, nineteen companies (61% of the targeted population) nominated seventy-four participants and four companies indicated staff members who were predisposed to distributing the questionnaires among their peers. These individuals constituted the sample framed by convenience of the current study.

The following part of this section discusses the pilot testing of the questionnaire. The questionnaire was piloted to ensure that amendments could be made before administrating the main survey, as suggested by O'Brien and Meadows (1999).

The pilot testing consisted of (1) the support of a committee of three academics; (2) face-to-face recorded interviews with a top manager from an oil and gas company and an expert from a petroleum institution; and (3) posted/handed questionnaires to six middle managers from two oil and gas companies. They were encouraged to fill in the questionnaire, and made oral or written comments and recommendations when applicable. Finally, in order to refine the pilot testing, as suggested by Converse and Presser (1986), four doctoral researchers without any experience in the management of upstream oil and gas projects were asked to read and comment on the questionnaire.

During the piloting of the questionnaire, the elements involved in the evaluation and control of strategic projects, as well as the list of techniques involved in those stages were thoroughly discussed with managers and experts in the UK upstream oil and gas sector. The pilot testing revisited the set of elements (and their operational definitions) involved in managing strategic projects proposed by the exploratory fieldwork, as well as examining the list of techniques reviewed by the literature and the terminology used for these techniques.

The remaining part of this section discusses the main survey. Seventy-eight survey packets were posted to named multidisciplinary managers holding top, medium and lower positions and to staff who would distribute the questionnaires among their peers, scattered over England and Scotland. Each mail packet enclosed a sample of the questionnaire, a covering letter and a pre-paid envelope. None of the packets posted to staff who would distribute the questionnaires, however, were returned.

Twenty respondents answered the questionnaire up to the initial deadline. A few of them asked the researcher to e-mail the questionnaire, as they preferred e-mailed to postal questionnaires. The contacting process started precisely after the deadline. Reminder letters were not sent out to the participants. Instead, participants were assiduously contacted through telephone calls and e-mails. Forty respondents answered positively after being contacted. On that occasion, some participants asked for the questionnaire to be e-mailed to them, instead of it being posted.

Sixty questionnaires were received back. Fifty-four questionnaires were considered valid observations (90% of the original sample), which were multiples from fifteen (three big, seven medium and five small) companies. Of the seventy-four questionnaires sent out to nominated individuals, the response rate was 73%. This excellent rate reflected the high commitment of the potential respondents to the questionnaire. This exceptional rate resulted from following different tactics suggested by Converse and

Presser (1986), which include (1) a covering letter which included the primary contact name in each company; and (2) contacting respondents at different instants in different ways, such as e-mails and telephone calls. However, it resulted essentially from the *a priori* nomination of participants.

In this study the sample was framed by convenience through judgmental sampling in order to achieve a group of individuals with specific characteristics within a population of small proportions. Nevertheless, it seems to be representative of the population. First, the company's and respondents' response rates were high (respectively 48% and 73%). Second, the confidence intervals of the variables varied, on average, 12% around the means, which is considered a minor variation.

On average, the surveyed sample broadly involved a multidisciplinary, male group of managers. They were middle managers with a long-term experience in the field, long-term job commitment, and short-term international managerial experience. They belonged to a diverse group of international, integrated and plc's UK-resident upstream oil and gas affiliates. The overall results of the questionnaire are described in the next chapter.

3.4.3 – Confirmatory Investigation

The last phase of the proposed methodology was the confirmatory investigation. The confirmatory investigation aimed to overcome some practical limitations of the questionnaire, such as open responses, as suggested by Rudestam and Newton (1992), and validate the proposed sets of techniques for successful strategic project management.

The confirmatory investigation was divided into two stages. The first consisted of structured follow-up telephone interviews, each one lasting between five and ten minutes, carried out in March 2000. They aimed to identify the likely reasons for the respondents' lack of awareness of some techniques, and not using them. Twenty-five respondents were selected randomly among those who had a degree of unfamiliarity with some techniques. The results of the follow-up interviews are described in the next chapter.

The second stage occurred in February 2001. It consisted of posting (or e-mailing) two documents (a copy of the report of the research findings and a proposal of sets of techniques for successful strategic project management) to thirty-seven respondents who agreed to receive the report. A covering letter, a one-page assessment sheet (see Appendix IV for details) and a pre-paid envelope were provided with the documents. The assessment sheet invited the participants to give their opinion about the quality and efficacy of the proposed sets.

Nine assessment sheets were returned up to the initial deadline. Participants were contacted through e-mails and telephone calls exactly after the deadline. Twelve respondents answered positively after being contacted. On that occasion, some participants asked for the questionnaire to be e-mailed again.

Twenty-one assessment sheets were received back (response rate of 57%), which were multiples from eleven (two big, five medium and four small) companies, according to the originally surveyed companies. The results of the assessment sheet are described in Chapter 5 ("Techniques to Support Successful Strategic Project Management"). Table 3.6 summarises overleaf the stages of the confirmatory investigation.

TABLE 3.6 – STAGES OF THE CONFIRMATORY INVESTIGATION

Stage		Research Technique	Objective	Period of Realisation
Number	Denomination			
III.1	Confirmatory Investigation – Part I	Structured Follow-up Telephone Interviews	To validate the research findings	March 2000
III.2	Confirmatory Investigation – Part II	One-page Assessment Sheet	To validate the proposed set of techniques	February 2001

3.5 – Limitations of the Study

This study has inevitable limitations, despite the researcher's persistent attempts to maintain a singular degree of quality. There are four types of limitation, namely those caused by (1) the research methodology; (2) the way in which the research instruments were designed and applied; (3) the conceptual simplifications; and (4) the sampling design.

The general limitations caused by the research methodology, as mentioned by Converse and Presser (1986), are short-term and selective memories. Participants are often requested to recall information in the medium- or long-term, but short-term memory tends to dominate. According to Stern (1979), participants seem to prefer disclosing information that favours them at present.

There are some practical limitations associated with the way the research techniques were designed and applied. Exploratory interviews were conducted at an early stage in the research project. Some questions could be formulated differently to adjust better to the research purposes. Moreover, the exploratory investigation was applied to a single company. Nevertheless, these problems did not prevent the exploratory investigation from being successfully attained. The pilot testing of the questionnaire supported the reviewed literature and revisited the exploratory findings.

The design of the questionnaire presented some problems. In the first section, the chosen category of strategic project should be the one that best fits the last strategic project. The location (UK or abroad) of the last strategic project undertaken was not asked, nor was it described. Meanwhile, the investment climate should reflect the average climate throughout the strategic project management. These problems, however, did not significantly affect the questionnaire findings.

In the second section, although the list of techniques for managing strategic projects was thoroughly reviewed by the literature and the terminology used for these techniques was carefully examined during the questionnaire piloting, examples of some techniques were chosen to represent some techniques (PERT-CPM for scheduling and financial performance monitoring for progress measurement) to help clarify the respondents. However, these examples might have confused a few respondents. Other respondents considered the term "generally used" too open. Some managers holding specific management levels generally use a technique at some moments, but they may not consider such techniques as generally applicable. Nor was there any guarantee that a non-answered box is a "no" or a "missing value", if a respondent was doubtful about the terminology used for a technique. Interviewees examined the terminology used for these techniques during the questionnaire piloting. However, due to a restricted number of interviewees, follow-up interviews were carried out to clarify these issues after the questionnaire administration. The questionnaire findings were confirmed by the follow-up interviews.

In the third and fourth sections, there were different time frames (strategic project management in general terms vs. last strategic project management) which might, to some extent, have confused some participants. This problem was minimised by applying differentiated guidelines for each question and different colours for subsections. Some respondents considered the term "always addressed" as being open. An element involved in strategic project management can always be addressed for a specific situation or category of strategic projects, but not always addressed in general terms. Nevertheless, this problem did not have a significant effect on the questionnaire findings. The respondents occasionally linked, for instance, meetings, reports, peer reviews and electronic mails, instead of techniques, to the elements involved in strategic project management. However, the former took a peripheral part in the analysis.

The first part of the confirmatory investigation conducted by telephone only generated twenty-five interviewees. However, there were reasons for restricting the number of interviewees. First, they were randomly selected among those who had a degree of unfamiliarity with certain techniques. Finally, the number of interviews stopped when the reasons for the managers' unfamiliarity with the techniques became repetitive. The second part of the confirmatory investigation sent assessment sheets to the respondents who would be willing to receive a copy of the summary report on the research findings. The number of respondents of the assessment sheets was small, and therefore the statistical analysis was limited. It is important to mention that the assessment sheet was not tested before its administration due to time constraints, and that the main reason for the respondents not to answer the assessment sheet was lack of available time.

There are also some limitations associated with theoretical simplifications. First, techniques differ from information systems or commercially available software tools, as well as documents, guidelines or communication tools such as meetings, reports, peer reviews and electronic mails. Second, this research focuses on the critical description of the techniques rather than discussing the constraints to one's actions, or on the managerial sanction, in using them. The techniques are those used after the conception of a strategic project.

Third, techniques are listed separately in the questionnaire. The association of a diverse range of techniques with a broader process is not followed by this research project, although being suggested by some authors in the project management field. Respondents could have associated, for instance, risk analysis with a wide range of application areas, probably in the context of risk management processes, as stressed by Chapman and Howden (1997). According to Chapman and Howden (*op. cit.*), the risk management process comprises a number of techniques such as discounting procedures in various forms (*e.g.* NPV, IRR, payback period), sensitivity analysis and decision-tree analysis. Any difference between techniques definition used in this research project and techniques definition understood by questionnaire participants was mitigated during the questionnaire piloting, which fed back on the participants` understanding on the techniques. During the questionnaire piloting, interviewees agreed with a list of separate techniques.

Fourth, the techniques listed in the questionnaire were comprehensive, but by no means exhaustive. This list was based on an extensive literature review and examined during the questionnaire piloting, when interviewees agreed with the terminology used for the listed techniques. Furthermore, respondents were invited to include any additional technique they often use in managing strategic projects when completing the questionnaire. These additional techniques included capital expenditure (CAPEX), life cycle costs, return on capital employed (ROCE), reserve-to-production ratio and development cost per barrel, which were also taken into account in the design of the sets of techniques for successful strategic project management. Fifth, techniques were categorised, in the exploratory fieldwork, into evaluation and control techniques, for the purposes of simplification. This *a priori* categorisation was tested during the core investigation.

Sixth, evaluation and control elements involved in managing strategic projects did not include issues associated with contractors and partners. Seventh, success elements are contextual, as they are, in this work, associated with the management of UK upstream oil and gas projects. For instance, economic and political uncertainties are believed not to explain successful strategic project management, as the North Sea is considered to be a stable environment.

Eight, the linkage between successful strategic project management and successful companies played no part in the current investigation. Finally, the measures for a strategic project's success are referred to a strategic project's termination. Intermediate measures between the evaluation and control stages, however, were not taken into account.

There are some limitations caused by the sampling design. First, neither the targeted population nor the sample size were sufficiently large, which did not allow for the application of some advanced multivariate analysis, namely structural equation modelling. Furthermore, the sub-groups of elements established by the questionnaire were the chosen way of overcoming the small sample size in order to employ multivariate techniques. However, the quality of the results outweighed the reduced sample size. As observed by White (2000), the precision of information is more meaningful than the sample size.

Second, the observations in each company must be independent. Nevertheless, there was no complete guarantee of such independence. The need for independent observations could be relaxed without loosing much relevant information.

Third, although the sample was designed by convenience, it appears to be representative of the population. There are some reasons for that. First, the response rates both from the companies and individuals were high. Second, the tight confidence intervals of the findings gave an indication of the range within which the population values are likely to be. However, generalisations from the sample to the population are considered in this study with caution.

Fourth, generalisations to any other population are, in the first instance, untimely (Shoham, 1999). However, the great majority of companies surveyed were international, and most managers had international experience. The findings, therefore, can contribute to the extension of the conceptual boundaries and improve current practices in managing upstream oil and gas strategic projects.

Fifth, it is relevant to verify whether the non-respondents of the questionnaire had a distinct view from the respondents, and, if they did, whether the number of non-respondents was sufficiently large to impact on the respondents' common view

(Shoham, 1999). As the research study attained an extremely high response rate, this problem was considered irrelevant. A random group of non-respondents was contacted, and the main reasons for not responding were lack of available time and the length of the questionnaire. As Shoham (1998, 1999) observes, these reasons are not consistently related to the response rate, and therefore the non-response rate is not believed to impact substantially on the results.

Finally, the current study was non-experimental and was unable to control independent variables. Therefore, causal relationships between the independent variables and the dependent variables must be considered with caution (Chou, 1998).

3.6 – Ethical Issues

According to Blaxter *et al.* (1996), research projects frequently evoke ethical issues, especially where people are involved. Research ethics is based on a clear agreement between the researcher and the researched. The researcher must *"[...] exercise responsibility in the processes of data collection, analysis and dissemination"* (*ibid.*: 146).

Ethical principles were continuously exercised at all stages of this research project. Primary contacts, gatekeepers and participants were treated with care and probity, while participants were free to co-operate in any stage of the research project and the rules were clearly stated at each stage of the data collection.

In the exploratory investigation, interviewees were asked for consent prior to tape recording their interviews. In the core investigation, companies were asked for informed consent before completing the questionnaire. The questionnaire was posted to the companies in advance, if requested. In the confirmatory investigation, respondents were asked for consent before providing additional information and responding to the assessment sheet. At all stages of the data collection, data confidentiality and anonymity of the participants were formally declared. During the data analysis and the dissemination of the results, the researcher also exercised the principles of confidentiality and anonymity.

3.7 – Concluding Remarks

This chapter gave an overview of existing research paradigms and methods of data collection in the social sciences. It also outlined the methodological path to be followed in this research project, including the methods of data analysis. The limitations of the current study and ethical issues were discussed at the end of this chapter.

The proposed methodology followed a triangular approach and was divided into three phases: exploratory investigation, core investigation and confirmatory investigation. The exploratory investigation aimed to give a sense of reality to the research problem, to motivate the design of the remaining phases of the proposed research methodology, and to support the reviewed literature in outlining the research hypotheses. It was divided into two stages: exploratory fieldwork and exploratory deskwork. The former involved face-to-face recorded interviews, while the latter consisted of theoretical analysis. The exploratory fieldwork aimed to give an overall picture of corporate strategies, strategic opportunities and strategic projects, to understand the evaluation and control of strategic projects, and to describe a set of elements involved in strategic project evaluation and control. The exploratory deskwork, meanwhile, constituted a search for a correspondence between the elements obtained from practice and theory, placed the elements within a conceptual framework, and investigated the role of techniques in addressing, in theoretical terms, such elements.

The core investigation involved questionnaire design, a proposal of statistical analysis and questionnaire administration. It aimed to produce a questionnaire which was able to test the research hypotheses, generalise the exploratory findings, consolidate the overall findings, and support the proposal of sets of techniques for successful strategic project management. The questionnaire design was divided into four steps: sampling procedure, questionnaire structure, measurement scales and operational definitions of the research items of measurement, and the reliability and validity of the questionnaire. The statistical analysis referred to a proposal of statistical techniques for data analysis. The questionnaire administration was divided into three steps: institutional support and primary access, questionnaire piloting, and main survey.

The confirmatory investigation sought to validate some questionnaire findings and the proposed sets. It was divided into two stages. The former involved follow-up telephone interviews and the latter consisted of an assessment sheet. Along with the description of the proposed research methodology, the efforts made to put it into practice were thoroughly illustrated.

The following chapter of this study is the research findings chapter. It aims to present and discuss the overall results and revisit the research hypotheses of the current study. It is divided into two parts: exploratory findings and core findings. The exploratory findings refer to the exploratory investigation. The core findings, meanwhile, combine the questionnaire results with the results obtained from the follow-up interviews, which are part of the confirmatory investigation.

Chapter 4

RESEARCH FINDINGS

4.1 – Introduction

This chapter discusses the overall findings of the current research project. It is divided into two main parts: the exploratory findings and the core findings. While the former is associated with the exploratory investigation, the latter combines the results of the questionnaire with those obtained from follow-up interviews. The final part of the chapter revisits the research hypotheses.

The chapter is divided into five sections. Section 4.2 begins by discussing the findings of the exploratory fieldwork, which broadly seeks to identify and define elements respectively involved in evaluating and controlling strategic projects. The exploratory deskwork searches for a correspondence between the elements obtained from practice and theory, the proposal of a conceptual framework to support these elements, and the role of techniques in addressing, in theoretical terms, these elements. Section 4.3 introduces the core findings, which involve the findings of the questionnaire and follow-up interviews. The core findings are divided into three parts: univariate and bivariate analyses, multivariate analysis and qualitative analysis. The first broadly describes the overall sample. The second explores the relationship between the group of elements involved respectively in strategic project evaluation and control, and different levels of a strategic project's success. The third discusses the questionnaire's open-ended questions. Section 4.4 revisits the research hypotheses. Finally, Section 4.5 points out the concluding remarks and introduces the next chapter.

4.2 – Exploratory Findings

This section aims to discuss the exploratory findings of the current research project. The exploratory findings emerged both from the interviews undertaken during the exploratory fieldwork and the conceptual analysis, which formed part of the exploratory deskwork. These findings are presented in the following sections.

4.2.1 – Findings of the Exploratory Fieldwork

This section outlines the findings of the exploratory fieldwork. They are based on a set of interviews that took place in July 1998 with nine managers holding top and medium positions in a single upstream oil and gas company.

These findings included the interviewees' definition of corporate strategies, strategic opportunities and strategic projects, the description of the evaluation and control of strategic projects, and the identification and definition of elements involved in the evaluation and control of strategic projects. The elements were categorised into evaluation and control elements. It is relevant to mention here that the interviewees stressed the importance of the outcomes of a strategic project in the description of the evaluation and control of strategic projects.

Corporate strategy is defined as a set of actions (or a current way) to achieve previously identified long-term corporate objectives. These actions are responsible for corporate growth, improvement and reforms. According to the interviewees, there are two different kinds of strategy: business strategy and competitive strategy. The former refers to what a company wishes to be in the future, *i.e.* a company's soul. The latter refers to a company's market positioning in a specific industry.

A strategic opportunity is suggested to be anything a company can take advantage of in order to improve its competitive position and achieve the highest corporate results. For the interviewees, a strategic opportunity is essential for a company to complete a trajectory within a specific scenario. A strategic opportunity is usually an output of corporate visioning. It is sometimes a hidden option, and opens up a competitive differential to the company. The corporate vision is responsible for conceiving the corporate strategies and continuously developing distinguishing strengths, such as resources and capabilities, to acquire, maintain and renew a competitive advantage before the competitors. It consequently takes advantage of a strategic opportunity.

A strategic project is considered to be an entity involving a specific investment associated with a corporate strategic area, and represents the vehicle used to put a strategic opportunity into practice. According to the interviewees, a strategic project is a means of realising and implementing a strategic opportunity. It is a conceptual and physical description of the mechanisms to attain a strategy. A strategic project must be applicable and executable, *i.e.* a representation of reality, have a business orientation and be in line with corporate mission and goals. While conceiving a strategic project, it is important to address important issues such as the actions to be taken in order to develop critical resources, to successfully consolidate a position and to boost internal satisfaction.

Strategic projects are considered as few, relevant, front line, big size, innovative, value creating and market positioning projects. They are seen as both external and internal agents, not only opening up external channels, but also enlightening internal strengths. They might have an impact on the company in the long run and also provide high long-term results. However, they are often perceived as high-risk projects, because they often admit the possibilities of negative financial results.

The evaluation of strategic projects, as suggested by the interviewees, refers to their design, planning and valuation in order to allow ultimately for their comparison and ranking. From a financial perspective, the evaluation of a strategic project is a hard task. It is difficult to associate strategic results with financial results, although the former explains the latter. On the one hand, interviewees with a strategic background considered that a strategic project might not necessarily be financially oriented but presumably they are thought to be financially beneficial in the long run. For them, financial results are important, although they are not essential, because other results – indirect and not easily (or even) measurable, are also important, such as market position, customer satisfaction, internal satisfaction, image, reputation, access, social and environmental impacts, among others. On the other hand, interviewees with a financial background considered that even if financial results are indirect, they are also fundamental.

An important question was posed: is it possible to link strategic results to financial ones? If so, how? For this purpose, the interviewees recommended to build a bridge among different perspectives, including the financial one. One interviewee suggested that a strategic project could be evaluated through multidimensional macro quantifiers in order to measure their contributions to the corporate results.

As has been declared by some interviewees, the process of evaluating a strategic project starts by identifying a strategic opportunity associated with a number of expected results. A strategic opportunity motivates the conception of one or more strategic projects. If a company has both the basic resources and capabilities – or is able to get them at a reasonable time, and also allocates its best resources to realise the planned actions, it has the needed competencies to create, acquire, maintain and renew a competitive advantage. In order to acquire a strategic opportunity, a company participates in auctions and bidding processes, among others, and also establishes an effective interaction within the company and between the company and its peers. For these interviewees, during the acquisition of a strategic opportunity, the strategic project is the instrument used to build a relationship based on mutual faith, in order to exchange ideas, reinforce a suitable image and prospect a profitable market positioning. The evaluation of a strategic project is usually associated with the process of acquiring a strategic opportunity.

According to the interviewees, a strategic project can be controlled by checking whether goals are attained, actions are performed as planned and results are successfully achieved. The development of a certain number of actions allows a company to achieve a strategic project's expected results successfully. First, a company might allocate its best resources to its strategic projects. Second, a strategic project must be effectively controlled. The process of control usually corrects eventual deviations from the desired values during a project's implementation. However, as some interviewees suggested, corrective actions might not be effective, as most of the changes are quite irreversible.

Although a continuous, systematised re-evaluation of a strategic project should have been carried out from the inception of the strategic project, as stated by the interviewees, a company must have a proactive attitude in order to transform its future. A reactive, traditional performance measurement system is not unconditionally insufficient, but a proactive control is also necessary to accomplish an effective strategic project control. As some interviewees added, a strategic project's diffusion within the organisation, an effective managerial involvement, changes in the organisational routines and continuous training are also requirements for effective control.

For the interviewees, control is usually associated with the process of sustaining and renewing an acquired strategic opportunity. During this process, a strategic project can be stopped due to a lack of reliability and feasibility, and is adapted due to internal and/or external circumstances and replaced by more attractive strategic projects. Strategic projects, however, are usually not effectively controlled.

Three main reasons were advanced for ineffective control. First, control is in itself a difficult matter. Secondly, planning is usually not suitably performed and directly affects a strategic project's overall performance. Finally, there is often an inadequate regime of managerial compensation. Beyond this, a strategic project must be accurately and continuously controlled to guarantee successful outcomes. Time, effort and resources are seen as the key variables in controlling strategic projects. Effective control has the power to dynamically execute, transform and adapt a strategic project. According to the interviewees, if a company is sufficiently skilful and organised to proactively seek new targets and rely on historical performance measures, then it might be able to accomplish an effective control.

This section presents now the remaining and most important part of the findings of the exploratory fieldwork. The interviewees proposed and defined sets of elements respectively involved in the evaluation and control of strategic projects, as seen in Tables 4.1 and 4.2 in the following pages. These sets of elements (and their operational definitions) were re-examined during the questionnaire piloting in order to adjust the design of the final version of the questionnaire.

TABLE 4.1 – EVALUATION ELEMENTS AND OPERATIONAL DEFINITIONS

Evaluation Element	Operational Definition
Feasibility	Strategic project's difficulty of realisation and implementation
Timescale	Strategic project's time to maturity
Durability	Strategic project's economic life, *e.g.* platform production life span
Flexibility	Strategic project's flexibility to adapt to changes in external circumstances
Time	Time value of money
Financial Capability	Firm's financial situation
Financial Leverage	Firm's requirement to raise external funding, *e.g.* project finance, leasing
Financial Market Uncertainty	Uncertainty related to financial market variables, *e.g.* oil price, exchange rate
Competition	Firm's rivalry to competitors
Economic Uncertainty	Uncertainty related to economic environment, *e.g.* growth, inflation
Social Uncertainty	Uncertainty related to social environment, *e.g.* cultural issues, customer attitudes
Political Uncertainty	Uncertainty related to political environment, *e.g.* taxation, expropriation, government support
Environmental Uncertainty	Uncertainty related to environmental legislation, pressure groups
Geological Uncertainty	Uncertainty related to geological issues, *e.g.* oil(gas) reserve
Technological Uncertainty	Uncertainty related to changes in technology
Corporate Alignment	Strategic project's adherence to corporate mission and goals
Competency Alignment	Strategic project's fit with corporate strengths
Interdependency	Strategic project's interaction with other projects and activities
Cash Flows	Costs and benefits by time period
Financial Summary Measures	Strategic project's financial measures
Environmental Impact	Strategic project's impact on environment
Social Impact	Strategic project's impact on society
Political Impact	Strategic project's impact on key stakeholders, *e.g.* government
Market Share	Firm's market position due to the strategic project
Organisational Impact	Strategic project's impact on the organisation

TABLE 4.2 – CONTROL ELEMENTS AND OPERATIONAL DEFINITIONS

Control Element	Operational Definition
Financial Market Scanning	Monitoring of financial market information, *e.g.* oil price, exchange rate
Budgetary Constraints	Financial constraints affecting a strategic project's execution
Market Scanning	Monitoring of customer and competitor information, *e.g.* brand image, competitor activity
Economic Scanning	Monitoring of economic information, *e.g.* growth, inflation
Environmental Scanning	Monitoring of environmental information, *e.g.* water emission, oil pollution
Political Scanning	Monitoring of political information, *e.g.* taxation, expropriation, government support
Corporate Alignment Scanning	Monitoring of strategic project's adherence to corporate mission and goals
Project Milestones Scanning	Monitoring of progress against strategic project's milestones
Product Monitoring	Monitoring of product information, *e.g.* oil quality, appropriate gas supply
Managerial Interaction	Ability to promote involvement, commitment and leadership
Resources Deployment	Ability to apply current resources and competencies
Learning	Ability to learn from past experience, *e.g.* interim and post-appraisal
Innovative Routines	Ability to change organisational routines
Innovative Technologies	Ability to introduce new technologies
Financial Targets	Degree to which financial targets (*e.g.* costs, incomes, financial summary results) are achieved
Timescale Targets	Degree to which strategic project's deadlines are met
Customer Satisfaction	Level of customer contentment achieved
Environmental Targets	Degree to which environmental targets are achieved
Market Position	Level of market position achieved
Corporate Alignment	Degree to which corporate mission and goals are supported
Employee Satisfaction	Level of internal contentment and morale achieved
Organisational Communication	Quality of internal communication around the strategic project
Employee Development	Degree of development of employee skills
Technological Development	Degree of development and diffusion of technology
Organisational Adaptability	Degree of organisational adaptability to changes in external circumstances

4.2.2 – Findings of the Exploratory Deskwork

This section outlines the findings of the exploratory deskwork. These findings are based on a conceptual analysis carried out between August and October 1998, and are divided into three parts: (1) the search for a correspondence between the elements obtained from practice and theory; (2) the distribution of the elements within a conceptual framework;

and (3) the investigation of the role of techniques in addressing, in theoretical terms, these elements.

The first part of this section, based as it is on the reviewed literature, aims to explore the correspondence between the elements obtained from practice and theory. Tables 4.3 and 4.4 present in the following pages the theoretical sources for, respectively, each evaluation and control element.

TABLE 4.3 – CORRESPONDENCE BETWEEN EVALUATION ELEMENTS AND THEORY

Evaluation Element	Theoretical Source
Feasibility	Cooper and Chapman (1987), Lock (2000e)
Timescale	Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), Dyson and Berry (1998)
Durability	Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), Nanda (1996), Dyson and Berry (1998), Grant (1998), Slater *et al.* (1998)
Flexibility	Kester (1984, 1993), Evans (1991), Kulatilaka and Marcus (1992), Bunn and Salo (1993), Kemna (1993), Dixit and Pindyck (1994), Smith and Nau (1995), Schoemaker (1995), Brealey and Myers (1996), Buckley and Tse (1996), Ward and Chapman (1996), Leslie and Michaels (1997), Buckley (1998), Kogut and Kulatilaka (1998), Amram and Kulatilaka (1999a,b)
Time	Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), Buckley (1998), Dyson and Berry (1998), Slater *et al.* (1998), Brewer *et al.* (1999), Turner (2000b)
Financial Capability	Stewart (1994), Dyson and Berry (1998)
Financial Leverage	Modigliani and Miller (1958), Brealey and Myers (1996)
Financial Market Uncertainty	Chapman *et al.* (1987), Cooper and Chapman (1987), Van Horne (1992), Dixit and Pindyck (1994), Smith and Nau (1995), Brealey and Myers (1996), Dyson and Berry (1998), Slater *et al.* (1998), Amram and Kulatilaka (1999b)
Competition	Chapman *et al.* (1987), Smit and Ankun (1993), Buckley and Tse (1996), Kulatilaka and Perotti (1996), Amram and Kulatilaka (1999a)
Economic Uncertainty	Chapman *et al.* (1987), Cooper and Chapman (1987), MacNulty (1977), Vanston Jr. (1977), Becker (1983), Dixit and Pindyck (1994)
Social Uncertainty	MacNulty (1977), Vanston Jr. (1977), Chapman *et al.* (1987)
Political Uncertainty	MacNulty (1977), Vanston Jr. (1977), Becker (1983), Chapman *et al.* (1987), Cooper and Chapman (1987), McGrath (1999)
Environmental Uncertainty	Cooper and Chapman (1987), Dixit and Pindyck (1994)
Geological Uncertainty	Dixit and Pindyck (1994)
Technological Uncertainty	MacNulty (1977), Becker (1983), Chapman *et al.* (1987), Cooper and Chapman (1987)
Corporate Alignment	MacNulty (1977), Becker (1983), Dyson and Foster (1983), Andrews (1997)
Competency Alignment	MacNulty (1977), Becker (1983), Dyson and Foster (1983), Nanda (1996), Grant (1998), Kogut and Kulatilaka (1998), Amram and Kulatilaka (1999b)
Interdependency	Kasanen (1993), Dyson and Berry (1998)
Cash Flows	Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), Dyson and Berry (1998)
Financial Summary Measures	Van Horne (1992), Weston and Copeland (1992), Brealey and Myers (1996), Dyson and Berry (1998)
Environmental Impact	Cooper and Chapman (1987), Dixit and Pindyck (1994), Black (1997)
Social Impact	Becker (1983), Cooper and Chapman (1987), Black (1997)
Political Impact	Becker (1983), Cooper and Chapman (1987), Black (1997), McGrath (1999)
Market Share	Smit and Ankun (1993), Ward and Grundy (1996), Dyson and Berry (1998)
Organisational Impact	Becker (1983), Kaplan and Norton (1992)

TABLE 4.4 – CORRESPONDENCE BETWEEN CONTROL ELEMENTS AND THEORY

Control Element	Theoretical Source
Financial Market Scanning	Dyson and Berry (1998), Amram and Kulatilaka (1999b)
Budgetary Constraints	Weingartner (1974), Chapman *et al.* (1987), Dyson and Berry (1998)
Market Scanning	Amram and Kulatilaka (1999b)
Economic Scanning	McGrath (1997)
Environmental Scanning	Dixit and Pindyck (1994)
Political Scanning	McGrath (1997, 1999)
Corporate Alignment Scanning	Nanda (1996), Foss (1997a), Grant (1998), Amram and Kulatilaka (1999b)
Project Milestones Scanning	Miller (1963), Simons (1995), Dawson (2000), Lock (2000d)
Product Monitoring	Foss (1997a), Brewer *et al.* (1999)
Managerial Interaction	Kaplan and Norton (1992), Foss (1997a), Buckley (1998), Grant (1998), Bontis *et al.* (1999)
Resources Deployment	Nanda (1996), Ward and Chapman (1996), Andrews (1997), Foss (1997a), Grant (1998), Kogut and Kulatilaka (1998), Amram and Kulatilaka (1999b), Dyson and Berry (1998), Bontis *et al.* (1999), Mooraj *et al.* (1999), Dawson (2000), Lock (2000c), Murray-Webster and Thiry (2000), Pharro (2000)
Learning	Morris *et al.* (1991), Kaplan and Norton (1992), Dixit and Pindyck (1994), Chi and Nystrom (1995), Schoemaker (1995), Buckley and Tse (1996), Nanda (1996), Andrews (1997), Foss (1997a), Leslie and Michaels (1997), Bowman and Moskowitz (1998), Grant (1998), Kogut and Kulatilaka (1998), Slater *et al.* (1998), Amram and Kulatilaka (1999b), Bontis *et al.* (1999), McGrath (1999), Mooraj *et al.* (1999), Turner (2000b)
Innovative Routines	Nanda (1996), Andrews (1997), Grant (1998), Bowman and Moskowitz (1998), Kogut and Kulatilaka (1998), Amram and Kulatilaka (1999b), Bontis *et al.* (1999), Brewer *et al.* (1999)
Innovative Technologies	Bontis *et al.* (1999), Brewer *et al.* (1999)
Financial Targets	Kaplan and Norton (1992), Kasanen and Trigeorgis (1993)
Timescale Targets	Miller (1963), Dawson (2000), Lock (2000d)
Customer Satisfaction	Porter (1985), Ward and Grundy (1996), Foss (1997a), Lebas (1999), Brewer *et al.* (1999)
Environmental Targets	Dixit and Pindyck (1994)
Market Position	Smit and Ankun (1993), Andrews (1997)
Corporate Alignment	Dyson and Foster (1983), Kaplan and Norton (1992), Andrews (1997)
Employee Satisfaction	Buckley (1998), Bontis *et al.* (1999), McGrath (1999)
Organisational Communication	Kaplan and Norton (1992), Nanda (1996), Foss (1997b), Grant (1998), Amram and Kulatilaka (1999a,b)
Employee Development	Amram and Kulatilaka (1999b), Bontis *et al.* (1999), Brewer *et al.* (1999)
Technological Development	Nanda (1996), Grant (1998), Bontis *et al.* (1999), Brewer *et al.* (1999)
Organisational Adaptability	Nanda (1996), Grant (1998), Kogut and Kulatilaka (1998), Mooraj *et al.* (1999), Bontis *et al.* (1999)

The second part of this section aims to place the proposed sets of elements within a conceptual framework, so as to examine the extent to which these elements are multidisciplinary in nature.

As was previously discussed in the research methodology chapter, this framework involves two dimensions. The first consists of four perspectives (financial, external environment, internal business, and learning and innovation) introduced by Kaplan and Norton's (1992) Balanced Scorecard and later critiqued and amended by Bontis *et al.* (1999).

The second dimension involves three categories of elements, namely context and content elements, discussed by Pettigrew and Whipp (1991) and Pettigrew (1997), and outputs, discussed by Dyson and O'Brien (1998). For simplification, context and content elements are referred to as process elements, *i.e.* elements involved in the evaluation and control processes. Outputs are the results of the evaluation and control processes.

Tables 4.5 and 4.6, as seen overleaf, respectively place the evaluation and control elements within the proposed framework, according to different perspectives and categories. The perspectives and categories are the "*bi-dimensional*" conceptual dimensions to which the elements are related. The proposed framework is also discussed in Asrilhant and Dyson (2000), and is tested in Section 4.3.2.1 ("Factor Analysis").

TABLE 4.5 – EVALUATION ELEMENTS THROUGH DIFFERENT PERSPECTIVES AND CATEGORIES

	Financial	External Environment	Internal Business	Learning and Innovation
Context	Time Financial Capability Financial Leverage Financial Market Uncertainty	Competition Economic Uncertainty Social Uncertainty Political Uncertainty Environmental Uncertainty Geological Uncertainty Technological Uncertainty	Corporate Alignment Competency Alignment Interdependency	
Content			Feasibility Timescale Durability Flexibility	
Output	Cash Flows Financial Summary Measures	Environmental Impact Social Impact Political Impact Market Share	Organisational Impact	

TABLE 4.6 – CONTROL ELEMENTS THROUGH DIFFERENT PERSPECTIVES AND CATEGORIES

	Financial	External Environment	Internal Business	Learning and Innovation
Context	Financial Market Scanning Budgetary Constraints	Market Scanning Economic Scanning Environmental Scanning Political Scanning	Corporate Align. Scanning Project Milestones Scanning Product Monitoring Managerial Interaction Resources Deployment	Learning Innovative Routines Innovative Technologies
Content				
Output	Financial Targets Timescale Targets	Customer Satisfaction Environmental Targets Market Position	Corporate Alignment Employee Satisfaction Org. Communication	Employee Development Tech. Development Org. Adaptability

In relation to Tables 4.5 and 4.6, two premises may be assumed, as follows:

1. The learning and innovation perspective is only considered in the control stage because this where the opportunity to learn and innovate arises, and therefore learning and innovation are crucial at the control stage; and
2. the strategic project's content is only considered in the evaluation stage because its conception and framing are examined at that stage.

The final part of this section aims to examine the extent to which techniques address, in theoretical terms, the proposed set of elements. First, Table 4.7 introduces a list of techniques for managing strategic projects reviewed by the literature (Section 2.3 - "Techniques for Managing Projects"). During the exploratory deskwork techniques were separated, for simplification, into evaluation and control techniques. They are the mainly used techniques for facilitating, respectively, project evaluation and control. This separation is tested in Section 4.3.4.3 ("Main Stage of Application of Techniques").

TABLE 4.7 – EVALUATION AND CONTROL TECHNIQUES

Evaluation Techniques	Control Techniques
Return on Investment (ROI)	Capital Rationing
Net Income	Manpower Rationing
Payback Period	Scheduling
Internal Rate of Return (IRR)	Financial Performance Monitoring
Net Present Value (NPV)	Activity-Based Costing
Leveraged NPV	Economic Value Added
Risk-Adjusted NPV	Balanced Scorecard
Sensitivity Analysis	Intellectual Capital
Cost-Benefit Analysis	
Forecasting	
Scenario Analysis	
Contingency Analysis	
Decision-Tree Analysis	
Simulation	
Risk Analysis	
Optimisation	
Human Resources Accounting	
Real Options	
Cognitive Mapping	
Game Theory	
Utility Function	

The list of techniques proposed by Table 4.7 was examined during the questionnaire piloting. The pilot testing reviewed the list of techniques itself and the terminology adopted by these techniques in order to adjust the design of the final version of the questionnaire. In the questionnaire piloting, the interviewees suggested including accounting summary measures (ROI and net income) and recommended to make explicit examples for financial performance monitoring (*e.g.* ROI over time) and scheduling (*e.g.* PERT-CPM). The interviewees also understood the terminology used by this work to define the listed techniques, namely summary measures (ROI, net income, NPV, IRR, payback period), sensitivity analysis, decision-tree analysis and risk analysis, as well as agreeing with a list of separate techniques instead of in a context of a wider process involving a collection of techniques.

Finally, the list of evaluation and control techniques, extensively discussed in the literature review chapter and examined during the questionnaire piloting (see Table 4.7) was connected, respectively, to the evaluation and control elements. These elements were proposed by the interviewees in the exploratory fieldwork and revisited in the questionnaire piloting (see Tables 4.1 and 4.2), and linked to theory (see Tables 4.3 and 4.4) and placed in a conceptual framework according to different perspectives and categories (see Tables 4.5 and 4.6) during the exploratory deskwork.

The connection between techniques and elements are seen in Tables 4.8 and 4.9 in the following pages. This connection is based on the reviewed literature (Chapter 2), and gives an idea of the extent to which techniques facilitate, in theoretical terms, strategic project management. This section ends by outlining some preliminary conceptual findings.

TABLE 4.8A – CONNECTION OF EVALUATION TECHNIQUES WITH EVALUATION ELEMENTS

Evaluation Element / Evaluation Technique	Feasibility	Timescale	Durability	Flexibility	Time	Financial Capability	Financial Leverage
Return on Investment						✔	✔
Net Income						✔	✔
Payback Period (*)		✔					
Internal Rate of Return		✔	✔		✔		
Net Present Value (NPV)		✔	✔		✔		
Leveraged NPV		✔	✔		✔		✔
Risk-Adjusted NPV (**)		✔	✔		✔		
Sensitivity Analysis		✔	✔		✔		
Cost-Benefit Analysis		✔	✔		✔		
Forecasting							
Scenario Analysis			✔	✔			
Contingency Analysis			✔				
Decision-Tree Analysis			✔	✔	✔		
Simulation	✔						
Risk Analysis	✔		✔		✔		
Optimisation						✔	
Human Resources Accounting			✔		✔		
Real Options			✔	✔	✔		
Cognitive Mapping							
Game Theory							
Utility Function							

(*) Non-discounted payback period
(**) NPV discounted at a project's risk-adjusted rate

TABLE 4.8B – CONNECTION OF EVALUATION TECHNIQUES WITH EVALUATION ELEMENTS (CONTD.)

Evaluation Element / **Evaluation Technique**	Financial Market Uncertainty	Competition	Economic Uncertainty	Social Uncertainty	Political Uncertainty
Return on Investment					
Net Income					
Payback Period (*)					
Internal Rate of Return					
Net Present Value (NPV)					
Leveraged NPV					
Risk-Adjusted NPV (**)	✔				
Sensitivity Analysis					
Cost-Benefit Analysis					
Forecasting	✔		✔	✔	✔
Scenario Analysis	✔	✔	✔	✔	✔
Contingency Analysis	✔	✔	✔	✔	✔
Decision-Tree Analysis	✔				
Simulation					
Risk Analysis			✔	✔	✔
Optimisation					
Human Resources Accounting					
Real Options	✔		✔		
Cognitive Mapping					
Game Theory		✔			
Utility Function					

(*) Non-discounted payback period
(**) NPV discounted at a project's risk-adjusted rate

TABLE 4.8C – CONNECTION OF EVALUATION TECHNIQUES WITH EVALUATION ELEMENTS (CONTD.)

Evaluation Element / **Evaluation Technique**	Env. Uncertainty	Geological Uncertainty	Tech. Uncertainty	Corporate Alignment	Competency Alignment	Inter-dependency
Return on Investment						
Net Income						
Payback Period (*)						
Internal Rate of Return						
Net Present Value (NPV)						
Leveraged NPV						
Risk-Adjusted NPV (**)						
Sensitivity Analysis						
Cost-Benefit Analysis						
Forecasting			✔			
Scenario Analysis	✔		✔	✔	✔	
Contingency Analysis	✔		✔	✔	✔	
Decision-Tree Analysis		✔				
Simulation	✔	✔	✔			
Risk Analysis	✔	✔	✔			
Optimisation						✔
Human Resources Accounting						
Real Options		✔	✔			✔
Cognitive Mapping						
Game Theory						
Utility Function						

(*) Non-discounted payback period
(**) NPV discounted at a project's risk-adjusted rate

TABLE 4.8D – CONNECTION OF EVALUATION TECHNIQUES WITH EVALUATION ELEMENTS (CONTD.)

Evaluation Element / **Evaluation Technique**	Cash Flows	Fin. Sum. Measures	Environmental Impact	Social Impact	Political Impact	Market Share	Org. Impact
Return on Investment							
Net Income							
Payback Period (*)	✔	✔					
Internal Rate of Return	✔	✔					
Net Present Value (NPV)	✔	✔					
Leveraged NPV	✔	✔					
Risk-Adjusted NPV (**)	✔	✔					
Sensitivity Analysis	✔	✔					
Cost-Benefit Analysis	✔	✔	✔	✔	✔		
Forecasting							
Scenario Analysis	✔	✔	✔	✔	✔		
Contingency Analysis	✔	✔	✔	✔	✔		
Decision-Tree Analysis	✔	✔					
Simulation			✔	✔	✔		
Risk Analysis	✔	✔	✔	✔	✔		
Optimisation	✔	✔					
Human Resources Accounting	✔	✔					
Real Options	✔	✔					
Cognitive Mapping							
Game Theory						✔	
Utility Function							

(*) Non-discounted payback period
(**) NPV discounted at a project's risk-adjusted rate

TABLE 4.9A – CONNECTION OF CONTROL TECHNIQUES WITH CONTROL ELEMENTS

Control Element / **Control Technique**	Financial Market Scanning	Budgetary Constraints	Market Scanning	Economic Scanning	Environmental Scanning
Capital Rationing		✔			
Manpower Rationing					
Scheduling		✔			
Financial Performance Monitoring	✔				
Activity-Based Costing					
Economic Value Added					
Balanced Scorecard					
Intellectual Capital					

TABLE 4.9B – CONNECTION OF CONTROL TECHNIQUES WITH CONTROL ELEMENTS (CONTD.)

Control Element / **Control Technique**	Political Scanning	Corporate Alignment Scanning	Project Milestones Scanning	Product Monitoring	Managerial Interaction
Capital Rationing		✔			
Manpower Rationing		✔			
Scheduling			✔		
Financial Performance Monitoring		✔			
Activity-Based Costing					
Economic Value Added					
Balanced Scorecard					✔
Intellectual Capital					✔

Table 4.9c – Connection of Control Techniques with Control Elements (contd.)

Control Element / Control Technique	Resources Deployment	Learning	Innovative Technologies	Innovative Routines	Financial Targets	Timescale Targets
Capital Rationing						
Manpower Rationing						
Scheduling	✔	✔			✔	✔
Financial Performance Monitoring		✔			✔	
Activity-Based Costing		✔				
Economic Value Added		✔			✔	
Balanced Scorecard	✔	✔		✔	✔	
Intellectual Capital	✔	✔	✔	✔		

Table 4.9d – Connection of Control Techniques with Control Elements (contd.)

Control Element / Control Technique	Customer Satisfaction	Environmental Targets	Market Position	Corporate Alignment	Employee Satisfaction
Capital Rationing				✔	
Manpower Rationing				✔	
Scheduling					
Financial Performance Monitoring				✔	
Activity-Based Costing					
Economic Value Added					
Balanced Scorecard	✔	✔	✔	✔	
Intellectual Capital					

TABLE 4.9E – CONNECTION OF CONTROL TECHNIQUES WITH CONTROL ELEMENTS (CONTD.)

Control Element / Control Technique	Organisational Communication	Employee Development	Technological Development	Organisational Adaptability
Capital Rationing				
Manpower Rationing				
Scheduling				
Financial Performance Monitoring				
Activity-Based Costing				
Economic Value Added				
Balanced Scorecard	✔			✔
Intellectual Capital		✔	✔	✔

At this stage, the aim of this research is to identify to what extent techniques address, in theoretical terms, those elements involved in strategic project evaluation and control. Prior to that, it is important to mention that although some techniques do not tackle any of the elements (*e.g.* cognitive mapping), it does not mean that these techniques would not be included in the list of techniques. It solely means that these techniques (1) do not address the set of elements proposed by the current work, which is by no means complete; (2) are separated, for simplification, into evaluation and control techniques; and (3) focus on the evaluation and control of strategic projects after their setting up.

According to Tables 4.8 and 4.9, the examined techniques for managing strategic projects are not individually sufficient to address all elements involved in managing strategic projects. These techniques lead separately to partial solutions. Some preliminary conceptual findings, based on the tables above, are discussed as follows.

Although evaluation techniques are insufficient in themselves to tackle all evaluation elements, a combination of some of these techniques is able to tackle a great number of elements. Some summary measures, such as NPV and IRR, address almost the same realm of elements. Techniques that incorporate uncertainty, namely scenario analysis, address another domain of elements. According to Ashford *et al.* (1990), summary measures are usually normative methods, originating from the financial and accounting domains, which neglect that which cannot be objectively measured. Ashford *et al.* (*op. cit.*) suggest that instead of merely criticising the use of normative methods, one must recognise what should be done for a better application of these methods.

Control techniques are also individually insufficient to tackle control elements in their entirety. However, these techniques extensively address the elements involved in strategic project control. A possible explanation for this might be that control techniques involve both a traditional, prescriptive approach based on objective, quantifiable measures, which includes such techniques as capital rationing and financial performance monitoring, as well as a prescriptive approach that has the additional feature of being descriptive, including such techniques as the Balanced Scorecard and Intellectual Capital. If only the traditional techniques, which are usually adopted by organisations for controlling projects, were connected to the elements, most of the underlying elements would not be addressed. As Kaplan and Norton (1992) state, traditional control systems originate from the accounting and financial domains to overlook the concept of control and favour a control bias.

Although firms aim to measure objectively their decision-making processes, this seems to be a fallacious goal. In strategic project management, as Dyson and Foster

(1980) observe, it is difficult to analyse all financial consequences of a strategic investment. According to Becker (1983), most elements are multidisciplinary and not always quantifiable. Quantifiable elements are, as MacNulty (1977) notes, only part of what decision-makers need. It is desirable to measure what is manageable to quantification, as Dyson and Foster (*op. cit.*) and Ashford *et al.* (1990) add, but not at the expense of losing valuable information which can be only qualitatively described. Therefore, according to Schnaars (1990), quantitative methods tend to focus on aspects that are easily quantified. *"[...] Benefits [that] cannot be quantified at all, [...] should not be omitted from the appraisal but formally stated as potential benefits"* (Ashford *et al.*, *op. cit.*: 250). A possible solution for managing strategic projects lies in a trade off between quantitative and qualitative assessments. This study, however, focuses attention on the former.

4.3 – Core Findings

This section presents the findings from the core (questionnaire based) investigation and the follow-up interviews. It is divided into three parts: (1) univariate and bivariate analyses; (2) multivariate analysis; and (3) qualitative analysis.

The univariate and bivariate analyses broadly describe the overall sample. Sub-samples according to a firm's size are also examined. Multivariate analysis investigates the relationship between groups of elements involved in strategic project evaluation and control and four levels of a strategic project's success. For both parts the statistical package SPSS version 8.0 was used. Finally, the qualitative analysis part discusses the questionnaire's open-ended questions.

4.3.1 – Univariate and Bivariate Analyses

This section is basically organised according to the structure of the questionnaire. In each section, the characteristics of the items of measurement (percentages, means, standard deviations and confidence intervals), correlation matrices (Spearman's correlation indexes), and difference of means (t-test) based on the overall sample are presented. Sub-samples according to a firm's size are also examined.

Nevertheless, it is important to note that some variables[1] may be skewed. The mean and standard deviation can be misleading measures for these variables. The median and range should, therefore, also be presented. In order to compare skewed to non-skewed variables, the mean and standard deviation are presented in tables. The median and range of the skewed variables are presented in Appendix V. Spearman's correlation indexes complement the discussion of the results, and are presented in Appendix VI. In the current study highly correlated variables have a correlation index of at least 0.66; medium correlated variables have a correlation index between 0.65 and 0.33; and weakly correlated variables have a correlation index of less than 0.32.

The discussion relating to the various sections of the questionnaire is preceded by general information on the questionnaire, including the (1) sample size; (2) unit of analysis; (3) questionnaire's reliability; and (4) demographic data, as seen in the following.

---

[1] The term variable refers to item of measurement (univariate analysis, bivariate analysis and factor analysis) and to variable (multiple regression models).

Sixty questionnaires were returned out of seventy-four questionnaires sent out to nominated respondents. The final sample size includes fifty-four valid questionnaires[2]. The reasons for the exclusion of six questionnaires are the following: (1) one questionnaire was received after the beginning of the data analysis; (2) one questionnaire contained more than 50% of missing values; and (3) four questionnaires persistently presented a high number of outliers and extreme values for univariate (single item of measurement), and multivariate (groups of items of measurement involved in a specific section of the questionnaire) analyses. These observations could impact the overall analysis, but they were removed from the sample, as it was not possible to check whether they were representative of the population. Nevertheless, no pattern could be observed to these observations.

Prior to the selection of the sample size, an analysis of missing data was conducted. Among the fifty-eight questionnaires analysed, twenty-nine questionnaires were complete. Nineteen questionnaires had less than 5% of missing values, and the remaining slightly exceeded 5% of missing values.

Part of the missing values found in the incomplete questionnaires was not influential, as they involved censored data. Censored data *"[...] are incomplete in a systematic and known way"* (Hair *et al.,* 1997: 36) and operate at random (*ibid.*). Censored data in this study are presented in the following. First, in some questions there was an option called "don't know", which, for statistical purposes, is considered to be a missing value. Second, in Section 4, respondents said that they were not fully, or just partly, involved in the control of strategic projects and, consequently, they did not

[2] In this study, questionnaires are also called observations or cases.

answer the whole section, or a significant part of it. Finally, one respondent openly refused to answer some questions. Censored data are considered, therefore, '*ignorable*' (random) missing data (*ibid.*). Missing data, including censored data, involved only 6% of the overall data.

Here, with the exception of censored data, no pattern can be observed to the missing data. It appears that respondents simply ignored some questions, and, therefore, missing data might be considered random.

Finally, although the current sample involved fifteen companies each with multiple respondents, three of these companies had a significant number of respondents compared to the remaining companies. As a result, it was appropriate to check whether the respondents from these three companies would have an impact on the results of the overall sample. Chi-square test was applied to examine whether there were statistically significant differences between the group of three companies and the group of remaining companies. In the analysis carried out with thirteen results, only two of them (15%) differed statistically, which does not represent an expressive number. In general terms, this study assumes that the current sample is not influenced by any of the surveyed companies.

The following paragraphs discuss the unit of analysis of this questionnaire, which is the strategic project. As a result, it is possible to receive multiple questionnaires from the same company. This increased the potential sample size, as there are only thirty-one leading UK upstream oil and gas companies. A careful visual analysis of the questionnaires was carried out. The questionnaires received from a single company seemed to be independent observations in the vast majority of cases, *i.e.* these questionnaires addressed different strategic projects. Furthermore, apart from Section 1, the other sections of the questionnaire referred to general questions about strategic project management and, therefore, did not rely on the data of the last strategic project undertaken. Hence, the requirement for independent observations was fulfilled.

The next paragraphs discuss the questionnaire's reliability. Prior to this, Table 4.10 presents the reliability index (Cronbach Alpha) for the overall questionnaire and each section. For details see Appendix II ("Questionnaire").

TABLE 4.10 – QUESTIONNAIRE'S RELIABILITY

Section / Questionnaire	Cronbach Alpha (%)	Number of Cases	Number of Items
Section 1 (Excluding strategic project's categories)	65	43	10
Section 1A (Investment Climate)	61	52	7
Section 1B (Management of Last Strategic Project)	65	45	3
Section 3 (Evaluation elements)	89	38	50
Section 4 (Control elements)	89	39	50
Section 5A (Strategic project management in general terms)	67	50	3
Section 5B (General statements on strategic project management	5	51	5
Questionnaire (Excluding strategic project's categories and section 5B)	95	24	113

The overall reliability of the questionnaire was extremely high (95%). According to Spector (1994), the large number of analysed items might have contributed to an increase to the questionnaire's reliability. Section 2 contained only dichotomous items of measurement and, therefore, a reliability index was not applicable. Sections 3 and 4 had high reliability indexes, despite the large number of items. Sections 1 and 5A had individually acceptable reliability indexes; according to Hair *et al.* (1997), for exploratory questionnaires, a reliability index should exceed 60%. In Section 1 the list of categories of strategic projects was not considered in the calculation, as it was a forced-option question to classify strategic projects.

Section 5B had an extremely low reliability index. The questions involved in this section were controversial, mobilising as they did to the respondents' opinions. There are likely reasons for Section's 5B extremely low reliability index. First, a single respondent answered several questions with high scores and answered a few more questions with low scores. At the same time, the respondents overall answered the same questions with very different scores. Many sensitivity analyses, by for instance removing some of the questions, were employed to increase its reliability index without success. As a result, the information provided by Section 5B was only used qualitatively.

Finally, prior to the discussion of the results, Table 4.11 presents overleaf a summary of the demographic data of the sample under examination. The sample consists of a multidisciplinary, male group of middle managers, with a long-term experience in the field, a long-term job commitment, and a short-term international managerial experience, who work for a wide range of big, medium and small integrated, international plc's UK-resident oil and gas affiliates.

TABLE 4.11 – DEMOGRAPHIC DATA

Item		Value
Number of mailed (nominated) questionnaires		74
Length of the questionnaire		10 pages
Number of received questionnaires		60
Sample size (Valid observations) (*)		54
Response rate (Valid observations)		73%
Population of UK leading upstream oil and gas companies		31
Number of companies surveyed		15
Company response rate		48%
Number of big companies surveyed (**)		3
Number of medium companies surveyed (**)		7
Number of small companies surveyed (**)		5
Number of respondents from big companies (*)		13
Number of respondents from medium companies (**)		23
Number of respondents from small companies (**)		16
Proportion of male : female respondents		84%:16%
Proportion of respondents with doctoral degree		22% (all male)
Proportion of top managers : middle managers : lower managers (***)		13%:73%:10%
Number of respondents in each position (*)	Director	8
	Exploration Manager	6
	Engineering & Technology Manager	5
	Corporate & Strategic Planning Manager	5
	Commercial & Legal Manager	5
	Project Manager	4
	Senior Analyst	4
	Operations Manager	4
	New Ventures Manager	3
	Development Manager	3
	Prospect Inventory Manager	2
	Asset Manager	1
	Human Resource Manager	1
Average period working in the field		17.8 years
Average period working in the company		11.9 years
Average period working in the position		2.5 years
Proportion of respondents with international managerial experience		73%
Average period of international managerial experience		5.4 years
Proportion of respondents from plc's : limited companies		65%:35%
Proportion of respondents from affiliates : parent companies		67%:33%
Proportion of respondents from integrated : non-integrated companies		71%:29%
Proportion of respondents from international : national companies		95%:5%

(*) Two respondents were anonymous (3.7% of the sample) and three did not inform their position (5.6% of the sample)

(**) **Big:** Turnover greater than £1.0 Billion (B) and/or more than 2,000 employees.
Medium: Turnover between £200 Million (M) and £1.0 B and/or number of employees between 300 and 2,000.
Small: Turnover less than £200 M and/or less than 300 employees

(***) 4.0% of the respondents were not included in any of the management levels.

4.3.1.1 – Univariate and Bivariate Analyses of Section 1 of the Questionnaire

This section discusses the findings of Section 1 of the questionnaire (for details see Appendix II, "Questionnaire"). It is divided into three parts: (1) the last strategic project's categories; (2) the investment climate during the management of the last strategic project; and (3) the last strategic project's degree of success. Each part presents the scale of measurement (if applicable), the results, and comments on the results. Spearman's correlation indexes complement, when necessary, the univariate analysis. Tables with the correlation indexes are fully presented in Appendix VI.

Table 4.12 presents the last strategic project's categories, which results are following discussed.

TABLE 4.12 – LAST STRATEGIC PROJECT'S CATEGORIES

Category	Participation (%)
Marginal Field Development (1)	31.5
Giant Field Development (1)	20.4
Asset Disposal	11.1
Field Exploration	9.3
Company Acquisition / Merger (2)	9.3
Infrastructure	5.6
Market Entry / Re-entry (2)	3.8
Corporate Information System (2)	1.8
Technology Research and Development (2)	1.8
Asset Acquisition (2)	1.8
Organisational Restructuring (2)	1.8
Strategic Alliance (2)	1.8

1. Field development often includes infrastructure and gas utilisation and usually considers joint ventures, partnerships and strategic alliances. One case also considers employee capability programme and another case considers company merger.
2. These categories are associated with "high" strategic projects and represent approximately 22% of the examined projects. It seems to be an excellent proportion of the underlying strategic projects, as these projects often represent a small proportion of a company's projects portfolio and usually involve inside information.

According to the last table, 78% of the examined strategic projects represent the core business and are taken to be those projects that enclose strategic features. The remaining projects are those associated with the top management level, which usually involve inside information.

The above categories of strategic projects give some indications of the current trends in the UK upstream oil and gas sector. First, the UK upstream oil and gas sector is a mature province with a lack of new opportunities (43% of the projects refer to marginal field developments and asset disposals). Second, companies seek new opportunities in the UK province and mainly in new markets, through joint ventures, partnerships and strategic alliances (43% of the projects refer to market entry/re-entry, strategic alliance, asset acquisition, field exploration, giant field development and infrastructure). Finally, companies follow a global trend of cost reduction, re-engineering and introduction of new information technologies (14% of the projects refer to organisational restructuring, corporate information system, and company acquisitions and mergers).

The following paragraphs discuss the investment climate during the management of the respondents' last strategic project. Prior to this, the scale used for measuring the investment climate during the management of the last strategic project and the overall results (Table 4.13) are presented overleaf.

Scale of Measurement: Investment Climate during the Management of the Last Strategic Project				
Industry's economic situation	1	Recessive	5	Expansive
Oil price	1	Low	5	High
Your firm's financial situation	1	Poor	5	Excellent
Your firm's market position	1	Weak	5	Strong
Strength of competition in the industry	1	Low	5	High
Your firm's attitude towards risk	1	Conservative	5	Innovative
Your firm's decision-making style	1	Directive	5	Consensus-driven

TABLE 4.13 – INVESTMENT CLIMATE IN THE MANAGEMENT OF THE LAST STRATEGIC PROJECT

Item of Measurement	Mean	SD
Industry's economic situation	2.58 (2.35-2.80)*	.80
Oil price	2.57 (2.31-2.84)*	.98
Firm's financial situation	3.13 (2.83-3.43)*	1.08
Firm's market position	3.07 (2.79-3.35)*	1.03
Strength of competition in the industry	3.61 (3.38-3.84)*	.83
Firm's attitude towards risk	2.74 (2.43-3.06)*	1.15
Firm's decision-making style	3.17 (2.85-3.48)*	1.15

(*) Lower and upper bounds of 95% confidence interval for mean

According to the table above, there is a picture of a recessive, highly competitive sector associated with low oil prices. According to the respondents, surveyed companies are extremely diverse. On average, companies have a healthy financial situation (30% of them have a poor financial situation and 43% of them have an excellent financial situation). They have an intermediary market position, with three well-defined groups: weak, intermediate and strong market position, a neutral (tending to conservative) attitude towards risk, and an intermediary (tending to consensus-driven) decision-making style.

There is a high correlation between a firm's financial situation and its market position. Firms with strong market position (big companies) tend to have a healthy financial situation. There is a medium correlation between oil prices and the industry's economic situation. When the industry is under expansion, oil prices are at a high level. Finally, in the period of analysis of the respondent's last strategic project, the industry's economic situation was medium correlated with market position. In an expansive economic situation, firms tend to be stronger in the market.

The following paragraphs discuss the degree of success of the last strategic project. Prior to this, the scale used for measuring the last strategic project's degree of success and the overall results (Table 4.14) are presented.

Scale of Measurement: Last Strategic Project's Degree of Success				
1: Strongly Disagree	2: Disagree	3: Indifferent	4: Agree	5: Strongly Agree

TABLE 4.14 – LAST STRATEGIC PROJECT'S DEGREE OF SUCCESS

Item of Measurement	Mean	SD	Description
Successfully completed (*i.e.* goals and results were successfully attained)	3.88 (3.60-4.16)*	.98	Successful completion (14% unsuccessful – scores 1 and 2, and 74% successful – scores 4 and 5)
Financially successful	3.80 (3.45-4.16)*	1.19	Financially successful (22% unsuccessful – scores 1 and 2, and 70% successful – scores 4 and 5)
Successful for strategic (*i.e.* non-financial) reasons	4.00 (3.75-4.25)*	.87	Successful for strategic reasons (4% unsuccessful – scores 1 and 2, and 78% successful – scores 4 and 5)

(*) Lower and upper bounds of 95% confidence interval for mean

According to Table 4.14, the respondents claim that their last strategic projects were successfully completed, *i.e.* goals and results were satisfactorily achieved. Last strategic projects were both financially successful and successful for strategic reasons. However, 22% of the respondents considered their last strategic projects financially unsuccessful, mainly due to low oil prices.

In the management of their last strategic projects, there was a medium correlation between its successful completion and its financial success, between its successful completion and its success for strategic reasons, and between its financial success and success for strategic reasons. It appears that a successful strategic project management results from the combination of successful completion, financial success and success for strategic reasons, which each one having an impact on the other. As observed by some of the respondents, the low oil prices in recent years covered by the research had a significant impact on the completion and the financial results of the last strategic projects.

4.3.1.2 – Univariate Analysis of Section 2 of the Questionnaire

The following part of this section discusses the findings of Section 2 of the questionnaire regarding the level of awareness and use of techniques in managing strategic projects. Prior to this, two relevant issues must be highlighted here. First, the techniques listed in the questionnaire were comprehensive, but by no means exhaustive. This list was based on an extensive literature review and validated during the questionnaire piloting. Respondents also included additional techniques, which were excluded from the original list, but they are used in managing strategic projects.

Second, techniques were listed separately in the questionnaire. However, according to Chapman and Howden (1997), respondents could have associated, for instance, risk analysis with a wide range of application areas, probably in the context of risk management processes, which comprises a group of techniques, such as sensitivity analysis, discounting procedures in various forms (*e.g.* NPV, IRR, payback period), and decision-tree analysis. Nevertheless, interviewees agreed with a list of separate techniques during the exploratory fieldwork. Any difference between techniques definition used in this research project and techniques definition understood by questionnaire participants was mitigated during the questionnaire piloting, through interviews with a restricted number of managers. As a result, follow-up interviews were carried out after the questionnaire administration to feedback on the eventual lack of understanding of the techniques.

The following analysis is divided into two parts: (1) the proportion and level of managerial of awareness of techniques; and (2) the proportion and level of managerial use of techniques in general terms. The results of the follow-up interviews complement the analysis. A table on the level of managerial use of techniques in general terms, conditional to managerial awareness, is compared to the tables on the level of managerial awareness and the use of techniques in general terms.

The following paragraphs discuss the proportion and level of awareness of techniques for managing strategic projects. Prior to the discussion, the overall results are displayed on Table 4.15 overleaf.

TABLE 4.15 – PROPORTION AND LEVEL OF AWARENESS OF TECHNIQUES

Technique	Proportion of Managerial Awareness (%)	Level of Managerial Awareness
1. Return on Investment (ROI) Payback Period Internal Rate of Return (IRR) Net Present Value (NPV) Sensitivity Analysis	100	Extremely High
2. Net Income Risk Analysis	96 (91-100)*	
3. Decision-Tree Analysis	94 (88-100)*	
4. Cost-Benefit Analysis	93 (86-100)*	
5. Forecasting	89 (81-97)*	
6. Scenario Analysis	87 (78-96)*	
7. Risk-Adjusted NPV	85 (76-94)*	
8. Simulation	82 (72-92)*	
9. Scheduling (*e.g.* PERT-CPM)	76 (65-87)*	High
10. Financial Performance Monitoring (*e.g.* ROI over time)	74 (62-86)*	
11. Capital Rationing	72 (60-84)*	
12. Contingency Analysis	67 (54-80)*	
13. Optimisation	60 (47-73)*	
14. Activity-Based Costing	54 (41-67)*	Average
15. Manpower Rationing	51 (38-64)*	
16. Economic Value Added	47 (34-60)*	
17. Real Options Game Theory	43 (30-56)*	
18. Leveraged NPV	39 (26-52)*	Low
19. Balanced Scorecard Utility Function	38 (25-51)*	
20. Intellectual Capital	25 (13-37)*	
21. Cognitive Mapping	17 (7-27)*	Extremely Low
22. Human Resource Accounting	11 (3-19)*	

(*) Lower and upper bounds of 95% confidence interval for proportion

According to the table above, respondents have a high, and at least average, level of awareness of, respectively, 62% and 79% of the listed techniques.

Almost all of the respondents are aware of ROI, net income, payback period, IRR and NPV, as claimed by Barwise *et al.* (1989), Stewart (1994), Buckley and Tse (1996) and Slater *et al.* (1998), as well as sensitivity analysis and cost-benefit analysis.

However, they are either unfamiliar or extremely unfamiliar with, respectively, leveraged NPV and human resource accounting (HRA). These techniques seem to be associated with specific groups of managers or situations.

Respondents are well aware of techniques that incorporate uncertainty, namely risk analysis, decision-tree analysis, forecasting, scenario analysis, risk-adjusted NPV and simulation. However, although respondents are highly aware of contingency analysis, they are less aware of this than other similar techniques, such as forecasting and scenario analysis.

Respondents are highly aware of some techniques that deal with some extent of mathematical complexity, such as scheduling, financial performance monitoring and capital rationing. However, they are only fairly aware of optimisation, Activity-Based Costing (ABC) and manpower rationing.

The majority of the respondents is not fully familiar with complex or recently developed techniques, as claimed by Slater *et al.* (1998), such as Economic Value Added (EVA), Real Options, Game Theory, Balanced Scorecard and Utility Function. An insignificant number of respondents are aware of Cognitive Mapping and Intellectual Capital. The latter is a recently developed knowledge-based technique. Respondents appear to be more aware of recently developed techniques that have a financial orientation.

The following paragraphs discuss the proportion and level of managerial use of techniques in general terms for managing strategic projects. Prior to the discussion, the overall results are displayed on Table 4.16 overleaf.

TABLE 4.16 – PROPORTION AND LEVEL OF USE OF TECHNIQUES IN GENERAL TERMS

Technique	Proportion of Managerial Use in General Terms (%)	Level of Managerial Use in General Terms
1. Net Present Value (NPV)	98 (94-100)*	Practically Always
2. Internal Rate of Return (IRR)	96 (91-100)*	
3. Sensitivity Analysis	91 (83-99)*	
4. Return on Investment (ROI)	87 (78-96)*	
5. Net Income	82 (72-92)*	
6. Payback Period	80 (69-91)*	
7. Forecasting	76 (65-87)*	Frequently
8. Risk Analysis	74 (62-86)*	
9. Risk-Adjusted NPV	65 (52-78)*	
10. Scheduling (*e.g.* PERT-CPM)	57 (44-70)*	Occasionally
11. Decision-Tree Analysis	56 (43-69)*	
12. Scenario Analysis Simulation	50 (37-63)*	
13. Cost-Benefit Analysis	43 (30-56)*	
14. Financial Performance Monitoring (*e.g.* ROI over time)	41 (28-54)*	
15. Contingency Analysis	33 (20-46)*	Rarely
16. Optimisation	32 (20-44)*	
17. Capital Rationing	28 (16-40)*	
18. Activity-Based Costing	17 (7-27)*	
19. Leveraged NPV Manpower Rationing Balanced Scorecard	9 (1-17)*	Practically Never
20. Economic Value Added Real Options	4 (0-9)*	
21. Intellectual Capital Human Resource Accounting	2 (0-6)*	
22. Cognitive Mapping Game Theory Utility Function	Nihil	

(*) Lower and upper bounds of 95% confidence interval for proportion

According to the table above, respondents have a frequent or at least an occasional use of, respectively, only 31% and 52% of the listed techniques.

Respondents nearly always use NPV, IRR, ROI, net income and payback period, as claimed by Barwise *et al.* (1989, Stewart (1994), Buckley and Tse (1996) and Slater *et* *al.* (1998), and sensitivity analysis. They frequently use some techniques that incorporate uncertainty, namely forecasting, risk analysis and risk-adjusted NPV.

However, respondents only occasionally use certain techniques, such as cost-benefit analysis, scenario analysis, decision-tree analysis, simulation, scheduling and financial performance monitoring.

Respondents rarely use optimisation, contingency analysis, capital rationing or ABC. They also virtually never use a wide range of techniques. These include leveraged NPV, HRA, manpower rationing, as claimed by Slater *et al.* (1998), and more recently developed or complex techniques (Balanced Scorecard, EVA, Real Options, Intellectual Capital, Game Theory, Utility Function and Cognitive Mapping).

Tables 4.15 and 4.16, previously presented, are based on the results of the questionnaire. However, despite the thorough literature review and the questionnaire piloting, it was appealing to clarify eventual ambiguities regarding the respondents' lack of familiarity with some techniques, and identify the reasons for not using these techniques. For this purpose, a number of follow-up telephone interviews were carried out with twenty-five respondents in March 2000. The respondents were randomly selected among those who had a level of unfamiliarity with at least one technique. Nevertheless, the level of unfamiliarity of some interviewees did not compromise the validity of the results of Section 2 of the questionnaire.

According to the interviews, the main reasons include (1) the unfamiliarity with the terminology (*i.e.* openness of the term, unawareness of the term or awareness of a different terminology); (2) the misunderstanding of the context of application (*i.e.* with what project category or management level the technique is associated); (3) lack of relevance of the technique (*e.g.* use at specific instances, difficult acceptance by top management or indirect/subjacent use); (4) lack of confidence in proper use of the technique (*i.e.* informal use); and (5) constraining one's awareness by a given example (in the questionnaire, examples of scheduling and progress measurement techniques were given and could have constrained some of the respondents' awareness of these techniques). The following paragraphs summarise the interviewees' reasons for their lack of familiarity with some techniques, and not using them.

Some interviewees also know scenario analysis as scenario planning. Some interviewees do not use scenario analysis on a regular basis, as it is usually applied at a corporate level, in specific instances. Some interviewees associated contingency analysis with contingency costs or contingency planning (*e.g.* costs of new discoveries), although the literature associates contingency analysis with contingency scenario analysis, *i.e.* a base and a contingency scenario. Some interviewees needed to understand the context (*e.g.* project level, corporate level) in which forecasting was used.

Interviewees commonly understood risk-adjusted NPV as the expected NPV, *i.e.* weighting NPVs by different probabilities of occurrence. Interviewees appear to associate it with expected monetary value, an outcome from decision-tree analysis, which is often used for exploration projects. None of the interviewees considered risk-adjusted NPV as the NPV discounted at a project's risk-adjusted rate. Cost-benefit analysis is considered a technique used in specific parts of a project.

Some interviewees needed to understand the context (*e.g.* reservoir, pipeline or financial modelling) in which simulation was used. Although simulation is usually associated with technical modelling and risk analysis with financial modelling, interviewees sometimes considered simulation similar to risk analysis.

Some interviewees did not consider PERT-CPM the best example of scheduling, as they seem to be more aware of Gantt charts. Other interviewees were not completely confident in formally using scheduling techniques. Nor did some interviewees consider ROI over time as the best example for financial performance monitoring, as they seem to be more aware of return on capital employed (ROCE) than ROI. Many interviewees were not completely confident on formally using financial performance monitoring and do not use it on a regular basis, as it is usually applied on a corporate level.

Some interviewees consider optimisation in two different ways. First, it is seen as a way of optimising (or re-engineering) the technical side of a project in order to reduce costs (*e.g.* facility design, field development). Second, it is considered as a means of portfolio management upgrading via project interaction, *i.e.* to find out the most effective use of capital that generates the optimal outcomes (*e.g.* exploration planning, exploration prospects ranking via risk-reward approach).

Some interviewees were unfamiliar with capital and manpower rationing. They also appear to use them informally. Interviewees were unfamiliar with recently developed or complex techniques, such as Balanced Scorecard, real options, EVA, game theory, utility function, cognitive mapping, Intellectual Capital and HRA. Intellectual Capital is occasionally known as knowledge management.

Finally, interviewees were not ambiguous about such techniques as summary measures (*e.g.* net income, ROI, NPV, IRR, payback period), sensitivity analysis, decision-tree analysis and risk analysis.

The follow-up interviews motivated the investigation as to the extent that techniques were used by those aware of them. The first step is to calculate the proportion of respondents who are simultaneously aware and use each technique. Both scales of measurement (managerial awareness of techniques and use of techniques in general terms) can be summated, as they are considered objective, related to each other and categorically consistent. For instance, 96% of the respondents are aware of risk analysis and 74% of them use it in general terms. As a result, 71% (0.96*0.74) of the respondents are aware and use it in general terms. The same procedure was carried out to the remaining techniques. In this case, if a respondent ticked the box "awareness", he/she was really aware of the technique. However, when he/she did not tick that box, he/she could be doubtful as to whether he/she was aware of the technique. Therefore, only the respondents that were aware of the technique were considered to take part in the analysis.

The second step is to calculate the level of managerial use of techniques in general terms, conditional to the respondents' level of awareness. For instance, 96% of the respondents were aware of risk analysis and 74% of them used it in general terms. As a result, 77% (0.74/0.96) of the respondents used it in general terms, conditional to their level of awareness. The same procedure was carried out to the remaining techniques. This procedure corrects an eventual distortion originated from doubtful respondents.

The final step compares the results of steps 1 and 2, and examines whether there are any changes of level of awareness and use between them. Some interesting findings arise from the above procedure. First, forecasting may be seen as the technique that addresses uncertainty with the highest level of use among those respondents who were aware of it, even higher than the payback period. Second, scheduling, comparing to other techniques that deal with some degree of mathematical complexity, is the only technique with a high level of use among those respondents who were aware of it. Finally, the Balanced Scorecard seemed to be a technique in ascendancy among those respondents who were aware of it. It was the only recently developed technique that did not present an insignificant managerial level of use conditional to the level of awareness.

4.3.1.3 – Univariate and Bivariate Analyses of Sections 3 and 4 of the Questionnaire

This section discusses the results of Sections 3 and 4 of the questionnaire (for details see Appendix II, "Questionnaire"). Prior to the discussion of these findings, some relevant general information is presented. All elements involved in evaluating and controlling strategic projects are described in statistical terms. However, the reliability and construct validity of groups of items of measurement are only tested in Section 4.3.2.1 ("Factor Analysis").

Sections 3 and 4 present, respectively, tables for evaluation and control elements, according to their level of relevance and the extent of addressing them in practice. These tables display respectively the mean (including a 95% confidence interval for mean) and standard deviation of each element's level of relevance and the extent of addressing it in practice.

Two scales were employed, respectively, to (1) measure a respondent's subjective (personal) opinion on level of relevance of each element; and (2) measure the extent to which a respondent objectively addresses, in general terms, each element in practice. The scales are categorically different and might be not summated. Here they are presented, as follows.

Scale of Measurement: Level of Relevance of Each Element				
1: Absolutely Irrelevant	2: Irrelevant	3: Indifferent	4: Relevant	5: Absolutely Relevant
Scale of Measurement: Extent of Addressing Each Element				
1: Never Addressed	2: Rarely Addressed	3: Occasionally Addressed	4: Frequently Addressed	5: Always Addressed

Finally, Spearman's correlation indexes for each group of elements complement, when necessary, the univariate analysis. Tables with the correlation indexes are fully presented in Appendix VI.

This section now presents the findings of Section 3 of the questionnaire. It includes the results, and comments on the results, for each group of evaluation elements. These elements are divided into evaluation process elements (characteristics, financial evaluation elements, internal evaluation elements and external evaluation elements) and evaluation outputs.

The characteristics of a strategic project are the first group of process elements. Prior to the discussion of the results, Table 4.17 presents overleaf the main characteristics of the distribution and confidence interval for mean.

TABLE 4.17 - STRATEGIC PROJECT'S CHARACTERISTICS

Strategic Project's Characteristic	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Feasibility	4.61[a] (4.46-4.76)*	.56	4.22 (3.98-4.47)*	.90
Timescale	4.39 (4.20-4.58)*	.68	4.33[a] (4.11-4.56)*	.82
Durability	4.20 (3.95-4.45)*	.92	4.15 (3.91-4.40)*	.89
Flexibility	3.85 (3.62-4.08)*	.83	3.37 (3.09-3.65)*	1.01

a. Skewed items of measurement. See Appendix V for medians and ranges.

(*) Lower and upper bounds of 95% confidence interval for mean

According to the table above, feasibility is the most relevant characteristic and timescale is the one most frequently addressed. Although flexibility is considered a relevant characteristic, it is only occasionally addressed in practice. It is the least relevant and addressed characteristic. Although 69% of the respondents consider it relevant or absolutely relevant, only 45% of them frequently or always address it. Respondents might not know how to address flexibility.

Financial evaluation elements are the second group of process elements. Prior to the discussion of the results, Table 4.18 presents overleaf the main characteristics of the distribution and confidence interval for mean.

TABLE 4.18 - FINANCIAL EVALUATION ELEMENTS

Financial Evaluation Element	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Time	4.70[a] (4.55-4.85)*	.54	4.55[a] (4.31-4.79)*	.87
Financial Market Uncertainty	4.63[a] (4.42-4.84)*	.76	4.32[a] (4.02-4.63)*	1.11
Financial Capability	4.28 (4.02-4.53)*	.94	3.94 (3.63-4.26)*	1.15
Financial Leverage	3.37 (3.05-3.68)*	1.14	3.10 (2.78-3.42)*	1.13

a. Skewed items of measurement. See Appendix V for medians and ranges.
(*) Lower and upper bounds of 95% confidence interval for mean

According to the table above, time is the financial evaluation element which respondents consider the most relevant and that is most frequently addressed in practice. Financial market uncertainty is the next one.

Although 74% of the respondents consider financial capability a relevant or absolutely relevant element, 34% of them never, rarely or only occasionally address it. Respondents are indifferent as to financial leverage. It is the least relevant and addressed financial evaluation element. Respondents consider it relevant for new business opportunities, as funding is regularly available for attractive investment opportunities and therefore they do not need to seek external funding. 60% of the respondents consider financial leverage irrelevant, absolutely irrelevant or are indifferent about it, and 72% of them never, rarely or only occasionally address it.

Financial capability and financial leverage are medium correlated in terms of relevance and the extent to which they are addressed. Therefore, they seem to be complementary financial evaluation elements.

External evaluation elements are the third group of process elements. Prior to the discussion of the results, Table 4.19 presents the characteristics of the distribution, and confidence interval for mean.

TABLE 4.19 - EXTERNAL EVALUATION ELEMENTS

External Evaluation Element	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Geological Uncertainty	4.83[a] (4.67-5.00)*	.61	4.76[a] (4.61-4.91)*	.55
Environmental Uncertainty	4.09 (3.85-4.34)*	.90	3.69 (3.39-3.98)*	1.08
Technological Uncertainty	3.92 (3.70-4.15)*	.83	3.79 (3.49-4.10)*	1.10
Economic Uncertainty	3.67 (3.41-3.92)*	.93	3.48 (3.19-3.78)*	1.08
Political Uncertainty	3.63 (3.35-3.91)*	1.01	3.26 (2.92-3.60)*	1.23
Competition	3.33 (3.02-3.64)*	1.12	3.27 (2.94-3.60)*	1.19
Social Uncertainty	2.66 (2.38-2.94)*	1.02	2.45 (2.16-2.74)*	1.05

a. Skewed items of measurement. See Appendix V for medians and ranges.
(*) Lower and upper bounds of 95% confidence interval for mean

According to the table above, geological uncertainty is the most relevant and frequently addressed external evaluation element, followed by environmental and technological uncertainties. Geological uncertainty is the core technical uncertainty of the upstream oil and gas sector.

Environmental (green) uncertainty has gradually become an important source of uncertainty in the upstream oil and gas sector due to an increasing influence of pressure groups. In the UK, environmental (green) issues represent a key topic and seem to be solidly established within oil and gas companies. Although 76% of the respondents consider environmental uncertainty as being relevant or absolutely relevant, 41% of them never, rarely or only occasionally address it.

Technological uncertainty is a fundamental source of uncertainty in a sector highly dependent on technological change. New technologies are a means of making opportunities technically feasible. Although 70% of the respondents consider it relevant or absolutely relevant, 38% of them never, rarely or only occasionally address it. Geological, environmental and technological uncertainties represent the triad of relevant technical uncertainties in the upstream oil and gas sector.

Some interesting correlations emerge here. First, environmental uncertainty is medium correlated with competition in terms of level of relevance. In highly competitive environments, environmental uncertainty seems to be more crucial. Companies tend to be more aware of environmental (green) issues in competitive environments, most likely to obtain and sustain a distinguished image from customers and society. Second, technological uncertainty is medium correlated with economic uncertainty in terms of the extent to which they are addressed. In expansive economic conditions, technological uncertainty seems to be more relevant.

Economic uncertainty is the next important external evaluation element, but it is occasionally addressed. 57% of the respondents consider economic uncertainty relevant or absolutely relevant. However, 50% of them never, rarely or only occasionally address it in practice.

Political uncertainty has been considered by theorists as an important source of uncertainty in the contemporary business world. McGrath (1999) states that the elimination of political uncertainty ideally allows for the elimination of uncertainty as a whole. 59% of the respondents consider political uncertainty relevant or absolutely relevant. However, 56% of them never, rarely or only occasionally address it in practice. Political and economic uncertainties seem not to be crucial because of the UK stable political and economic environment.

Some further interesting correlations emerge. First, in terms of level of relevance, economic and political uncertainties are medium correlated with social uncertainty. In terms of the extent to which they are addressed in practice, economic and political uncertainties are, respectively, medium and almost highly correlated with social uncertainty. Political, economic and social uncertainties represent the triad of external uncertainties. In terms of both level of relevance and the extent to which they are addressed in practice, political uncertainty is medium correlated with competition. In highly competitive environments, political uncertainty seems to be more crucial.

Although the last strategic project's investment climate indicates a highly competitive UK upstream oil and gas sector, respondents are generally indifferent to competition. This appears to be an appealing finding. Possible reasons for this include (1) the historical partnerships in the sector; (2) the segmentation of the market among the existing companies; (3) the high number of current mergers and acquisitions in the sector and the fear of the respondents to discuss the issue; (4) the lack of interest (and potential) of medium and small companies to compete with the big ones; and (5) the inability of the respondents to address competition. While 56% of the respondents consider competition irrelevant, absolutely irrelevant, or are indifferent to it, 58% of them never, rarely or occasionally address it in practice.

Finally, social uncertainty is the least relevant and addressed external evaluation element: only 17% consider it relevant or absolutely relevant, and 18% frequently or always address it in practice. Likely reasons for this include the historical lack of commitment between upstream oil and gas companies with customer behaviour, and the focus of this research on the UK market. The sector appears to be highly attached to financially orientated decisions.

Internal evaluation elements are the fourth group of process elements. Prior to the discussion of the results, Table 4.20 presents the characteristics of the distribution and confidence interval for mean.

TABLE 4.20 - INTERNAL EVALUATION ELEMENTS

Internal Evaluation Element	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Corporate Alignment	4.57[a] (4.40-4.75)*	.63	4.19 (3.94-4.43)*	.91
Competency Alignment	4.12 (3.90-4.33)*	.78	3.75 (3.46-4.04)*	1.03
Interdependency	3.92 (3.68-4.17)*	.87	3.49 (3.21-3.77)*	1.01

a. Skewed item of measurement. See Appendix V for median and range.
(*) Lower and upper bounds of 95% confidence interval for mean

According to the last table, corporate alignment is the most relevant and frequently addressed internal evaluation element, followed by competency alignment. In general terms, although respondents consider internal evaluation elements to be relevant, they have some difficulty in addressing competency alignment and interdependency in practice.

Evaluation outputs are the last group of evaluation elements. Prior to the discussion of the results, Table 4.21 presents the characteristics of the distribution and confidence interval for mean.

TABLE 4.21 - EVALUATION OUTPUTS

Evaluation Output	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Cash Flows	4.54[a] (4.31-4.77)*	.84	4.41[a] (4.15-4.66)*	.94
Financial Summary Measures	4.40[a] (4.12-4.67)*	.94	4.31[a] (4.03-4.59)*	.97
Environmental Impact	4.24[a] (3.99-4.49)*	.91	4.11 (3.84-4.38)*	.98
Organisational Impact	3.83 (3.60-4.06)*	.84	3.42 (3.14-3.69)*	.99
Political Impact	3.42 (3.10-3.73)*	1.15	3.19 (2.89-3.49)*	1.09
Market Share	3.31 (3.00-3.62)*	1.10	3.12 (2.82-3.41)*	1.05
Social Impact	2.81 (2.52-3.10)*	1.04	2.68 (2.38-2.98)*	1.09

a. Skewed items of measurement. See Appendix V for medians and ranges.
(*) Lower and upper bounds of 95% confidence interval for mean

According to the above table, cash flows are the most relevant and frequently addressed evaluation output, followed by financial summary measures and environmental impact. Cash flows and financial summary measures are medium correlated both in terms of level of relevance and the extent to which they are addressed in practice. These are traditional relevant evaluation outputs in the upstream oil and gas sector, which are emphasised by the current wave of shareholder power reinforcement, as observed by Oyon and Mooraj (1999).

Financial summary measures are medium correlated with organisational impact in terms of the extent to which they are addressed. Financial outcomes appear to impact the organisation and vice-versa.

Environmental (green) impact has become a requirement for upstream oil and gas companies to survive in the event of the strictest regulations, pressure groups and a more demanding, conscious society. Environmental impact is medium correlated with political impact and social impact in terms of the extent to which they are addressed in practice.

Organisational impact is a relevant evaluation output, but only occasionally addressed. Respondents seem to find difficult to address it in practice. Organisational impact is medium correlated with market share in terms of the extent to which they are addressed in practice. Being an internally capable company seems to affect its market position positively.

Respondents are almost indifferent to political impact, and only occasionally address it. 59% of the respondents consider political impact relevant or absolutely relevant and 50% of them frequently or always address it. Political impact seems to have higher importance in many overseas projects.

Respondents are indifferent (43% consider relevant or absolutely relevant) to, and only occasionally address (35% frequently or always address) market share. They claim that only extremely large scale projects could have an impact on market share. The lack of sufficient attention paid to market share fits with the lack of sufficient attention paid to competition. Market share is medium correlated with social impact, both in terms of the level of relevance and the extent to which they are addressed in practice. Being concerned about society may affect a firm's market share positively.

Finally, social impact is the least relevant and addressed evaluation output. Only 25% of the respondents consider it relevant or absolutely relevant, and only 17% frequently or always address it in practice. A likely reason for this is the sector's historical lack of commitment to society and externalities. The sector seems to be highly attached to a financially orientated decision making process.

This chapter now discusses the findings of Section 4 of the questionnaire. It includes the results, and comments on these, for each group of control elements. These elements are divided into control process elements (financial control elements, internal control elements and external control elements) and control outputs. In the questionnaire the learning & innovation control elements, suggested by the proposed framework, were considered to be internal control elements.

Financial control elements are the first group of process elements. Prior to the discussion of the results, Table 4.22 presents the characteristics of the distribution and confidence interval for mean.

TABLE 4.22 - FINANCIAL CONTROL ELEMENTS

Financial Control Element	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Budgetary Constraints	4.52[a] (4.30-4.74)*	.74	4.42[a] (4.17-4.66)*	.85
Financial Market Scanning	3.98 (3.67-4.29)*	1.09	3.82 (3.51-4.12)*	1.07

a. Skewed items of measurement. See Appendix V for medians and ranges.
(*) Lower and upper bounds of 95% confidence interval for mean

According to the last table, budgetary constraints are the most relevant and frequently addressed financial control element. According to the respondents, there is usually a persistent dispute regarding corporate budget. Financial market scanning is also a relevant and frequently addressed control element. However, although 67% of the respondents consider financial market scanning relevant or absolutely relevant, 43% of them never, rarely or only occasionally address it in practice.

External control elements are the second group of process elements Prior to the discussion of the results, Table 4.23 presents the characteristics of the distribution and confidence interval for mean.

TABLE 4.23 - EXTERNAL CONTROL ELEMENTS

External Control Element	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Environmental Scanning	4.14 (3.89-4.40)*	.89	3.94 (3.67-4.21)*	.94
Political Scanning	3.52 (3.23-3.81)*	.98	3.37 (3.06-3.68)*	1.04
Economic Scanning	3.31 (3.00-3.62)*	1.04	3.13 (2.82-3.45)*	1.06
Market Scanning	2.98 (2.65-3.30)*	1.08	2.82 (2.51-3.13)*	1.03

(*) Lower and upper bounds of 95% confidence interval for mean

According to the last table, environmental (green) scanning is the most relevant and frequently addressed external control element, followed by political scanning. There is, however, no statistically significant difference of means between environmental scanning and environmental uncertainty.

On average, respondents are indifferent to political and economic scanning, as they consider the UK political and economic environment stable. 50% of the respondents consider political scanning irrelevant, absolutely irrelevant or are indifferent to it. 54% of them never, rarely or only occasionally address it. 53% of the respondents consider economic scanning irrelevant, absolutely irrelevant or are indifferent about it. However, 67% of them never, rarely or only occasionally address it.

Respondents consider economic uncertainty more relevant (N=45, t=2.463, sig. 0.018) than economic scanning. However, there is no statistically significant difference of means between the extent to which economic scanning and economic uncertainty are addressed. There is also no statistically significant difference of means between political scanning and political uncertainty. Economic scanning and political scanning are medium correlated with market scanning, in terms of level of relevance and the extent to which they are addressed. The monitoring of competitors' activities and a company's image seem to be affected by economic and political situations.

Market scanning is the least relevant and addressed external control element. 33% of the respondents consider it relevant or absolutely relevant, and 25% frequently or always address it in practice. This finding fits with the lack of relevance of, and with how infrequently, competition and market share in the evaluation of strategic projects are addressed. Respondents do not focus overtly on cultural issues and customer behaviour, despite the recent increasing interest on cultural issues in managing overseas business opportunities. Possible reasons include the focus of this research project on the UK market and that the upstream segment's customer is the downstream segment, which has become part of the same company during the 1970s process of vertical integration. The sector seems to focus on partners and contractors instead.

Internal control elements are the third group of process elements. Prior to the discussion of the results, Table 4.24 presents the characteristics of the distribution and confidence interval for mean.

TABLE 4.24 - INTERNAL CONTROL ELEMENTS

Internal Control Element	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Project Milestones Scanning	4.50[a] (4.30-4.70)*	.68	4.31 (4.04-4.58)*	.93
Learning	4.35[a] (4.13-4.57)*	.76	3.63 (3.35-3.90)*	.96
Managerial Interaction	4.18 (3.94-4.42)*	.83	3.84 (3.57-4.10)*	.92
Resource Deployment	4.12 (3.88-4.36)*	.83	3.94 (3.71-4.17)*	.80
Innovative Technologies	3.96 (3.69-4.23)*	.92	3.60 (3.34-3.87)*	.92
Corporate Alignment Scanning	3.96 (3.65-4.26)*	1.05	3.56 (3.23-3.89)*	1.13
Product Monitoring	3.76 (3.43-4.09)*	1.10	3.72 (3.40-4.03)*	1.04
Innovative Routines	3.51 (3.17-3.86)*	1.18	3.00 (2.69-3.31)*	1.06

a. Skewed items of measurement. See Appendix V for medians and ranges.
(*) Lower and upper bounds of 95% confidence interval for mean

According to the above table, project milestones scanning is the most relevant and frequently addressed internal control element. It is medium correlated with resource deployment, learning, managerial interaction and innovative technologies in terms of level of relevance or the extent to which they are addressed in practice. Monitoring the deadlines of a strategic project seems to be more than simply controlling whether deadlines are met in expected cost, time and specification. It also needs managerial involvement, commitment and leadership, proper deployment of current resources and competencies, reviewing a strategic project based on experiential learning and redesigning it, if necessary.

Learning, managerial interaction and resource deployment are the next relevant internal control elements. Learning is medium correlated with managerial interaction and resource deployment, in terms of level of relevance or the extent to which they are addressed in practice. Managerial interaction is medium correlated with resource deployment, innovative technologies and innovative routines, in terms of level of relevance and the extent to which they are addressed in practice. Resource deployment is medium correlated with innovative routines in terms of the extent to which they are addressed in practice. The mentioned internal control elements (learning, managerial interaction, resource deployment, innovative technologies and innovative routines) constitute the foundations of the RBV of the firm. Nevertheless, it is important to note that although 88% of the respondents consider learning a relevant or absolutely relevant element, 46% of them never, rarely or only occasionally address it in practice.

Innovative technologies are the next relevant internal control element. It is essential in a sector that relies on new technological solutions to make projects technically feasible. Although 71% of the respondents consider innovative technologies a relevant or absolutely relevant element, 46% of them never, rarely or only occasionally address it.

Although corporate alignment scanning is a relevant internal control element (71% of the respondents consider it relevant or absolutely relevant), 46% of them never, rarely or only occasionally address it in practice. Respondents address corporate alignment scanning less frequently than corporate alignment in the evaluation process (N=48, t=4.539, sig. 0.00). This is a danger that a strategic project might weaken its corporate alignment during its execution.

Product monitoring is considered an indifferent, occasionally addressed internal control element. 44% of the respondents consider it irrelevant, absolutely irrelevant or are indifferent to it, and 44% of them never, rarely or only occasionally address it in practice. Traditionally, product monitoring is associated with practices such as TQM, which were introduced into some organisations during the 1980s. However, respondents appear to pay less attention to this than to other internal control elements. Product monitoring seems to be part of the operational routines, which may partly explain the managerial lack of attention. Product monitoring is medium correlated with innovative technologies in terms of the extent to which they are addressed in practice. Product monitoring appears to be associated with technological innovation.

Innovative routines are the least relevant and addressed internal control element. Although 51% of the respondents consider it relevant or absolutely relevant, only 26% of them always or frequently address it in practice. Despite the visible importance devoted to learning, the UK upstream oil and gas sector seems to resist monitoring and changing processes. This sector is likely to consider more relevant (N=47, t=2.245, sig. 0.030) and address more frequently (N=47, t=3.481, sig. 0.001) the introduction of new technologies rather than changing routines.

Control outputs are the last group of control elements. Prior to the discussion of the results, Table 4.25 presents overleaf the characteristics of the distribution and confidence interval for mean.

TABLE 4.25 - CONTROL OUTPUTS

Control Output	Level of Relevance		Extent of Addressing	
	Mean	SD	Mean	SD
Financial Targets	4.77[a] (4.61-4.93)*	.56	4.52[a] (4.32-4.72)*	.68
Timescale Targets	4.52 (4.35-4.69)*	.58	4.35 (4.13-4.58)*	.79
Environmental Targets	4.34 (4.09-4.59)*	.84	4.02 (3.77-4.27)*	.85
Corporate Alignment	4.00 (3.74-4.26)*	.87	3.61 (3.33-3.89)*	.95
Organisational Communication	3.96 (3.71-4.21)*	.86	3.19 (2.89-3.50)*	1.04
Organisational Adaptability	3.75 (3.54-3.96)*	.73	3.08 (2.83-3.34)*	.87
Technological Development	3.71 (3.45-3.97)*	.90	3.34 (3.05-3.63)*	.98
Employee Development	3.68 (3.41-3.95)*	.91	3.09 (2.83-3.34)*	.88
Employee Satisfaction	3.57 (3.29-3.86)*	.97	2.83 (2.54-3.11)*	.95
Customer Satisfaction	3.20 (2.82-3.58)*	1.27	3.02 (2.71-3.33)*	1.03
Market Position	3.02 (2.73-3.32)*	.96	2.79 (2.51-3.07)*	.91

(*) Lower and upper bounds of 95% confidence interval for mean

According to the above table, financial targets are the most relevant and frequently addressed control output, followed by timescale targets. Both types of output fit with the traditional engineering perspective on project management, which still dominates in the UK upstream oil and gas sector. Respondents tend to associate successful project management with achieving a project's expected costs and financial results, and meeting its deadlines in expected time, cost and specification.

Financial targets are medium correlated with timescale targets, corporate alignment, environmental (green) targets and organisational communication, in terms of level of relevance or the extent to which they are addressed in practice. Timescale targets are medium correlated with corporate alignment and environmental targets, in terms of level of relevance or the extent to which they are addressed in practice. According to the respondents, financial and timescale targets might be in consonance with corporate goals, internal communication and environmental standards.

Environmental (green) targets are the next relevant and frequently addressed control output. Oil and gas companies are aware of the power of pressure groups. Apart from this, companies are certainly concerned with environmental problems, because they involve high, irreversible costs that directly affect their image. In terms of the extent to which they are addressed in practice, environmental targets are medium correlated with organisational communication and technological development. Environmental targets seem to be facilitated by technological evolution and internal communication.

Corporate alignment is also a relevant and frequently addressed control output. While 78% of the respondents consider it relevant or absolutely relevant, 56% frequently or always address it in practice.

Organisational communication is a relevant, but only occasionally addressed, control output. While 70% of the respondents consider it relevant or absolutely relevant, only 36% of them frequently or always address it in practice. Organisational communication is medium correlated with organisational adaptability, technological development, employee satisfaction and employee development, both in terms of level of relevance and the extent to which they are addressed in practice. Organisational communication seems to impact on internal motivation, qualification and adaptability.

Organisational adaptability is also a relevant, but only occasionally addressed, control output. It represents a key issue in modern management theory, such as RBV of the firm, which stresses the importance for a firm of adapting internally due to external conditions. Organisational adaptability is medium correlated with employee satisfaction, technological development and employee development in terms of level of relevance or the extent to which they are addressed in practice. Organisational adaptability appears to boost internal motivation and qualification.

Technological and employee developments are relevant but only occasionally addressed control outputs. Although technological development is a challenge for the upstream oil and gas sector's long-term survival, respondents consider more relevant (N=47, t=2.041, sig. 0.047) and address more frequently (N=46, t=2.384, sig. 0.021) the introduction of new technologies rather than technological development. Technological development is medium correlated with employee development, employee satisfaction and customer satisfaction, in terms of level of relevance or the extent to which they are addressed in practice. Technological development appears to boost internal motivation and qualification, and to affect a company's image.

Employee development represents an important concern for a firm's long-term survival. Knowledge, competencies, skills and employee empowerment are associated with the foundations of modern techniques for managing knowledge-based projects, such as Intellectual Capital. Employee development is medium correlated with employee satisfaction, both in terms of level of relevance and the extent to which they are addressed in practice, and seems to boost internal motivation.

Employee satisfaction is seen as an indifferent, occasionally addressed control output. 55% of the respondents consider it relevant or absolutely relevant, but 78% of them never, rarely or only occasionally address it in practice. In terms of level of relevance, employee satisfaction is medium correlated with customer satisfaction. Customers are more satisfied when dealing with motivated employees.

Customer satisfaction is also an indifferent, occasionally addressed control output. 56% of the respondents consider it irrelevant, absolutely irrelevant or are indifferent to it, and only 29% frequently or always address it in practice. The downstream sector – '*the immediate customer*', is usually part of the company and consequently respondents seem to believe that monitoring both oil quality and gas supply properly at the delivery point and environmental (green) issues, ensues in satisfied customers. Customer satisfaction is medium correlated with market position, both in terms of level of relevance and the extent to which they are addressed in practice. Satisfied customers appear to allow a firm to build up a stronger market position.

According to the foregoing paragraphs, at first, the lack of attention paid to employee and customer satisfaction suggests that upstream oil and gas companies tend to focus on achieving financial targets and meeting milestones, and that they overemphasise their commitment with shareholders, sometimes at the expense of other stakeholders, such as customers and employees.

Secondly, the lack of importance devoted to employee development and satisfaction suggests that the upstream oil and gas companies tend not to dedicate great concern to their employees. The current tendency not to have long-term career planning in the sector and the high rate of unemployment during recent years as a result of low oil prices and organisational restructuring programmes are likely reasons.

Market position is the least relevant and addressed control output. Only 35% of the respondents consider it relevant or absolutely relevant, and 19% frequently or always address it in practice. This finding fits with the lack of managerial attention paid to competition, market share and market scanning.

4.3.1.4 – Univariate and Bivariate Analyses of Section 5 of the Questionnaire

This section discusses the findings of Section 5 of the questionnaire. First, it describes the degree of success of a strategic project in general terms. Spearman's correlation indexes complement the univariate analysis, and are fully presented in Appendix VI. Prior to this, the scale used for measuring the strategic project's degree of success in general terms, and the overall results (Table 4.26) are presented, as follows.

Scale of Measurement: Strategic Project's Degree of Success in General Terms				
1: Strongly Disagree	**2:** Disagree	**3:** Indifferent	**4:** Agree	**5:** Strongly Agree

TABLE 4.26 – STRATEGIC PROJECT'S DEGREE OF SUCCESS IN GENERAL TERMS

Item of Measurement	Mean	SD	Description
Successfully completed (*i.e.* goals and results are successfully attained)	3.79 (3.58-4.00)*	.75	Successfully completion (6% unsuccessful – scores 1 and 2, and 71% successful – scores 4 and 5)
Financially successful	3.69 (3.46-3.91)*	.79	Financially successful (4% unsuccessful - scores 1 and 2, and 57% successful – scores 4 and 5)
Successful for strategic (*i.e.* non-financial) reasons	3.58 (3.36-3.80)*	.76	Successful for strategic reasons (6% unsuccessful – scores 1 and 2, and 54% successful – scores 4 and 5)

(*) Lower and upper bounds of 95% confidence interval for mean

According to the above table, on average, respondents claim that their strategic projects are successfully completed and financially successful in general terms.

However, they only claim that their strategic projects are nearly successful for strategic reasons in general terms. Strategic project's successful completion is medium correlated with both financial success and success for strategic reasons. It seems that a strategic project's successful completion influences financial success and success for strategic reasons.

If one compares the results of strategic project management in general terms (Table 4.26) to the management of the last strategic projects (Table 4.14), some conclusions can be drawn. Although the scores are higher in the last strategic project management than in the management of strategic projects in general terms, the difference of means is only statistically significant for strategic results (N= 45, t=4.748, sig.=0.00). First, respondents may assume that they have improved over time. Second, they may also have an active short memory and tend to overestimate the last strategic project's performance at the expense of a strategic project's performance in general terms.

Finally, the last strategic project management presents a higher proportion of unsuccessful completions and financial results than the management of strategic projects in general terms. Low oil prices, mainly during 1998, might contribute to the unsuccessful completion and financial results of recent strategic projects.

4.3.1.5 - Complementary Analysis: Awareness and Use of Techniques Affected by a Firm's Size

The previous discussion was based on the original sample, which consisted of thirteen, twenty-three and sixteen questionnaires belonging to respondents of, respectively, big, medium and small companies (two questionnaires were anonymous). A question is addressed: what are the techniques significantly affected by a firm's size, according to the managerial awareness or use in general terms? This section seeks to answer this question.

In the first instance, the chi-squared test is employed for each technique in order to select the statistically significant techniques affected by a firm's size. The statistically significant techniques must exceed the table chi-square test and, for practical reasons, the proportion of cells that have less than five expected counts must be less than 20%.

The chi-square test was chosen because of the combination of ordinal data with small sub-samples. In practical terms, the chi-square test requires a minimum of twelve observations to be applied. Melewar and Saunders (1999) applied the chi-square test to their small sample, which consisted of forty observations. In a second stage, for those techniques affected by a firm's size, boxplots were run in order to identify the values according to a firm's size.

Table 4.27 presents overleaf those techniques that are significantly affected by a firm's size, according to managerial awareness or use in general terms. However, other analyses across a firm's size or category of strategic project were not possible to be performed due to the combination of highly skewed items of measurement with less than twelve observations by a firm's size or category of project.

TABLE 4.27 – TECHNIQUES AFFECTED BY A FIRM'S SIZE

Item of Measurement	Criterion of Measurement	Chi-Square Test	Proportion (%)		
			Big firms	Medium firms	Small firms
Leveraged NPV	Managerial Awareness	Pearson chi-square: 7.22 (*) df=2 2-sided asymptotic sig.=0.027 % of cells that have less than five expected counts: 0	8	52	44
Scheduling	Managerial Use in General Terms	Pearson chi-square: 11.06 (*) df=2 2-sided asymptotic sig.=0.004 % of cells that have less than five expected counts: 0	92	52	41

(*) Significant Pearson Chi-square test (p <.05)

According to the table above, respondents in smaller firms appear to be more aware of external funding as a means of facilitating the approval and execution of their strategic projects. Respondents in bigger firms seem to use more frequently scheduling techniques for managing their strategic projects.

4.3.2 – Multivariate Analysis

This section is that of the multivariate analysis. In the last section, the univariate and bivariate analyses draw a picture of the most relevant and frequently addressed elements involved in evaluating and controlling strategic projects. At this point it is stimulating to explore what are the elements that are believed to explain, in general terms, a strategic project's (1) successful completion; (2) financial success; (3) success for strategic (*i.e.* non-financial) reasons; and (4) successful management. The dimension success is, therefore, added to the current debate.

In order to link the elements involved in strategic project evaluation and control to these four levels of a strategic project's success, some regression models can be run. The role of these models is to provide some potentially interesting insights into the management of strategic projects, and to help propose sets of techniques for facilitating successful strategic project management.

There are four candidates for dependent variable, as has previously been presented. Three of them were explicitly discussed in Section 4.3.1.4. They include (1) the successful completion of a strategic project; (2) its financial success; and (3) its success for strategic reasons. The last candidate for dependent variable is a strategic project's successful management. It results from the linear combination of successful completion, financial success and success for strategic reasons. Nevertheless, a question remains: what are the independent variables of the regression models? It is time to recapitulate some important issues related to the independent variables, as follows.

As was discussed in the last chapter, the observations-to-items of measurement ratio of the original sample is less than five. Multivariate analysis cannot be therefore employed. A way of feasibly overcoming this practical obstacle could be to use the sub-groups of items of measurement presented in the questionnaire as a starting point to identify a number of factors that could integrate valid and reliable items of measurement. The literature review and the exploratory investigation justify these sub-groups of elements. As a result, the factors (or variables) reduced the number of items of measurement, which allowed for employing regression analysis. The regression models aim to associate the factors with different levels of success of a strategic project. For this reason the items of measurement were those associated with the extent to which each one is addressed in practice, so that one could measure the impact of addressing each factor on a strategic project's success.

4.3.2.1 – Factor Analysis

This section discusses the application of factor analysis. First, as discussed in the previous chapter, the application of factor analysis is conditional to some assumptions (Hair *et al.*, 1997), such as (1) the number of observations must exceed fifty; (2) the observations-to-items of measurement ratio must exceed five; and (3) in order to accommodate the data set, missing values are replaced by the mean series.

According to Hair *et al.* (1997), the steps for the factor analysis are divided into first solution and factor analysis interpretation. The steps for the first solution are (1) correlation indexes greater than 0.30 must be substantial; (2) the partial correlation among items of measurement must be small; (3) the overall Bartlett test of sphericity must be statistically significant; (4) the MSA of each item of measurement and each factor must exceed 0.50 to be acceptable, desirably exceeding 0.60; and (5) each factor's Cronbach Alpha must exceed 0.60 for exploratory research. In the case of the thresholds not being met for steps (4) and (5), item(s) of measurement must be removed.

The previous steps (1 to 5) are also applied during the factor analysis interpretation. Some additional steps are necessary to be complied. They include (1) the model used to obtain factor solutions is the principal component analysis; (2) the chosen stopping criterion to extract the number of factors is the latent root. The scree test is used to endorse the latent root solution and the *a priori* criterion is applied only if the latent root solution has no practical significance; (3) the method used for factor rotation is VARIMAX; (4) the percentage of variance explained by the factors must be preferentially *circa* 0.60; and (5) factor loadings must exceed 0.30, preferentially 0.50, and the percentage of communality for each factor loading must exceed 0.50.

In this study, factors are often summated scales of valid and reliable items of measurement. If further analysis is not possible to improve the summated scale, a surrogate item of measurement is chosen instead. The summated scales consider only the observations with no missing values so that they could thoroughly characterise the factor they are related to.

The following part of this section discusses the sub-groups of items of measurement associated with the evaluation of strategic projects. In the evaluation stage, the sub-groups are (1) financial evaluation elements; (2) internal evaluation elements (inclusive of strategic project's characteristics); (3) external evaluation elements; and (4) evaluation outputs.

Table 4.28 presents overleaf the final factor solution for the financial evaluation elements. It is important to note that, for simplification, only the main summary measures (MSA, Bartlett test of sphericity, percentage of total variance explained and Cronbach Alpha) are presented. The two extracted factors are (1) "macro" financial elements; and (2) "micro" financial element.

TABLE 4.28 – FINAL FACTOR SOLUTION FOR FINANCIAL EVALUATION ELEMENTS

Items of Measurement		Time, Financial Capability, Financial Leverage and Financial Market Uncertainty
Number of Observations-to-Items of Measurement Ratio		13.5
Number of Extracted Factors		2
Factor 1	Label	"Macro" Financial Elements
	Items of Measurement	Financial Capability and Financial Leverage
Factor 2	Label	"Micro" Financial Element
	Item of Measurement	Time [(a)]
Overall MSA (%)		57
Bartlett Test of Sphericity (Significance)		12.05 (0.007)
Total Variance Explained (%)		81
Cronbach Alpha – Factor 1 (%)		60

a. Surrogate item of measurement. Time was chosen to represent it, as it had the higher score for "the extent of addressing".

Table 4.29, as seen overleaf, presents the final factor solution for internal evaluation elements. The two extracted factors are (1) isolated and portfolio characteristics; and (2) internal alignment elements.

TABLE 4.29 – FINAL FACTOR SOLUTION FOR INTERNAL EVALUATION ELEMENTS

Items of Measurement		Feasibility, Timescale, Durability, Flexibility Corporate Alignment, Competency Alignment and Interdependency
Number of Observations-to-Items of Measurement Ratio		7.7
Number of Extracted Factors		2
Factor 1	**Label**	**Isolated and Portfolio Characteristics**
	Items of Measurement	Feasibility, Timescale, Durability, Flexibility and Interdependency
Factor 2	**Label**	**Internal Alignment Elements**
	Items of Measurement	Corporate Alignment and Competency Alignment
Overall MSA (%)		70
Bartlett Test of Sphericity (Significance)		61.32 (0.00)
Total Variance Explained (%)		56
Cronbach Alpha – Factor 1 (%)		69
Cronbach Alpha – Factor 2 (%)		70

Table 4.30, as seen overleaf, presents the final factor solution for external evaluation elements. The two extracted factors are (1) social, political, economic and market elements; and (2) environmental and technological elements.

TABLE 4.30 – FINAL FACTOR SOLUTION FOR EXTERNAL EVALUATION ELEMENTS

Items of Measurement		Competition, Economic Uncertainty, Social Uncertainty, Political Uncertainty, Environmental Uncertainty, Geological Uncertainty and Technological Uncertainty
Number of Observations-to-Items of Measurement Ratio		7.7
Number of Extracted Factors		2
Factor 1	**Label**	**Social, Political, Economic and Market Elements**
	Items of Measurement	Social Uncertainty, Political Uncertainty, Economic Uncertainty and Competition
Factor 2	**Label**	**Environmental and Technological Elements**
	Items of Measurement	Environmental Uncertainty and Technological Uncertainty
Overall MSA (%)		59
Bartlett Test of Sphericity (Significance)		63.90 (0.00)
Total Variance Explained (%)		60
Cronbach Alpha – Factor 1 (%)		70
Cronbach Alpha – Factor 2 (%)		59[a]

a. Although the cut-off point for Cronbach Alpha is 60%, 59% is considered an acceptable value.

At last, Table 4.31 presents overleaf the final factor solution for evaluation outputs. The three extracted factors are (1) financial evaluation outputs; (2) internal business evaluation outputs; and (3) external environment evaluation outputs.

TABLE 4.31 – FINAL FACTOR SOLUTION FOR EVALUATION OUTPUTS

Items of Measurement		Cash Flows, Financial Summary Measures, Environmental Impact, Social Impact, Political Impact, Market Share and Organisational Impact
Number of Observations-to-Items of Measurement Ratio		7.7
Number of Extracted Factors		3
Factor 1	**Label**	**Financial Evaluation Outputs**
	Items of Measurement	Cash Flows and Financial Summary Measures
Factor 2	**Label**	**Internal Business Evaluation Output**
	Items of Measurement	Organisational Impact
Factor 3	**Label**	**External Environment Evaluation Outputs**
	Items of Measurement	Environmental Impact, Social Impact and Political Impact
Overall MSA (%)		64
Bartlett Test of Sphericity (Significance)		60.71 (0.00)
Total Variance Explained (%)		77
Cronbach Alpha – Factor 1 (%)		75
Cronbach Alpha – Factor 3 (%)		72

The following part of this section discusses the sub-groups the items of measurement associated with the control of strategic projects. In the control stage, the sub-groups are (1) financial control elements; (2) internal control elements; (3) external control elements; and (4) control outputs.

Table 4.32 presents overleaf the final factor solution for the financial control elements. The only extracted factor is a surrogate item of measurement, labelled financial control element.

TABLE 4.32 – FINAL FACTOR SOLUTION FOR FINANCIAL CONTROL ELEMENTS

<table>
<tr><th colspan="2">Items of Measurement</th><th>Budgetary Constraints and Financial Market Scanning</th></tr>
<tr><td colspan="2">Number of Observations-to-Items of Measurement Ratio</td><td>27</td></tr>
<tr><td colspan="2">Number of Extracted Factors</td><td>1</td></tr>
<tr><td rowspan="2">Factor</td><td>Label</td><td>Financial Control Element</td></tr>
<tr><td>Item of Measurement</td><td>Budgetary Constraints[(a)]</td></tr>
</table>

a. Surrogate Item of Measurement. The items of measurement together presented a MSA of 50%, Bartlett Test of Sphericity (significance) of 1.272 (0.259), and Cronbach Alpha of 28%. Budgetary Constraints was chosen to represent the factor, as it had the higher score for "extent of addressing".

Table 4.33, as seen overleaf, presents the final factor solution for the internal control elements. The two extracted factors are (1) "hard" internal elements; and (2) "soft" internal elements.

TABLE 4.33 – FINAL FACTOR SOLUTION FOR INTERNAL CONTROL ELEMENTS

Items of Measurement		Corporate Alignment Scanning, Project Milestones Scanning, Product Monitoring, Managerial Interaction, Resource Deployment, Learning, Innovative Routines and Innovative Technologies
Number of Observations-to-Items of Measurement Ratio		6.8
Number of Extracted Factors		2
Factor 1	**Label**	**"Hard" Internal Elements**
	Items of Measurement	Project Milestones Scanning, Product Monitoring and Innovative Technologies
Factor 2	**Label**	**"Soft" Internal Elements**
	Items of Measurement	Managerial Interaction, Resource Deployment, Learning and Innovative Routines
Overall MSA (%)		77
Bartlett Test of Sphericity (Significance)		84.80 (0.00)
Total Variance Explained (%)		60
Cronbach Alpha – Factor 1 (%) **Cronbach Alpha – Factor 2 (%)**		61 77

Table 4.34 presents overleaf the final factor solution for the external control elements. The only extracted factor is labelled external environment control elements.

TABLE 4.34 – FINAL FACTOR SOLUTION FOR EXTERNAL CONTROL ELEMENTS

Items of Measurement		Market Scanning, Economic Scanning, Environmental Scanning and Political Scanning
Number of Observations-to-Items of Measurement Ratio		13.5
Number of Extracted Factors		1
Factor	**Label**	**External Environment Control Elements**
	Items of Measurement	Market Scanning, Economic Scanning and Political Scanning
Overall MSA (%)		66
Bartlett Test of Sphericity (Significance)		20.40 (0.00)
Total Variance Explained (%)		62
Cronbach Alpha (%)		71

Finally, Table 4.35, as seen overleaf, presents the final factor solution for the control outputs. The three extracted factors are (1) financial control outputs; (2) internal business control outputs; and (3) external environment control outputs.

TABLE 4.35 – FINAL FACTOR SOLUTION FOR CONTROL OUTPUTS

Items of Measurement		Financial Summary Measures, Timescale Targets, Customer Satisfaction, Environmental Targets, Market Position, Corporate Alignment, Employee Satisfaction, Organisational Communication, Employee Development, Technological Development and Organisational Adaptability
Number of Observations-to-Items of Measurement Ratio		4.9 [a]
Number of Extracted Factors		3
Factor 1	**Label**	**Financial Control Output**
	Items of Measurement	Financial Targets [b]
Factor 2	**Label**	**Internal Business Control Outputs**
	Items of Measurement	Organisational Communication, Organisational Adaptability, Employee Development and Employee Satisfaction
Factor 3	**Label**	**External Environment Control Outputs**
	Items of Measurement	Customer Satisfaction, Environmental Targets and Technological Development
Overall MSA (%)		80
Bartlett Test of Sphericity (Significance)		75.81 (0.00)
Total Variance Explained (%)		65
Cronbach Alpha – Factor 2 (%)		75
Cronbach Alpha – Factor 3 (%)		64

a. Although the cut-off point is five, 4.9 is considered acceptable.
b. Surrogate Item of Measurement. The items of measurement presented a Cronbach Alpha of 57%. Financial targets were the chosen element to represent the factor, as it had the higher score for "extent of addressing".

The framework proposed in Section 4.2.1 (Tables 4.5 and 4.6) was tested by using the extracted factors, as seen in Tables 4.36 and 4.37 overleaf.

Table 4.36 – Evaluation Elements through Different Perspectives and Categories – Revisited Framework

	Financial	External Environment	Internal Business
Context	**"Micro" Financial Element** Time **"Macro" Financial Elements** Financial Capability Financial Leverage	**Social, Political Economic and Market Elements** Competition Economic Uncertainty Social Uncertainty Political Uncertainty **Environmental and Technological Elements** Environmental Uncertainty Technological Uncertainty	**Internal Alignment Elements** Corporate Alignment Competency Alignment
Content			**Isolated and Portfolio Characteristics** Feasibility Timescale Durability Flexibility Interdependency
Output	**Financial Evaluation Outputs** Cash Flows Financial Summary Measures	**External Environment Evaluation Outputs** Environmental Impact Social Impact Political Impact	**Internal Business Evaluation Output** Organisational Impact

Table 4.37 – Control Elements through Different Perspectives and Categories – Revisited Framework

	Financial	External Environment	Internal Business
Context	**Financial Control Element** Budgetary Constraints	**External Environment Control Elements** Market Scanning Economic Scanning Political Scanning	**"Hard" Internal Elements** Project Milestones Scanning Product Monitoring Innovative Technologies **"Soft" Internal Elements** Managerial Interaction Resources Deployment Learning Innovative Routines
Content			
Output	**Financial Control Output** Financial Targets	**External Environment Control Outputs** Customer Satisfaction Environmental Targets Technological Development	**Internal Business Control Outputs** Organisational Communication Organisational Adaptability Employee Development Employee Satisfaction

The tested framework seems to have coherence and practical meaning, and some comments must be made about this. The learning and innovation perspective, although suggested by the original framework for the control stage, was not confirmed by the final factor solutions, as claimed by Bontis *et al.* (1999). However, the questionnaire was designed without including the learning & innovation control elements; these elements were, in turn, associated with the internal elements, as seen in Appendix II ("Questionnaire").

A question is then addressed: did the design of the questionnaire interfere with the framework testing? A likely answer would be that the interference was not significant. First, the outputs were placed together in the questionnaire and three factors were extracted: financial control outputs, internal business control outputs and external environment control outputs. A four-factor solution was carried out, but it had no practical meaning. Finally, three-factor solution of the control outputs fitted with the three-factor solution of the evaluation outputs.

4.3.2.2 – Multiple Regression Analysis

Having created variables (factors) to allow for employing regression analysis, it is time to recapitulate some assumptions for running the multiple regression models. They are (1) the regression models are used for explanatory purposes only; (2) the number of valid observations is maximised for each model. The evaluation and control stages have, respectively, fifty-one and forty-five valid observations; (3) in order to accommodate the data set, missing values are replaced by mean series; (4) the observations-to-independent variables ratio must be at least five; (5) the regression power must be at least 80%, for a significance level of 5%. In the case of not meeting such a target for any regression carried out, a remark is made. Assumptions (4) and (5) directly affect the generalisability of the results; and (6) prior to running the regression, it is assumed that any independent variable does not have any interaction (or moderator) effect upon any other independent variable, *i.e.* the relationship between each independent variable and the dependent variable is assumed as linear.

According to Hair *et al.* (1997), the steps for employing regression models are now recapitulated. First, the normality and linearity of the independent variables must be met. In the case of non-normality, tentative transformation of skewed variables is advisable. Second, the normality and homoscedasticity of the error term (or residuals) distribution must be met. Third, influential points (outliers and leverage points) are removed according to the procedure discussed in Chapter 3. Forth, it is necessary to assess the degree of multicollinearity among the predictors. In the case of multicollinearity, remedies must be followed. Fifth, even if an independent variable is selected as a predictor for a specific model, it is ratified only if this variable is significantly correlated with the dependent variable. Finally, the stepwise method is preferentially applied for the multiple regression models. The enter method is employed if the stepwise method is not applicable or for confirmatory reasons.

Eight models (*i.e.* four basic models with two alternatives ("A" and "B") each), as presented overleaf, were run in order to identify what evaluation and control factor(s) explain(s), respectively, successful completion, financial success, success for strategic reasons and successful management. Models types "A" and "B" respectively comprise nine and seven "candidates" for predictors.

Ideally, evaluation and control factors could be employed together, but there is insufficient data to justify that. Furthermore, having separate models for evaluation and control factors ensures that success elements are identified from both parts of the process, as a successful project will have needed both effective evaluation and control.

MODEL	DESCRIPTION
1A	Evaluation Factors vs. Successful Completion
1B	Control Factors vs. Successful Completion
2A	Evaluation Factors vs. Financial Success
2B	Control Factors vs. Financial Success
3A	Evaluation Factors vs. Success for Strategic Reasons
3B	Control Factors vs. Success for Strategic Reasons
4A	Evaluation Factors vs. Successful Management
4B	Control Factors vs. Successful Management

There are certain important issues regarding the regression models. First, the models are multiple linear regressions without mediating variables. Second, the evaluation and control factors were considered respectively in alternatives "A" and "B" for each model. Third, process elements and outputs were addressed by distinct factors in each model. Finally, all factors were considered in each model. For instance, for successful completion, control outputs were not the only independent variables. For financial success, financial factors were not the only independent variables. In the case of success for strategic reasons, non-financial factors were not the only independent variables.

Before running the models, skewed factors were tentatively normalised. Nevertheless, among the seven skewed factors, only two of them could be normalised ("macro" financial elements and internal alignment elements). Although the other five variables remained skewed, only one of them took part in a specific regression model.

However, the impact on the results was not significant, as there was no indication of any violation of normality, linearity and homoscedasticity.

The following part of this section presents the results of each regression model. Prior to that, it is important to highlight some issues. First, the scatterplots between each two independent variables, which are "candidates" for each regression model, did not violate the assumptions of normality, linearity and homoscedasticity.

Second, each regression model presents the results for the final step with no influential points left, unless when the removal of influential points might stop short of the above, as the sample may otherwise become too small.

Finally, Appendices VII to XIV present the statistics, histogram and the Lilliefors test of the standardised residuals for the final step of each regression model. There is no violation of normality. The scatterplots of each predictor and the predicted value against the studentised residuals did not indicate any violation of linearity and homoscedasticity.

The first regression model (Model 1A) runs the evaluation factors against successful completion, the results of which are seen in Table 4.38 overleaf.

TABLE 4.38 – RESULTS OF MODEL 1A: EVALUATION FACTORS AGAINST SUCCESSFUL COMPLETION

Item	Result
Number of Valid Obs.	45
Obs.-to-Indep. Var. Ratio	5.0
Method	Stepwise
Goodness-of-fit	R^2=0.216; Adjusted R^2=0.198 (*)
Overall Fit	F= 11.839 (sig. 0.001)
Standard Coefficient(s)	Isolated and Portfolio Characteristics: 0.465 (t=3.441, sig. 0.003)
Multicollinearity	No multicollinearity; VIF= 1
Assumptions	✔ (**)
Influential Points	No (***)

(*) Regression power less than 80%
(**) Appendix VII presents the statistics, histogram and Lilliefors test for the standardised residuals
(***) The model removed six influential points (11.8% of the valid sample)

According to the results of Model 1A, isolated and portfolio characteristics is the internal evaluation factor that explains a strategic project's successful completion. Model 1A is fitted. However, although the observations-to-independent variables ratio of Model 1A is five, its generalisability is not limitless, as the regression power is less than 80%. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method confirms the results of the stepwise method through a fitted, but not completely generalisable model (regression power less than 80%).

The second regression model (Model 1B) runs the control factors against successful completion, the results of which are seen in Table 4.39 overleaf.

TABLE 4.39 – RESULTS OF MODEL 1B: CONTROL FACTORS AGAINST SUCCESSFUL COMPLETION

Item	Result
Number of Valid Obs.	39
Obs.-to-Indep. Var. Ratio	5.6
Method	Stepwise
Goodness-of-Fit	R^2=0.346; Adjusted R^2=0.329
Overall Fit	F= 19.612 (sig. 0.00)
Standard Coefficient(s)	"Soft" Internal Elements: 0.589 (t=4.429, sig. 0.00)
Multicollinearity	No multicollinearity; VIF= 1
Assumptions	✔ (*)
Influential Points	No (**)

(*) Appendix VIII presents the statistics, histogram and Lilliefors test for the standardised residuals
(**) The model removed six influential points (13.8% of the valid sample)

According to the results of Model 1B, "soft" internal elements is the internal control factor that explains a strategic project's successful completion. Model 1B is fitted and generalisable. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method confirms the results of the stepwise method through a fitted, generalisable model.

The third regression model (Model 2A) runs the evaluation factors against financial success, the results of which are seen in Table 4.40 overleaf.

TABLE 4.40 – RESULTS OF MODEL 2A: EVALUATION FACTORS AGAINST FINANCIAL SUCCESS

Item	Result
Number of Valid Obs.	50
Obs.-to-Indep. Var. Ratio	5.6
Method	Stepwise
Goodness-of-Fit	R^2= 0.414; Adjusted R^2=0.389
Overall Fit	F= 16.610 (sig. 0.00)
Standard Coefficient(s)	Isolated and Portfolio Characteristics: 0.527 (t=4.668, sig. 0.00), "Macro" Financial Elements: 0.300 (t=2.661, sig. 0.011)
Multicollinearity	No multicollinearity; VIF: Isolated and Portfolio Characteristics: 1.022; "Macro" Financial Elements: 1.022
Assumptions	✔ (*)
Influential Points	No (**)

(*) Appendix IX presents the statistics, histogram and Lilliefors test for the standardised residuals

(**) The model removed one influential point (2.0% of the valid sample)

According to the results of Model 2A, isolated and portfolio characteristics and "macro" financial elements are those evaluation factors that explain a strategic project's financial success. Model 2A is fitted and generalisable. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method confirms the isolated and portfolio characteristics in explaining a strategic project's financial success through a fitted, generalisable model.

The fourth regression model (Model 2B) runs the control factors against financial success, the results of which are seen in Table 4.41 overleaf.

TABLE 4.41 – RESULTS OF MODEL 2B: CONTROL FACTORS AGAINST FINANCIAL SUCCESS

Item	Result
Number of Valid Obs.	42
Obs.-to-Indep. Var. Ratio	6.0
Method	Stepwise
Goodness-of-Fit	R^2=0.302; Adjusted R^2=0.285
Overall Fit	F=17.305 (sig. 0.00)
Standard Coefficient(s)	Internal Business Control Outputs: 0.550 (t=4.160, sig. 0.00)
Multicollinearity	No multicollinearity; VIF= 1
Assumptions	✔ (*)
Influential Points	No (**)

(*) Appendix X presents the statistics, histogram and Lilliefors test for the standardised residuals
(**) The model removed three influential points (6.7% of the valid sample)

According to the results of Model 2B, internal business control outputs is the internal control factor that explains a strategic project's financial success. Model 2B is fitted and generalisable. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method is fitted and generalisable, and it confirms the results of the stepwise method.

The fifth regression model (Model 3A) runs the evaluation factors against success for strategic reasons, the results of which are seen in Table 4.42 overleaf.

TABLE 4.42 – RESULTS OF MODEL 3A: EVALUATION FACTORS AGAINST SUCCESS FOR STRATEGIC REASONS

Item	Result
Number of Valid Obs.	45
Obs.-to-Indep. Var. Ratio	5.0
Method	Stepwise
Goodness-of-Fit	R^2= 0.283; Adjusted R^2=0.267
Overall Fit	F= 16.990 (sig. 0.00)
Standard Coefficient(s)	Isolated and Portfolio Characteristics: 0.532 (t=4.122, sig. 0.00)
Multicollinearity	No multicollinearity; VIF= 1
Assumptions	✔ (*)
Influential Points	No (**)

(*) Appendix XI presents the statistics, histogram and Lilliefors test for the standardised residuals
(**) The model removed six influential points (11.8% of the valid sample)

According to the results of Model 3A, isolated and portfolio characteristics is the internal evaluation factor that explains a strategic project's success for strategic reasons. Model 3A is fitted and generalisable. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method confirms the results of the stepwise method. It produces a not completely fitted, but generalisable model.

The sixth regression model (Model 3B) runs the control factors against success for strategic reasons, the results of which are seen in Table 4.43 overleaf.

TABLE 4.43 – RESULTS OF MODEL 3B: CONTROL FACTORS AGAINST SUCCESS FOR STRATEGIC REASONS

Item	Result
Number of Valid Obs.	38
Obs.-to-Indep. Var. Ratio	5.4
Method	Stepwise
Goodness-of-Fit	R^2= 0.247; Adjusted R^2=0.204 (*)
Overall Fit	F= 5.755 (sig. 0.007)
Standard Coefficient(s)	"Soft" Internal Elements: 0.382 (t=2.580, sig. 0.014); External Environment Control Elements: 0.377 (t=2.546, sig. 0.015)
Multicollinearity	No multicollinearity; VIF: "Soft" Internal Elements: 1.020; External Environment Control Elements: 1.020
Assumptions	✔ (**)
Influential Points	No (***)

(*) Regression power less than 80%
(**) Appendix XII presents the statistics, histogram and Lilliefors test for the standardised residuals
(***) The model removed seven influential points (15.6% of the valid sample)

According to the results of Model 3B, "soft" internal elements and external environment control elements are the control factors that explain a strategic project's success for strategic reasons. Model 3B is fitted, but not generalisable, as the regression power is less than 80%. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method confirms the external environment control elements in explaining a strategic project's success for strategic reasons. Nor does it produce a completely fitted, neither a completely generalisable model.

The seventh regression model (Model 4A) runs the evaluation factors against successful strategic project management, the results of which are seen in Table 4.44 overleaf.

Table 4.44 – Results of Model 4A: Evaluation Factors against Successful Strategic Project Management

Item	Result
Number of Valid Obs.	45
Obs.-to-Indep. Var. Ratio	5.0
Method	Stepwise
Goodness-of-Fit	R^2=0.528; Adjusted R^2=0.505
Overall Fit	F= 23.465 (sig. 0.00)
Standard Coefficient(s)	Internal Alignment Elements: 0.475 (t=4.164, sig. 0.00), Isolated and Portfolio Characteristics: 0.401 (t=3.518, sig. 0.001)
Multicollinearity	No multicollinearity; VIF: Internal Alignment Elements:1.158; Isolated and Portfolio Characteristics:1.158
Assumptions	✔ (*)
Influential Point	Case 35 (**)

(*) Appendix XIII presents the statistics, histogram and Lilliefors test for the standardised residuals

(**) The model removed six influential points (11.8% of the valid sample). If case 35 is removed, seven more cases are then subsequently removed, which is quite high comparing to the sample size, and does not imply any change in the results

According to the results of Model 4A, internal alignment elements, and isolated and portfolio characteristics are the internal evaluation factors that explain a strategic project's successful management.

Model 4A is highly fitted and generalisable. All assumptions are met and multicollinearity is not found. However, the model is not free of influential points. If case 35 is removed, seven more cases are then subsequently removed, which is quite high when compared to the sample size. Furthermore, it does not imply any change in the results. The enter method confirms the results of the stepwise method, but also indicates other predictors that explain a strategic project's successful management. It also produces a highly fitted and generalisable model.

Finally, the last regression model (Model 4B) runs the control factors against successful strategic project management, the results of which are seen in Table 4.45.

TABLE 4.45 – RESULTS OF MODEL 4B: CONTROL FACTORS AGAINST SUCCESSFUL STRATEGIC PROJECT MANAGEMENT

Item	Result
Number of Valid Obs.	39
Obs.-to-Indep. Var. Ratio	5.6
Method	Stepwise
Goodness-of-Fit	R^2=0.533; Adjusted R^2=0.507
Overall Fit	F= 20.520 (sig. 0.00)
Standard Coefficient(s)	"Soft" Internal Elements: 0.459 (t=3.478, sig. 0.001); "Hard" Internal Elements: 0.423 (t=3.450, sig. 0.001)
Multicollinearity	No multicollinearity; VIF: "Soft" Internal Elements: 1.157; "Hard" Internal Elements: 1.157
Assumptions	✔ (*)
Influential Points	No (**)

(*) Appendix XIV presents the statistics, histogram and Lilliefors test for the standardised residuals
(**) The model removed six influential points (13.3% of the valid sample)

According to the results of Model 4B, "soft" internal elements and "hard" internal elements are the internal control factors that explain a strategic project's successful management. Model 4B is highly fitted and generalisable. All assumptions are met, multicollinearity is not found, and the model is free of influential points. The enter method confirms the results of the stepwise method, and also produces a highly fitted and generalisable model.

The following paragraphs summarise the overall findings on the regression models. First, isolated and portfolio characteristics, internal alignment elements, "soft" internal elements and "hard" internal elements are the internal evaluation and control factors that explain a strategic project's successful management.

Second, isolated and portfolio characteristics, "macro" financial elements and internal business control outputs are the internal and financial evaluation and control factors that explain a strategic project's financial success.

Third, isolated and portfolio characteristics, "soft" internal elements and external environment control elements are the internal and external evaluation and control factors that explain a strategic project's success for strategic reasons. However, the results are subject to reservations. In the control stage, results are somewhat restricted to generalisation, as the regression power is less than 80%.

Fourth, isolated and portfolio characteristics and "soft" internal elements are the internal evaluation and control factors that explain a strategic project's completion. However, the results are subject to reservations. In the evaluation stage, results are somewhat restricted to generalisation, as the regression power is less than 80%.

Finally, some conclusions are drawn from the regression models, given the reservations. First, internal business elements often appear to explain a strategic project's success. Second, financial and non-financial elements appear to explain a strategic project's financial success. Finally, process elements appear to explain a strategic project's success rather than the outputs. It seems to be a controversial finding, as the success of a project is most closely assessed via its closing (financial) results. However, outputs record success rather than explain it.

4.3.3 – Comparing Results from Univariate, Bivariate and Multivariate Analyses

This section is an attempt to compare, in detail, the findings obtained from the univariate and bivariate analyses (Section 4.3.1) to those from the multivariate analysis

(Section 4.3.2). There is a set of multidisciplinary elements involved in strategic project management, according to the tested frameworks presented in Tables 4.36 and 4.37. They are divided into process elements (*i.e.* elements involved in the evaluation and control processes) and outputs (*i.e.* outcomes of the evaluation and control processes), and belong to three perspectives: financial, internal business and external environment. The elements can be grouped into those that are (1) relevant and frequently addressed; (2) relevant but occasionally addressed; and (3) indifferent and occasionally addressed.

Table 4.46 presents overleaf the elements identified by the research, which are drivers of successful strategic project management (success elements). Success elements are mainly process elements, and belong predominantly to the internal business perspective. Rockart (1979) links critical factors to success factors. Nevertheless, this study does not *a priori* assume success elements as critical elements. As seen in Table 4.46, although managers pay considerable attention to most of the success elements, as these elements drive a firm to concentrate on success, they only occasionally address some of these elements. Success elements seem not to be critical elements that receive constant and careful attention from management, as some elements are only critical in some specific contexts, which disclaims Rockart (1979), Kaplan and Norton (1992), Bontis *et al.* (1999), Clarke (1999) and Turner (2000a).

In an analogy to Rockart's (1979) categorisation, this study labels the relevant and frequently addressed elements as all-encompassing sector-based elements. The relevant but occasionally addressed elements are labelled as potential all-encompassing sector-based elements. Both types of elements are general to the upstream oil and gas sector as a whole. Finally, the indifferent and occasionally addressed elements, which are not critical, are labelled as specific elements (*i.e.* specific for firms, strategic projects or situations).

TABLE 4.46 – EVALUATION AND CONTROL SUCCESS ELEMENTS

Stage Type of Element	EVALUATION	CONTROL
Relevant and Frequently Addressed	Feasibility Timescale Durability Corporate Alignment Competency Alignment Financial Capability	Project Milestones Scanning Product Monitoring Managerial Interaction Resource Deployment
Relevant but Occasionally Addressed	Flexibility Interdependency	Learning Organisational Communication Organisational Adaptability Employee Development Innovative Technologies
Indifferent and Occasionally Addressed	Financial Leverage	Political Scanning Economic Scanning Market Scanning Innovative Routines Employee Satisfaction

Table 4.47 presents overleaf the elements to which managers pay great attention, but are not believed to explain success. These elements involve (1) those included in the factor analysis but not appearing to explain success; and (2) those left out of the factor analysis, but not accounting for significant variation in the original data set, also not appearing to explain success. These elements are both process elements and outputs, and belong largely to the financial and external environment (green issues) perspectives.

Table 4.47 – Evaluation and Control Elements Managers Pay Great Attention to but are not Believed to Explain Success

Stage Type of Element	EVALUATION	CONTROL
Relevant and Frequently Addressed	Time Geological Uncertainty Financial Market Uncertainty Environmental Uncertainty Technological Uncertainty Cash Flows Financial Summary Measures Environmental Impact	Budgetary Constraints Financial Market Scanning Environmental Scanning Financial Targets Timescale Targets Environmental Targets
Relevant but Occasionally Addressed	Economic Uncertainty Organisational Impact	Corporate Alignment Scanning Corporate Alignment Technological Development

Finally, Table 4.48 presents the elements to which managers pay little attention and, for the same reasons pointed out in the last paragraph, they are not believed to explain success. These are both process elements and outputs, and belong essentially to the external environment perspective.

Table 4.48 – Evaluation and Control Elements Managers Pay Little Attention to and are not Believed to Explain Success

Stage Type of Elements	EVALUATION	CONTROL
Indifferent and Occasionally Addressed	Competition Political Uncertainty Social Uncertainty Political Impact Market Share Social Impact	Customer Satisfaction Market Position

Some interesting insights into the elements involved in strategic project management are described in the following. First, flexibility and learning are success elements, but are only occasionally addressed. Second, managers are often indifferent to such success elements as financial leverage, innovative routines and employee satisfaction. Finally, managers pay little attention to market, political and social issues, especially in the evaluation stage.

As has previously been discussed, there appears to be a gap between the elements to which managers pay considerable attention and those elements that are believed to explain a strategic project's success. The results of the regression models suggest that the internal business elements often appear to explain, and differentiate, a strategic project's success. However, according to the univariate and bivariate analyses section, financial elements are often those to which managers pay great attention. In summary, the elements critical to success and those managers focus on but appear not to explain success do not constitute a good match.

4.3.4 – Qualitative Analysis

This section is that of qualitative analysis, which is related to the open-ended questions. It is divided into four parts: (1) guidelines for successful strategic project completion; (2) the reasons for using or not using each technique in managing strategic projects; (3) the main stage of application of techniques during the management of the last strategic project; and (4) the extent to which techniques address, in practice, the elements involved in the evaluation and control of strategic projects.

4.3.4.1 – Guidelines for Successful Strategic Project Completion

This section presents some guidelines for successful strategic project completion, which aim to promote good practice in strategic project management. These guidelines are based on the reasons for (and barriers to, if applicable) successful strategic project completion, given in response to Question 4 of Section 1 of the questionnaire. The guidelines are divided into eight main topics: (1) corporate planning, visioning and goals; (2) corporate communication and learning; (3) managerial interaction and teamwork; (4) time, budget and outcomes; (5) external environment; (6) partnerships and alliances; (7) contractors; and (8) external relations, as briefly discussed in the following.

Corporate Planning, Visioning and Goals

First, the company must delineate its future by identifying an initial direction and its vulnerabilities to the external environment. Second, it must promote a detailed corporate planning and organisation, and market investigation. Third, it must clearly identify and have a broad understanding of its corporate objectives via a balance of financial and strategic goals. Fourth, it must encourage a transparent emergence of strategies. Fifth, it must properly select a set of measurable outcomes. Finally, it must efficiently distribute the available funds. As a director said, "*strategic programme goals do not change but timeframe and ability to commit does*".

Corporate Communication and Learning

First, the company must communicate its strategic drivers from/to top management. Second, management must diffuse a harmonic message to stimulate the company. Third, managers must debate the appropriateness of a strategic project to the corporation. Fourth, managers must support faster internal sanctions. Fifth, top management must recognise a strategic project's risk so as to result in more effective decision making process. Sixth, managers at a project level must re-present the strategic project to top management in the case of an unsuccessful outset. Finally, managers must learn from failure, as data obtained is a relevant input for assessing future opportunities.

Managerial Interaction and Teamwork

First, there is a need for strong managerial assistance and commitment, and effective leadership and innovative management style. Second, it is appropriate to have a focused, compact and multidisciplinary project teamwork approach. Third, the team members must be aligned with, and committed to, the project manager. Fourth, the project team must boost empowered key project members. Finally, there is a need for skilled project management, which is a combination of expertise, pragmatism and knowledge.

Time, Budget and Outcomes

First, the project manager must produce a detailed project screening. As a top exploration manager said, "*identify the right project, do the project right*". Second, he/she must examine different, flexible alternatives to generate successful outcomes. Third, the project manager must negotiate an appropriate schedule, financial terms and liability reduction with partners and contractors. Fourth, he/she must suitably plan the commissioning of a strategic project. Fifth, the project manager must be able to execute a strategic project in time, budget and specification. Finally, he/she must negotiate fast completion of contracts and requirements.

External Environment

First, the project manager must identify favourable market conditions/drivers (*e.g.* low oil prices for mergers and acquisitions, willing and co-operative buyer, vendor keen to sell, control of a specific market). Second, he/she must search for the creation of commercial leverage. Third, the project manager must conduct a client-driven control stage. Fourth, he/she must regularly monitor financial market and economic variables (*e.g.* oil price, industry performance indicators). Finally, the project manager must also monitor competitor activities (*e.g.* pending acquisitions and mergers).

Partnerships and Alliances

First, the partners' selection must be based on a market approach. Second, it is advisable to minimise cultural divergence amongst the organisations involved. Third, it is appropriate to have open discussions and alignment along with partners' strategies and teams. Finally, it is important to implement solid joint venture relations.

Contractors

First, the contracting strategy must be based on the contractors' efficiency and health, safety and environmental capabilities. Second, it is required to instigate an open conduct from contractors through a transparent risk & reward performance scheme. Finally, the alignment between partners and contractors is fundamental.

External Relations

First, the project manager must implement initial and follow-up personal contacts. Second, managerial proactive actions must be reinforced to assure financial long-term outcomes. Finally, the project manager must monitor systematically the political situation (*e.g.* government encouragement, political sanctions), and must perceive the level of political risk and cultural barriers in the case of overseas projects.

4.3.4.2 – The Use of Techniques

This section discusses the reasons for using or not using each technique in managing strategic projects. These reasons were obtained from Section 2 of the questionnaire and the follow-up interviews.

Managers consider net income and ROI company standards, and IRR and NPV fundamental requirements. The payback period is less applied than the previous measures, and it lacks managerial credibility. Managers have criticised this for being a simplistic rule of thumb that usually ignores the time value of money, although suitable for less stable environments. Managers also suggest other measures, namely capital expenditure (CAPEX), return on capital employed (ROCE), life cycle costs (*i.e.* costs associated with the entire project life), and corporate hurdles, namely development cost per barrel and reserve-to-production ratio (R/P).

Sensitivity analysis is also a fundamental technique, and, according to a planning analyst, it is "*a simple to do, simple to understand tool*". Managers only occasionally use cost-benefit analysis for specific projects (*e.g.* technological and environmental projects) or parts of a project.

Leveraged NPV is rarely used because managers invariably invest in attractive investments without seeking external funding. Managers usually separate investment from financial decisions, and commonly use leveraged NPV for non-core business investments. Managers are frequently unfamiliar with human resource accounting.

Forecasting is often used at a corporate level, and is considered a primary technique. Risk analysis is considered a project-specific (*e.g.* exploration and environmental projects), but influential technique, often used in the early stages of evaluation, and occasionally in a qualitative way. Risk-adjusted NPV (*i.e.* weighted NPV by different probabilities of occurrence instead of the NPV discounted at a project's risk adjusted rate) is considered to be a project specific (*e.g.* exploration projects), but fundamental technique.

Scenario analysis is often used at a corporate level at specific instants through a limited number of scenarios, sometimes for *ad hoc* planning. It is usually used for corporate planning and international business evaluation. It is considered a controversial technique: some managers like it, some are reluctant to accept it, and others dislike it. Managers are occasionally inclined to use sensitivity analysis instead. Contingency analysis is usually associated with contingent costs and is commonly replaced by sensitivity analysis.

Decision-tree analysis and simulation are both considered to be project-specific (*e.g.* exploration and infrastructure projects) techniques. Decision-tree analysis is considered a powerful technique that focuses on key variables and simpler than continuous probabilistic techniques, such as risk analysis. Decision-tree analysis is usually associated with expected monetary value, and it is often used late when decisions are already made. Simulation is considered an intensive technique, which deals with complex problems associated with multiple technical variables not necessarily computed in monetary terms. Simulation is considered to be cost-effective for large scale projects.

Managers often apply some techniques informally. Optimisation can be used for both project evaluation and control. There are two meanings: first, re-engineering the technical side of a project in order to reduce costs. Second, to find the most effective use of capital that generates the optimal outcomes in a portfolio context. In the case of portfolio management, optimisation is considered a complex, time-consuming technique informally or intuitively used at a corporate level, which accounts for different departmental interests. Scheduling is used for both planning and control, and it is also considered an operational technique. Financial performance monitoring is still used at a corporate level to measure business performance. However, a few companies are now using it as a benchmark for project control. Capital rationing is often used at a corporate level to measure investment efficiency and ranking via cost management. ABC is generally replaced by homemade procedures. Manpower rationing is indirectly used through cost management (*e.g.* organisational charts), and is crucial for large scale projects.

While the main barrier for using utility function is the assessment of one's risk aversion level, the principles of game theory are just informally applied, for instance, for block bidding. Real options are considered extremely complex and difficult to quantify. A few companies use EVA for project post-completion assessment, and a few more are about to use it in the near future. A few companies have already started to use the Balanced Scorecard to measure business unit performance. A few more companies are introducing it for setting goals and control measures for project management. Finally, Intellectual Capital is often identified with knowledge management.

4.3.4.3 – Main Stage of Application of Techniques

This section investigates the categorisation of techniques into evaluation and control techniques. Table 4.49 presents overleaf the main stage of application (evaluation or control) of each technique during the respondents' last strategic project management. The main stage of application refers to the most frequently addressed elements (evaluation or control elements) by each technique. The respondents, however, did not mention some of the techniques, such as EVA, Game Theory, among others.

TABLE 4.49 – TECHNIQUES APPLIED IN THE RESPONDENTS' LAST STRATEGIC PROJECT MANAGEMENT

Evaluation	Control	Evaluation and Control
ROI ROCE Net Income NPV IRR Payback Period Life Cycle Costs Sensitivity Analysis Cost-Benefit Analysis Forecasting Risk Analysis Risk-Adjusted NPV Scenario Analysis Decision-Tree Analysis Simulation Contingency Analysis ABC Manpower Rationing	Scheduling Financial Performance Monitoring Capital Rationing Balanced Scorecard CAPEX	Optimisation Reserve-to-Production Ratio Development Cost per barrel

According to the above table, techniques can be categorised into evaluation and control techniques. While some techniques are more frequently applied to the evaluation of strategic projects, others are more frequently applied to the control of strategic projects. Among them, there are two surprises. First, optimisation is applied for both evaluation (*i.e.* optimising a project's conception) and control (*i.e.* identifying the portfolio of projects that generates the best outcomes subject to constraints). Second, ABC and manpower rationing are more frequently applied for evaluating strategic projects instead of for controlling them. However, the categorisation of evaluation and control techniques is, to some extent, restrictive, as techniques are flexible instruments and can be applied for both evaluation and control of strategic projects.

Although some techniques are more frequently applied respectively in the evaluation and control of strategic projects, most techniques address both evaluation and control elements. It seems that the evaluation and control of strategic projects seem to be, therefore, interrelated processes, as claimed by Simons (1995). The evaluation of strategic projects, however, seems to be more frequently addressed by techniques than the control of strategic projects.

4.3.4.4 – Techniques and Elements Linkages

This section presents those techniques which are mainly used in addressing, in practice, elements involved in the evaluation and control of strategic projects. The linkage between the elements involved in the evaluation and control of strategic projects and the use of techniques for tackling these elements was the most crucial, and an extremely important part of the questionnaire. During the questionnaire piloting, respondents tended not to build this bridge. In order to reduce their resistance, this part of the questionnaire recalled the respondents' recent past experience and asked about the techniques applied to the elements in the evaluation and control of their last strategic projects. This linkage will be part of the background for the proposal of sets of techniques for managing strategic projects successfully, to be discussed in the following chapter. Table 4.50 summarises overleaf the techniques that are mainly used in addressing, in practice, evaluation process elements and outputs.

TABLE 4.50 – TECHNIQUES THAT ARE MAINLY USED IN ADDRESSING EVALUATION PROCESS ELEMENTS AND OUTPUTS

Evaluation Process Element	Techniques Mainly Used in Practice
Geological Uncertainty	Simulation, Sensitivity Analysis, Risk Analysis
Time	NPV, IRR
Timescale	Scheduling, Payback Period, NPV
Financial Market Uncertainty	Sensitivity Analysis, Scenario Analysis
Feasibility	Risk Analysis, Scenario Analysis
Corporate Alignment	IRR, NPV
Durability	Sensitivity Analysis, NPV, Payback Period, Simulation
Financial Capability	Net Income, Capital Rationing
Technological Uncertainly	Risk Analysis, Scenario Analysis
Competency Alignment	Simulation, Scenario Analysis, Risk Analysis, Optimisation, Activity-Based Costing
Environmental Uncertainty	Risk Analysis, Scenario Analysis, Contingency Analysis
Interdependency	NPV, Decision-Tree Analysis, Risk-Adjusted NPV, Simulation, Risk Analysis, Scenario Analysis, Optimisation
Economic Uncertainty	Sensitivity Analysis, Scenario Analysis
Flexibility	Sensitivity Analysis, Scenario Analysis
Political Uncertainty	Sensitivity Analysis, Scenario Analysis
Competition	Scenario Analysis, Contingency Analysis
Financial Leverage	ROI, Net Income, IRR
Social Uncertainty	Risk Analysis, Contingency Analysis
Evaluation Output	**Techniques Mainly Used in Practice**
Cash Flows	NPV, Net Income
Financial Summary Measures	NPV, IRR, Net Income, ROI
Environmental Impact	Risk Analysis, Scenario Analysis, Contingency Analysis
Organisational Impact	Manpower Rationing, Net Income, IRR, Forecasting, Optimisation, Scenario Analysis, Capital Rationing
Political Impact	Forecasting, IRR, NPV, Risk-Adjusted NPV, Scenario Analysis, Contingency Analysis, Simulation
Market Share	Net Income, Forecasting
Social Impact	(*)

(*) No technique suggested by the respondents.

Table 4.51 summarises overleaf the techniques that are mainly used in addressing, in practice, control process elements and outputs.

TABLE 4.51 – TECHNIQUES THAT ARE MAINLY USED IN ADDRESSING CONTROL PROCESS ELEMENTS AND OUTPUTS

Control Process Element	Techniques Mainly Used in Practice
Budgetary Constraints	Scheduling, Capital Rationing
Project Milestones Scanning	Scheduling, Forecasting
Environmental Scanning	Risk Analysis, Scenario Analysis, Cost-Benefit Analysis, Sensitivity Analysis, Simulation
Resources Deployment	Scheduling
Managerial Interaction	Scheduling, Balanced Scorecard
Financial Market Scanning	Forecasting, Financial Performance Monitoring, Sensitivity Analysis
Learning	(*)
Product Monitoring	(*)
Innovative Technologies	ROI, NPV, Sensitivity Analysis, Scenario Analysis
Corporate Alignment Scanning	Capital Rationing, Scheduling, NPV, ROI, Balanced Scorecard, Optimisation
Political Scanning	IRR, Risk-Adjusted NPV, Sensitivity Analysis, Forecasting, Scenario Analysis, Contingency Analysis
Economic Scanning	Simulation, NPV, ROI, Sensitivity Analysis, Forecasting, Risk Analysis, Scenario Analysis
Innovative Routines	Risk Analysis, Contingency Analysis
Market Scanning	(*)
Control Output	**Techniques Mainly Used in Practice**
Financial Targets	Forecasting, Financial Performance Monitoring, NPV
Timescale Targets	Scheduling, Forecasting
Environmental Targets	Cost-Benefit Analysis, Sensitivity Analysis
Corporate Alignment	IRR, ROI, NPV, Risk-Adjusted NPV, Financial Performance Monitoring
Organisational Communication	Forecasting, Scheduling, IRR, Risk Analysis, Scenario Analysis
Technological Development	Decision-Tree Analysis, Simulation
Organisational Adaptability	(*)
Employee Development	(*)
Employee Satisfaction	Cost-Benefit Analysis, Forecasting, Scenario Analysis, Financial Performance Monitoring
Customer Satisfaction	(*)
Market Position	(*)

(*) No technique suggested by the respondents.

According to the tables above, the proposed evaluation and control elements respectively described in acceptable terms the evaluation and control of strategic projects. Moreover, techniques are effective facilitators in managing strategic projects. A diverse number of techniques tackle most elements involved in strategic project management. The above evidence disclaims Dyson and Foster (1980), Bontis *et al.* (1999) and Mooraj *et al.* (1999), who have referred to a restricted appropriateness and use of techniques to address the elements involved in managing strategic projects.

Nevertheless, techniques alone are not sufficient for this purpose. Respondents also suggest other means of tackling the elements involved in managing strategic projects, rather than the so-called techniques. They include discussions, meetings, presentations, negotiations, plans, reports, peer reviews, audits, newsletters, electronic mails, contracts, statutory regulations, sanctions, market surveys, training, qualitative assessments, research and development programmes, contacts and networks, which complement the techniques in managing strategic projects. Judgement and vision complement them in managing strategic projects. However, techniques are the focus of the current work.

Respondents suggest the inappropriate use of the techniques to tackle some of the evaluation and control elements. First, payback period, a short-term measure, is suggested to address durability, a long-term element. Second, ROI, an accounting measure, is suggested to tackle innovative technologies. Third, sensitivity analysis is incorrectly regarded as sufficient for tackling uncertainty. Sensitivity analysis is a technique for answering a wide range of 'what-if' questions. Finally, organisational impact is preferably addressed by short-term financial measures.

Managers do not appear to use recently developed techniques to tackle relevant, but occasionally addressed success elements, namely flexibility (*e.g.* Real Options), learning, organisational communication and organisational adaptability (*e.g.* Balanced Scorecard), and employee development and innovative technologies (*e.g.* Intellectual Capital). There is, therefore, the potential for the managerial application of recently developed techniques to facilitate the achievement of a firm's long-term success. These techniques might be usefully combined with traditional techniques as a means of facilitating successful strategic project management.

Some techniques might be suitably applied in specific situations. For instance, decision-tree analysis, risk-adjusted NPV, simulation, manpower rationing, portfolio optimisation and leveraged NPV could be applied either for specific projects (*e.g.* exploration, technological, environmental and non-core business projects), or for complex situations (*e.g.* large scale projects, multivariable problems or portfolio of projects). Corporate hurdles, namely R/P and cost development per barrel, and life cycle costs, although not discussed in the current research, are also suggested by the respondents to be useful measures for managing upstream oil and gas strategic projects.

4.4 – Revisiting the Research Hypotheses

Having outlined and discussed the research findings, it is time to revisit the research hypotheses. Table 4.52 points out overleaf the acceptance or rejection of the current research hypotheses, and complements with some comments.

TABLE 4.52 – ACCEPTANCE OR REJECTION OF, AND COMMENTS ON, THE RESEARCH HYPOTHESES

Hypothesis		Accept / Reject	Comments
I	Managers are invariably familiar with and always use some traditional techniques (*e.g.* NPV), and are unfamiliar with recently developed techniques for managing strategic projects	✔	Respondents are extremely aware of, and practically always use, summary measures for managing strategic projects. Respondents are also remarkably aware of, and practically always use, some of the techniques that address uncertainty or deal with some degree of complexity. However, they are often unfamiliar with recently developed or complex techniques.
II	There is a set of critical elements that explains a strategic project's success	✕	The proposed set of evaluation and control elements properly describes, respectively, the evaluation and control of strategic projects. Most elements are considered relevant and frequently addressed by the respondents and a subset of these elements is believed to explain a strategic project's success. There are also some relevant but occasionally addressed elements, and indifferent and occasionally addressed elements that are believed to explain a strategic project's success. In fact, not all success elements are critical, as managers do not pay careful and constant attention to all of them.
III	There is restricted appropriateness and use of techniques to address elements involved in managing strategic projects	✕	Techniques are effective facilitators in managing strategic projects. A diverse number of techniques tackle, in practice, most elements involved in strategic project management. However, techniques alone are not sufficient for this purpose. Meetings, reports, peer reviews and electronic mails, as well as judgement and vision, complement techniques in managing strategic projects.
IV	Planning and control are interconnected processes	✔	Techniques are flexible facilitators in managing strategic projects, as they are used for both evaluating and controlling strategic projects. Evaluation (including planning) and control seem to be, therefore, interrelated processes, although managers appear to perceive these processes as discrete and independent.

4.5 – Concluding Remarks

This chapter discussed the exploratory and core findings of the current research project. The exploratory findings were associated with the exploratory fieldwork and deskwork. The core findings, in turn, combined the results of the questionnaire with those obtained from the follow-up interviews. These interviews were part of the confirmatory investigation. The chapter ended by revisiting the research hypotheses.

The exploratory fieldwork investigated the definition of corporate strategy, strategic opportunity and the identification and definition of twenty-five multidisciplinary elements involved, respectively, in the evaluation and control of strategic projects.

The exploratory deskwork sought a theoretical correspondence for the proposed elements, placed these elements within a conceptual framework associated with different perspectives and categories, and investigated the role of techniques in addressing, in theoretical terms, these elements. The preliminary findings indicated that techniques *per se* are insufficient to address all the elements involved in the evaluation and control of strategic projects. However, a combination of traditional and recently developed techniques seems to tackle most of the elements.

The first part of the core investigation involved univariate and bivariate analyses of the overall sample and sub-samples according to a firm's size. This was confirmed through follow-up interviews. The results suggested that the current trends in the sector indicate a lack of new opportunities in the UK petroleum province, the search for new markets and opportunities on an alliance basis, and a focus on cost reduction, reengineering and the introduction of new information technologies.

According to the main findings, managers are fully aware of, and nearly always use, ROI, net income, NPV, IRR, payback period and sensitivity analysis. However, they only occasionally apply cost-benefit analysis and virtually never apply leveraged NPV and HRA. Managers often apply cost-benefit analysis for specific projects or parts of a project and managers in smaller firms appear to be more aware of external funding as a means of facilitating the approval and execution of their strategic projects.

Managers are well familiar with, and frequently use, some techniques that incorporate uncertainty, such as forecasting, risk analysis and risk-adjusted NPV. Forecasting may be seen as the technique that incorporates uncertainty with the highest use among those who are aware of it. However, managers only occasionally use other techniques that incorporate uncertainty, such as decision-tree analysis, scenario analysis and simulation, but rarely and virtually never apply, respectively, contingency analysis and cognitive mapping.

Managers are also highly aware of, but only occasionally apply, techniques that deal with some degree of mathematical complexity, such as scheduling and financial performance monitoring. Managers in bigger firms seem to use more frequently scheduling techniques for managing their strategic projects. However, managers are well familiar with, but rarely apply, capital rationing. They are fairly aware of, and rarely use, optimisation and ABC, but virtually never apply manpower rationing. This set of techniques is often applied informally.

Managers are not fully familiar with (and rarely use) complex techniques (game theory and utility function) and recently developed techniques (Real Options, EVA, Balanced Scorecard and Intellectual Capital). The Balanced Scorecard appears to be a technique in ascendancy among managers who are aware of it.

This research also detected a set of relevant and frequently addressed elements involved, respectively, in the evaluation and control of strategic projects. The UK upstream oil and gas sector appears to be attached to financially orientated decisions, focuses on financial issues, seeks to control the efficiency of tangible assets, resists changing current routines and overemphasises shareholders' interests, sometimes at the expense of customers and employees.

Nevertheless, great attention is placed on environmental (green) and geological issues. Internal alignment appears to be relevant in strategic project management, especially during the evaluation stage. Moreover, the foundations of the Resource-Based of the firm (learning, managerial interaction, resource deployment and innovative technologies) play a key role in that management. However, political, economic, social and market issues do not receive sufficient attention from managers.

The second part of the core investigation involved a multivariate analysis. The results of this section claims that there appears to be a gap between the elements to which managers often pay considerable attention in managing strategic projects, namely financial issues, and the elements that are believed to explain successful strategic project management, namely internal business issues. There are also some other interesting findings. First, financial success is also believed to be explained by non-financial elements. Second, process elements explain a strategic project's success rather than the outputs. The latter seems to be a controversial finding, as a project's success is most closely assessed via its closing (financial) results. However, outputs record success rather than explain it.

Finally, the qualitative analysis deliberated about the open-ended questions. The results indicated that techniques are effective facilitators for managing strategic projects, as managers apply a diverse range of techniques to address elements involved in strategic project management. Nevertheless, individual, explicit knowledge (*e.g.* techniques) alone is not sufficient for that purpose, as certain elements are not quantifiable, and techniques often tend to focus on quantified aspects. Group, explicit knowledge (*e.g.* reports), and the transferral of individual to group knowledge (*e.g.* peer reviews) complement techniques in managing strategic projects. Judgement and vision complement them in managing strategic projects.

As found by this research, techniques are more frequently used in the evaluation stage than in the control stage. Moreover, techniques are flexible instruments, as they are applied for both evaluating and controlling strategic projects. Evaluation and control seem to be, therefore, interrelated processes, although managers often perceive them as discrete and independent. There are also common processes such as the design phase of evaluating, and the redesign phase of controlling.

The following chapter will propose sets of techniques for assisting and systematising successful strategic project management. These sets are based on the results currently discussed in this chapter. An assessment sheet will validate the appropriateness of the proposed sets. Finally, the research question of the current research project will be revisited and challenged.

Chapter 5

TECHNIQUES TO SUPPORT SUCCESSFUL STRATEGIC PROJECT MANAGEMENT

5.1 – Introduction

This chapter proposes and validates a set of techniques for facilitating and supporting successful strategic project management, as applied to the UK upstream oil and gas sector. The set of techniques selected arises from the findings of Chapter 4 ("Research Findings"). This chapter ends by revisiting the research question of the current research project.

The chapter is divided into five sections. Section 5.2 proposes a set of techniques for facilitating successful strategic project evaluation and control, as applied to the UK upstream oil and gas sector. Section 5.3 introduces the final step of the confirmatory investigation, previously discussed in Chapter 3 ("Research Methodology"). An assessment sheet, which aims to validate the appropriateness of the proposed techniques, is broadly discussed. Section 5.4 revisits and challenges the research question of the thesis. Finally, Section 5.5 points out the concluding remarks and introduces the last chapter of this study.

5.2 – Techniques for Successful Strategic Project Management

This section proposes a set of techniques for successful evaluation and control of strategic projects. These techniques are based on the findings of Chapter 4 and are, therefore, justifiable in the context of the research that has been undertaken. The following paragraphs briefly review the main research findings that support the design of the proposed portfolio of techniques.

The exploratory investigation (exploratory fieldwork and exploratory deskwork) broadly identified and defined twenty-five multidisciplinary elements involved, respectively, in the evaluation and control of strategic projects. The exploratory findings indicated that techniques are insufficient *per se* to address all the elements involved in the evaluation and control of strategic projects. However, a combination of traditional and recently developed techniques seems to tackle most of the elements.

The core investigation (questionnaire based) identified the techniques mainly used in practice and the elements of the management process leveraging successful strategic project management (success elements), as discussed in the following.

Techniques are effective facilitators for managing strategic projects, as managers apply a diverse range of techniques to address most of the elements involved in strategic project management. Techniques are more frequently used in the evaluation stage than in the control stage. However, techniques are flexible instruments, as the same techniques are often applied in both evaluating and controlling of strategic projects.

Managers are fully aware of, and nearly always use, accounting and financial summary measures, and sensitivity analysis. Managers are well familiar with, and frequently use, some techniques that incorporate uncertainty, such as forecasting, risk analysis and risk-adjusted NPV. Managers are highly aware of but only occasionally use cost-benefit analysis, some techniques that incorporate uncertainty, such as decision-tree analysis, scenario analysis and simulation, and some techniques that deal with some degree of mathematical complexity, such as scheduling and financial performance monitoring.

Managers are highly familiar with, but rarely apply, contingency analysis and capital rationing. Managers are fairly aware of, but rarely apply, optimisation and ABC. They are also fairly familiar, but virtually never apply, manpower rationing. Managers are not familiar with (and rarely or virtually never use) leveraged NPV and HRA, as well as complex or recently developed techniques, such as cognitive mapping, game theory, utility function, real options, EVA, Balanced Scorecard and Intellectual Capital.

There is a set of success elements related to the evaluation and control of strategic projects. While great managerial attention is paid to financial, environmental (green) and geological issues, and little attention is paid to political, economic, social and market issues, internal business elements appear to be crucial in explaining successful strategic project management. There appears to be, therefore, a gap between the elements to which managers often pay considerable attention in managing strategic projects, namely financial issues, and the elements that are believed to explain successful strategic project management, namely internal business issues. Moreover, financial success is also believed to be explained by non-financial elements, and process elements seem to explain a strategic project's success rather than the outputs.

Having reviewed the main research findings, the next paragraphs discuss the rationale underlying the design of portfolios of techniques for facilitating successful strategic project evaluation and control in the UK upstream oil and gas sector. These portfolios are essentially based on the techniques that tackle the success elements involved in managing strategic projects, as discussed in the following.

Table 5.1, as seen overleaf, is a starting point to the design of the evaluation portfolio of techniques. It compares the main techniques applied in practice to those techniques that address in theory the evaluation success elements. The techniques used in practice to address the evaluation success elements are those techniques used by the respondents to manage their last strategic projects, and resulted from the core investigation (for details, see Tables 4.49 and 4.50). The techniques that address the evaluation success elements in theory are those reviewed by the literature, and resulted from the exploratory deskwork (for details, see Table 4.8). Techniques both used in practice and suggested by the reviewed literature are shown in bold.

TABLE 5.1 - TECHNIQUES FOR EVALUATION SUCCESS ELEMENTS

Evaluation Success Element	Techniques Mainly Used in Practice	Techniques that Address the Elements in the Reviewed Literature
Feasibility	**Risk Analysis**, Scenario Analysis	Simulation, **Risk Analysis**
Timescale	Scheduling, **Payback Period**, **NPV**	**Payback Period**, IRR, **NPV**, Leveraged NPV, Risk-Adjusted NPV, Sensitivity Analysis, Cost-Benefit Analysis
Durability	**Sensitivity Analysis**, **NPV**, Payback Period, Simulation	IRR, **NPV**, Leveraged NPV, Risk-Adjusted NPV, **Sensitivity Analysis**, Cost-Benefit Analysis, Scenario Analysis, Contingency Analysis, Decision-Tree Analysis, Risk Analysis, HRA, Real Options
Flexibility	Sensitivity Analysis, **Scenario Analysis**	**Scenario Analysis**, Decision-Tree Analysis, Real Options
Interdependency	NPV, Decision-Tree Analysis, Risk-Adjusted NPV, Simulation, Risk Analysis, Scenario Analysis, **Optimisation**	**Optimisation**, Real Options
Corporate Alignment	IRR, NPV	Scenario Analysis, Contingency Analysis
Competency Alignment	Simulation, **Scenario Analysis**, Risk Analysis, Optimisation, ABC	**Scenario Analysis**, Contingency Analysis
Financial Capability	**Net Income**, Capital Rationing	ROI, **Net Income**, Optimisation
Financial Leverage	**ROI, Net Income**, IRR	**ROI, Net Income**, Leveraged NPV

Table 5.2 summarises overleaf the recommended techniques that tackle each success element involved in the evaluation (design, planning and valuation) of strategic projects. The rationale for recommending the techniques is as follows (with further details in Appendix XV, Table 1). When there is a superimposition of the techniques mainly used in practice on those suggested by the reviewed literature, these techniques are commonly recommended. However, techniques mainly used in practice and suggested by the reviewed literature, which have strong theoretical or practical barriers to their use (*e.g.* payback period), are not recommended. When there is no superimposition, techniques suggested by the literature are preferentially recommended (not all of these were listed in the questionnaire). Techniques used in practice without a

clear theoretical support may also be recommended if there is no theoretical barrier to their use.

TABLE 5.2 – RECOMMENDED TECHNIQUES AND EVALUATION SUCCESS ELEMENTS

Evaluation Success Element	Recommended Techniques	Phase(s) of Analysis
Feasibility	Risk Analysis	Design
Timescale	NPV, Scheduling, IRR, Sensitivity Analysis	Planning / Valuation
Durability	NPV, Sensitivity Analysis, IRR	Valuation
Flexibility	Scenario Analysis, Real Options	Planning / Valuation
Interdependency	Optimisation	Valuation
Corporate Alignment	Scenario Analysis, Balanced Scorecard	Planning
Competency Alignment	Scenario Analysis, Balanced Scorecard	Planning
Financial Capability	Net Income, ROI	Valuation
Financial Leverage	ROI, Net Income	Valuation

Although the techniques recommended in Table 5.2 also address the majority of the evaluation elements managers pay considerable attention to, some techniques complement those recommended above, and will also take part in the evaluation set of techniques, as they support elements that may be important in other contexts.

First, forecasting addresses financial market uncertainty in the planning phase. Second, risk analysis addresses geological, technological and environmental uncertainties in the valuation phase. Finally, corporate hurdles, namely development cost per barrel and reserve-to-production ratio (R/P), which are specific and largely used techniques in the UK upstream oil and gas sector for managing strategic projects, are also recommended in the valuation of strategic projects. A more detailed rationale for the recommended techniques that tackle evaluation elements to which managers pay considerable attention is detailed in Appendix XV, Tables 2 and 3.

There is also a set of techniques that tackle evaluation elements to which managers pay little attention. These techniques are referred to in footnotes, instead of playing part in the core of the evaluation portfolio of techniques. The rationale for the recommended techniques is detailed in Appendix XV, Tables 4 and 5. These techniques are applied for specific companies (*i.e.* small, medium or big), projects (*e.g.* overseas and large scale projects) or situations (*e.g.* competitive environment), and include risk analysis, scenario analysis, simulation and game theory. The final proposed set of techniques to support the evaluation stage is presented in Table 5.3.

TABLE 5.3 – EVALUATION PORTFOLIO OF TECHNIQUES

Phase of Analysis	Recommended Techniques
DESIGN	**Risk Analysis** (*i.e.* NPV risk profile)
PLANNING (*)	**Balanced Scorecard** (For setting goals and measures) **Scenario Analysis / Forecasting** (*e.g.* to tackle financial market or economic uncertainties) **Scheduling** (*e.g.* Gantt Chart and GERT)
VALUATION (**)	**Accounting Measures** (Net income and ROI) **Financial Measures** (NPV and IRR) **Non-Financial Measures** (Corporate hurdles: development cost per barrel and R/P) **Sensitivity Analysis** (*e.g.* oil price, costs and reserves) **Risk Analysis** (*e.g.* to tackle geological, environmental and technological uncertainties) **Real Options** (*i.e.* the value of deferment added to NPV) **Optimisation** (*i.e.* to measure the combined effect (*e.g.* NPV) of a portfolio of projects)

(*) For specific projects (*e.g.* overseas projects) and depending on a firm's size, scenario analysis and risk analysis might include political issues (uncertainty and impact), social issues (uncertainty and impact), competition and market share.
(**) Reservoir simulation might be used for large scale exploratory projects. Game theory might also be applied in the case of a competitive environment. Risk analysis might also be used for tackling social uncertainty, in the case of overseas projects.

Some issues must be stressed with regard to the techniques recommended for the evaluation portfolio of techniques. In the design phase, risk analysis is used at the project level. It is a useful technique to conceive a strategic project, to identify its feasibility, to account for different sources of uncertainties, integrate the team involved in evaluating a strategic project, and to allow for the collection of further information.

Broadly, the planning phase seeks to align the corporate level with the project level. The Balanced Scorecard is used both at the corporate and project levels. In the former, it is responsible for setting corporate goals and measures. In the latter, it supports the setting of a strategic project's goals and measures in accordance with the corporate level. Scenario analysis, being a controversial technique, can be dropped from the evaluation set of techniques. In cases of unstable or competitive environments, however, scenario analysis appears to be a useful technique. Forecasting and scenario analysis are used at the corporate level, and are seen as options for either identifying scenarios for, or predicting, financial market and economic uncertainties. Scheduling (*e.g.* Gantt Chart and GERT) is used at the project level for planning a strategic project's budget, timescale and resources.

In the valuation phase, techniques are basically used at the project level. Accounting (net income and ROI), financial (NPV and IRR), and non-financial (development cost per barrel and R/P) measures comprise a portfolio of measures for valuing a strategic project. Sensitivity analysis is used to answer a range of *'what-if'* questions. Risk analysis upgrades the valuation of a strategic project by incorporating different types of uncertainty, namely geological, environmental and technological. Real options upgrade the valuation of a strategic project by adding the value of a strategic project's flexibility (deferment) to its NPV. Finally, optimisation views a strategic project's value (*e.g.* NPV) within a portfolio context.

Having introduced the evaluation portfolio of techniques, it is time to present the design of the control portfolio of techniques. Table 5.4, likewise Table 5.1, is a starting point to the design of the control portfolio of techniques. It compares the main techniques applied in practice (resulting from the core investigation - see Tables 4.49 and 4.51) to those techniques that address in theory the control success elements (resulting from the exploratory deskwork - see Table 4.9). Techniques both used in practice and suggested by the reviewed literature are shown in bold.

TABLE 5.4 - TECHNIQUES FOR CONTROL SUCCESS ELEMENTS

Control Success Element	Techniques Mainly Used in Practice	Techniques that Address the Element in the Reviewed Literature
Managerial Interaction	Scheduling, **Balanced Scorecard**	**Balanced Scorecard,** Intellectual Capital
Resource Deployment	**Scheduling**	**Scheduling**, Balanced Scorecard, Intellectual Capital
Learning	(*)	Scheduling, Financial Performance Monitoring (FPM), ABC, EVA, Balanced Scorecard, Intellectual Capital
Innovative Routines	Risk Analysis, Contingency Analysis	Balanced Scorecard, Intellectual Capital
Project Milestones Scanning	**Scheduling,** Forecasting	**Scheduling**
Product Monitoring	(*)	(**)
Innovative Technologies	ROI, NPV, Sensitivity Analysis, Scenario Analysis	Intellectual Capital
Political Scanning	IRR, Risk-Adjusted NPV, Sensitivity Analysis, Forecasting, Scenario Analysis, Contingency Analysis	(**)
Economic Scanning	Simulation, NPV, ROI, Sensitivity Analysis, Forecasting, Risk Analysis, Scenario Analysis	(**)
Market Scanning	(*)	(**)
Organisational Communication	Forecasting, Scheduling, IRR, Risk Analysis, Scenario Analysis	Balanced Scorecard
Organisational Adaptability	(*)	Balanced Scorecard, Intellectual Capital
Employee Development	(*)	Intellectual Capital
Employee Satisfaction	Cost-Benefit Analysis, Forecasting, Scenario Analysis, FPM	(**)

(*) No technique suggested by the respondents.
(**) No technique suggested by the reviewed literature.

Table 5.5 summarises overleaf the recommended techniques that tackle each success element involved in the control (management, review and redesign) of strategic projects. The rationale for recommending the techniques broadly follows the same rationale proposed for the evaluation success elements, with further details in Appendix XV, Table 6.

TABLE 5.5 – RECOMMENDED TECHNIQUES AND CONTROL SUCCESS ELEMENTS

Control Success Element	Recommended Techniques	Phase(s) of Analysis
Managerial Interaction	Balanced Scorecard, Scheduling	Management
Resource Deployment	Scheduling	Management
Learning	Scheduling, Financial Performance Monitoring, EVA, Balanced Scorecard	Management / Review
Innovative Routines	Balanced Scorecard, Risk Analysis	Management / Redesign
Project Milestones Scanning	Scheduling	Management
Product Monitoring	No recommendation	Management
Innovative Technologies	Intellectual Capital, Sensitivity Analysis	Management / Review
Political Scanning	IRR, Sensitivity Analysis, Scenario Analysis, Forecasting	Management / Review
Economic Scanning	Sensitivity Analysis, Scenario Analysis, Forecasting	Management / Review
Market Scanning	No recommendation	Management / Review
Organisational Communication	Balanced Scorecard	Management
Organisational Adaptability	Balanced Scorecard	Management
Employee Development	Intellectual Capital	Management
Employee Satisfaction	No recommendation	Management

Although the techniques recommended in Table 5.5 also address the majority of the control elements managers pay considerable attention to, some techniques complement those recommended above, and will also take part in the control set of techniques, again as they support elements that may be important in other contexts.

First, capital rationing addresses budgetary constraints in the management phase. Second, risk analysis addresses environmental scanning and technological development in the review phase. Third, real options address financial market scanning (*i.e.* monitoring of financial market information, *e.g.* oil price and exchange rate) in the review phase. Finally, the monitoring of corporate hurdles over time, namely development cost per barrel and R/P, are also recommended in the review phase. The rationale for the recommended techniques that tackle control elements to which managers pay considerable attention is detailed in Appendix XV, Tables 7 and 8.

There is also a set of techniques that tackle control elements to which managers pay little attention. These techniques are referred to in footnotes, instead of playing part in the core of the control portfolio of techniques. The rationale for the recommended techniques is presented in Appendix XV, Tables 9 and 10. These techniques are applied for specific projects (*e.g.* knowledge-intensive and large scale projects), or situations (*e.g.* competitive environment), and include manpower rationing, Balanced Scorecard and Intellectual Capital. The final proposed set of techniques to support the control stage is presented in Table 5.6 overleaf.

TABLE 5.6 – CONTROL PORTFOLIO OF TECHNIQUES

Phase of Analysis	Recommended Techniques
MANAGEMENT (*)	**Balanced Scorecard** (For calibrating goals and measures) **Scenario Analysis / Forecasting** (*e.g.* to tackle external environment scanning) **Capital Rationing** (Cash flow limits) **Scheduling** (*e.g.* Gantt Chart and GERT)
REVIEW	**Accounting Performance Monitoring** (EVA) **Financial Performance Monitoring** (NPV, IRR) **Non-Financial Performance Monitoring** (Corporate hurdles) **Sensitivity Analysis** (*e.g.* oil price, costs, reserves, environmental issues and technological issues) **Risk Analysis** (*e.g.* to tackle environmental scanning and technological development) **Real Options** (*i.e.* the value of expansion/contraction/abandonment added to NPV)
REDESIGN	**Risk Analysis** (*i.e.* NPV risk profile)

(*) Intellectual Capital might be used in cases of technological (or other knowledge-intensive) projects. The Balanced Scorecard might also focus on technological and employee developments to replace Intellectual Capital. Manpower rationing might be used in cases of large scale projects. The Balanced Scorecard might be used to tackle customer satisfaction and market position, in the case of a competitive environment.

Some issues must be stressed with regard to the techniques recommended for the control portfolio of techniques. The management phase is, to some extent, analogous to the planning phase in the evaluation set of techniques. Broadly, it seeks to sustain the alignment between the corporate level and the project level. The Balanced Scorecard is applied both at the corporate and project levels for calibrating, respectively, a firm's and a strategic project's goals and measures. Forecasting and scenario analysis continuously monitor external environment uncertainties, namely financial market, political, economic, market and environmental, through to the completion of a strategic project. Forecasting and scenario analysis feed information into techniques involved in the review phase. Scenario analysis, being a controversial technique, can be dropped from the control set of techniques. Capital rationing is also used at the corporate level, and is responsible for constraining the execution of a strategic project, mainly due to annual divisional cash flow limits. Scheduling (*e.g.* Gantt Chart and GERT) is used at the project level for reviewing the budget, timescale and resources of a strategic project through to its completion.

The review phase is, to some extent, analogous to the valuation phase in the evaluation set of techniques. Accounting (EVA), financial (NPV) and non-financial (development cost per barrel and R/P) performance monitoring comprise the review of a strategic project's value through to its completion. Sensitivity analysis is used to answer a range of *'what-if'* questions. Risk analysis reviews the value of a strategic project through to its completion by scanning different types of uncertainty, namely geological, environmental and technological. Real options review the value of a strategic project through to its completion by adding the value of a strategic project's flexibility (expansion, contraction or abandonment) to its NPV.

Finally, the redesign phase is, in fact, the design phase in the evaluation portfolio of techniques. In this phase, a strategic project faces a structural change and needs to be re-evaluated. Risk analysis is used to redesign a strategic project, re-examine its feasibility, and re-assess its cash flows.

This section presents now additional comments on the design of the portfolios of techniques. First, the recommended techniques focus attention essentially on the internal business perspective, which often explains successful strategic project management, and on the financial perspective, to which managers often pay considerable attention in managing strategic projects. The external environment perspective, however, is considered peripheral, as the UK upstream oil and gas sector is immersed in a stable political and economic environment, and is referred to in footnotes. In the case of managing overseas projects, this perspective becomes more relevant and appropriate techniques must be applied.

Second, the recommended techniques address process elements and non-financial elements, as these elements are believed to explain successful strategic project management, as well as techniques that address outputs and financial elements, as managers pay great attention to these elements in managing strategic projects. As a result, the proposed sets of techniques combine a mix of financially-oriented (short-term and long-term) and process-oriented techniques, which are occasionally under theoretical friction.

Third, the number of techniques recommended is kept at a minimum in order to avoid managerial need for a practical understanding of too wide range of techniques. The portfolios combine traditional and recently developed techniques in order to address most success elements, as described in the following paragraphs.

Managers are often highly familiar with and always/frequently use (*e.g.* ROI, net income, IRR, NPV, sensitivity analysis, forecasting and risk analysis) or at least occasionally use (*e.g.* scenario analysis and scheduling) the vast majority of the recommended techniques that tackle success elements involved in managing strategic projects. Managers appear to use scenario analysis at a corporate level, and to use scheduling informally. However, some additional techniques are also recommended. Although managers are well familiar with optimisation and capital rationing, they tend to apply them informally. Corporate hurdles, such as development cost per barrel and

R/P, although not included in the survey, are largely used in the upstream UK oil and gas sector. The evaluation and control sets of techniques are not only aligned with managerial needs for application, but they are also theoretically supported.

Recently developed techniques (*e.g.* Balanced Scorecard, real options and EVA) are also recommended, although managers are often unfamiliar with them, as they are value creation techniques that drive a firm to superior performance. Such techniques as game theory and manpower rationing, which managers are nearly unaware of and virtually never apply, and simulation, which managers are highly aware of but occasionally use, are recommended for specific projects (*e.g.* large scale projects) or situations (*e.g.* competitive environment), and are referred to in footnotes. Intellectual Capital is not included in the core of the control set of techniques because it is an extremely recent, untested technique. It is relevant to mention that most recommended techniques are traditional techniques, with particular prominence of risk analysis and scheduling in facilitating successful strategic project management.

There are some final comments on the proposed sets of techniques. First, the evaluation and control sets of techniques are general, comprehensive sets of techniques, which aim to embrace different categories of strategic projects (*e.g.* marginal field development, field exploration, company acquisition, etc), sizes (*i.e.* small, medium and big) and types (*i.e.* parent or affiliate, plc or limited, international or national) of companies, and levels of decision-making (*i.e.* corporate and project levels). These sets of techniques are in line with Chapman and Howden (1997), who combined various techniques as a process of managing projects.

Second, the application of the proposed techniques is dynamic, *i.e.* sequential, flexible and recursive. This is because phases of the evaluation and control stages may be concurrent and overlapping. For example, the control stage may involve redesign and further valuation in case of significant change including shock events.

Finally, the recommended techniques for both the evaluation and control sets of techniques overlap considerably, as techniques are seen as flexible instruments for facilitating strategic project management. Furthermore, it is important to mention that there is a need for applying techniques that introduce the notion of success in the evaluation stage, and formally applying techniques that address success in the control stage, as they are usually informally applied.

5.3 – Validation of the Proposed Sets of Techniques

This section discusses the validation of the proposed sets of techniques for successful strategic project management. A one-page assessment sheet was sent out to thirty-seven respondents who previously agreed to receive a copy of the report of the research findings. Twenty-one assessment sheets were received back (response rate of 57%). They were multiples from eleven (two big, five medium and four small) previously surveyed companies.

The assessment sheet asked the participants to give their opinion on the quality and efficacy of the proposed sets of techniques. This included eight closed questions and one open-ended question. The scales of measurement used for respectively the first seven closed questions and the last closed question, and the results (Table 5.7) are presented as follows. The results are presented in terms of frequencies due to the small number of responses.

Scale of Measurement: First seven closed questions of the assessment sheet				
1: Strongly Disagree	2: Disagree	3: Indifferent	4: Agree	5: Strongly Agree
Scale of Measurement: Last closed question of the assessment sheet				
1: Very Bad	2: Bad	3: Average	4: Good	5: Very Good

TABLE 5.7 – RESULTS OF THE ASSESSMENT SHEET

Item of Measurement	Description
The presentation of the proposed sets is adequate	52.6% agree and 5.3% disagree
The content of the proposed sets is adequate	61.2% agree or strongly agree, and no one disagrees
I believe that the proposed sets are comprehensive instruments for managing strategic projects	65% agree or strongly agree, and 10% disagree or strongly disagree
I believe that the proposed sets help systematise strategic project management	65% agree or strongly agree, and 15% disagree
I believe that the proposed sets will assist me in managing strategic projects	55% agree or strongly agree, and 10% disagree
I believe that the proposed sets are effective facilitators for successful strategic project management	63.1% agree or strongly agree, and 5.3% disagree
I intend to use the proposed sets as a benchmark for successful strategic project management	35.3% agree, and 35.3% disagree and strongly disagree
Overall score for the proposed sets	60% good and 40% average

According to the above results, the majority of the respondents consider the techniques as comprehensive and theoretically supported instruments that help systematise strategic project management, as well as effective facilitators for successful strategic project management. Managers seem to be broadly positive to whether the sets are well presented, as well as whether the sets will assist them in managing strategic projects. The respondents, however, are sceptical about using the proposed sets as a benchmark for successful strategic project management. Finally, the overall score for the sets is approximately good.

There are a few reasons for the above results. First, a wide range of multidisciplinary managers assessed the techniques. Second, there appears to be two distinct groups of managers: one, which is bigger, is quite enthusiastic on using techniques in managing strategic projects, and the other, which is sceptical about the real applicability of techniques. Third, some managers appear to resist adopting a new procedure, which is adopted only if it is field proven. Finally, the last closed question was strongly framed by attempting to associate the proposed techniques with a benchmark in the project management field.

The open-ended question asked for comments on the proposed sets of techniques, which are discussed in the following. Most managers are keen to use the techniques. A few managers resist accepting the sets for a number of reasons. First, they are not fully familiar with recently developed (not field proven) techniques. Second, they are wary of incorporating new routines and using the whole set of techniques. Third, the application of the techniques is a function of the application itself, which depends on the simplicity and expediency of their use. Finally, the techniques must require corporate sanctions to gain credit. A few more managers consider the techniques to be a useful reference to support a much wider process. Managers expect more than just techniques, but a methodology for applying them. In general, they argue that the sets are built in a systematic and logical way and present an adequate list of techniques. However, there are few issues regarding the appropriateness of the proposed sets. First, they do not help significantly in choice or implementation. Second, they do not include organisational issues. Third, they do not address the human factor in selecting, building and sustaining an appropriate project team. Finally, audits and peer reviews are crucial in project management, and allow managers for developing on the results obtained from techniques. The quality of interaction between technical, organisational and business aspects makes a difference in project management.

The evaluation set of techniques is considered to be suitable. However, it does not assess the risk profile of a project portfolio. Managers argue that there are too many techniques in the control set, where interventions play a key role. The control set overstates the use of performance monitoring techniques at the expense of techniques that enable the decisions to be made or redesign to be initiated. It also overlooks the relationship between corporate and project performance, which often occurs during the portfolio review.

5.4 – Revisiting the Research Question

Having proposed and validated the sets of techniques for facilitating successful strategic project management, it is time to revisit and challenge the research question of the current research project. The research question, discussed in Chapter 3, is ***"What is the role of techniques in facilitating successful strategic project management and the elements involved in that management?"*** The following paragraphs discuss the current research question.

Techniques are effective facilitators in managing strategic projects successfully. Managers are often familiar with and use a diverse number of techniques to tackle most of the success elements. These techniques represent the core of the proposed sets of techniques. However, in contrast to claims made by Rockart (1979), this research suggests that success elements have not received constant and careful attention from management. Indeed, some of these elements are only occasionally addressed.

Furthermore, other techniques address elements to which managers pay considerable attention but they are not believed to explain the success of a strategic project in the North Sea. However, these elements cannot be left out of the analysis, as these elements may be critical to success in other contexts. These techniques also take part in the proposed sets of techniques.

There are some techniques that tackle the elements to which respondents are indifferent, and are not believed to explain a strategic project's success. These elements cannot be also left out of the analysis, as they may be critical to success in other contexts, and they are considered to be specific to companies, projects or situations. These techniques are referred to in footnotes in the proposed sets of techniques.

The combination of traditional and recently developed techniques appears to minimise the gap between the elements that receive careful attention from managers (financial elements) and success elements (internal business elements), as well as taking into account the process and non-financial elements involved in successful strategic project management.

Nevertheless, there is also a gap between theory and practice. First, respondents are not aware of (and do not regularly use) some techniques that potentially could address the success elements involved in managing strategic projects. Respondents frequently tend to use a subset of simple, familiar techniques. Second, respondents occasionally misuse techniques to address some of the elements. Finally, the reviewed literature also recommends recently developed techniques, with which respondents are usually unfamiliar.

Some important issues must be outlined regarding both the limitations and magnitude of the current research project. First, the proposed sets of elements involved in strategic project management are a subset of the sufficient set of elements. Second, a theoretical review of techniques is unlikely to be satisfactory in absolute terms: the use of techniques in practice seems to be, in general terms, invariably broader than those suggested by the reviewed literature.

Third, the preliminary categorisation of techniques into evaluation and control techniques constrained, to some extent, the comprehensiveness of techniques in tackling the elements involved in managing strategic projects from a theoretical standpoint. However, the exploratory investigation of the extent to which techniques address these elements in theoretical terms was useful as a starting point. The research findings revisited, challenged and adjusted the exploratory investigation undertaken during the design of the sets of techniques, taking into account the most used techniques in practice.

Fourth, the current research proposed two separate sets of techniques to stress which techniques are most frequently applied in each stage (evaluation and control) of strategic project management. However, techniques are flexible facilitators in managing strategic projects: they can be used for both evaluating and controlling strategic projects. The design of the sets observed the high flexibility of the techniques, and they broadly adopted the same realm of techniques. The control set of techniques, for instance, recommends the use of forecasting and scenario analysis, which are in essence planning techniques. Evaluation and control seem to be interconnected processes, although managers often perceive them as discrete and independent.

Fifth, individual, explicit knowledge (*e.g.* techniques) alone is not sufficient for that purpose, as certain elements are not quantifiable, and techniques often tend to focus on quantified aspects. Group, explicit knowledge (*e.g.* reports), and the transferral of individual to group knowledge (*e.g.* peer reviews) complement techniques in managing strategic projects. Judgement and vision complement them in managing strategic projects. However, techniques are the focus of the current work.

Sixth, the formal use of techniques occurs more frequently in the evaluation stage rather than in the control stage. Techniques seem to be, therefore, often informally applied in the control stage.

Two important points must be highlighted here. First, although techniques are often formally used in the evaluation stage, there is a need to apply techniques that introduce the notion of success during the evaluation stage from a strategic project's early outset. These techniques (*e.g.* Balanced Scorecard.) address various evaluation success elements, namely isolated and portfolio characteristics and internal alignment elements. Second, there is a need for a formal application of techniques that introduce the notion of success during the control stage. These techniques (*e.g.* Balanced Scorecard) address several control success elements, namely "soft" internal elements and internal business control outputs.

Finally, although the recommended techniques in the proposed sets must be aligned with managerial needs for application, respondents appear to lack training in some traditional techniques, but they essentially lack understanding of recently developed or complex techniques. Respondents are fully aware of a number of traditional techniques, and regularly use them for managing strategic projects. However, they are unfamiliar with complex or recently developed techniques, and therefore rarely use them. Recently developed techniques seem to be potentially powerful techniques in facilitating a strategic project's success, and might be usefully combined with traditional techniques in order to address most of the elements involved in successful strategic project management.

However, managers resist adopting new procedures (Foss, 1997b), recently developed techniques are often considered complex (Slater *et al*, 1998) and there is no scientific evidence of a positive cost-benefit analysis arising from their application (Oyon and Mooraj, 1999). Therefore, as recently developed techniques are not mature, in the first instance they might be introduced as *'a way of thinking'*, as suggested by Schoemaker (1995) and Amram and Kulatilaka (1999b), in order to reduce managerial scepticism.

5.5 – Concluding Remarks

This chapter proposed sets of techniques as facilitators for managing strategic projects successfully, as applied to the UK upstream oil and gas sector. The chapter also presented an assessment sheet to validate the appropriateness of the proposed sets, and ended with revisiting and challenging the research question of the current research project.

The next chapter will close this research project. A number of conclusions for the current study and recommendations for future research will be pointed out and thoroughly discussed.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

This chapter closes this study and presents the conclusions of this investigation and recommendations for further research. This research project discussed extensively the role of techniques in assisting successful strategic project management, and the elements involved in that management, as applied to the UK upstream oil and gas sector.

Strategic project management is a challenging topic. First, strategic projects involve high uncertainty, comprise intangible benefits and promise attractive long-term financial outcomes. They are the learning vehicles whereby a vision can be realised and implemented, and they represent the core of corporate growth, change and value creation. Second, strategic projects must be managed successfully within an increasingly uncertain, changeable and competitive climate. However, there is a lack of theoretical investigation on, and empirical contribution to, the role of techniques as facilitators for successful strategic project management.

The research findings resulted from a triangular combination of exploratory interviews, questionnaires and follow-up interviews. On the basis of these methods, sets of techniques are proposed for facilitating successful strategic project management, and validated through assessment sheets. The limitations of the proposed methodology discussed along this work, however, did not compromise the generalisability of the results. The methodology was applied to the UK upstream oil and gas sector. This sector is an interesting domain of application, as it involves high level of uncertainty, strict environmental legislation, prohibitive regulations and an intense degree of competitiveness.

According to the research findings, a traditional engineering perspective on project management still seems to dominate. The sector appears to be attached to financially orientated decisions, focuses on financial issues, seeks to control the efficiency of tangible assets, resists changing current routines and overemphasises shareholders' interests, sometimes at the expense of customers and employees.

Nevertheless, great attention is paid to environmental (green) and geological issues. Internal alignment also appears to be relevant in strategic project management, especially during the evaluation stage. Moreover, the foundations of the Resource-Based View of the firm (learning, managerial interaction, resource deployment and innovative technologies) play a key role in that management. However, political, economic, social and market issues do not receive sufficient attention from managers.

The results suggest that the current trends in the sector indicate a lack of new opportunities in the UK petroleum province, the search for new markets and opportunities on an alliance basis, and a focus on cost reduction, reengineering and the introduction of new information technologies.

The present thesis validated a '*balanced*' set of multidisciplinary elements involved in strategic project management. These are divided into process elements (*i.e.* elements involved in the evaluation and control processes) and outputs (*i.e.* outcomes of the evaluation and control processes), and belong to three perspectives: financial, internal business and external environment. The elements can be grouped into those that are (1) relevant and frequently addressed; (2) relevant but occasionally addressed; and (3) indifferent and occasionally addressed.

There are some elements identified by this research that are believed to be drivers of successful strategic project management, known as success elements. However, success elements do not necessarily receive constant and careful attention from management, which disclaims Rockart (1979). Managers are also indifferent to, and occasionally address, certain success elements, as these are critical only in some specific contexts, which seems to disclaim Rockart (1979), Kaplan and Norton (1992), Bontis *et al.* (1999), Clarke (1999) and Turner (2000a).

In the evaluation stage, the relevant and frequently addressed success elements are feasibility, timescale, durability, corporate alignment, competency alignment and financial capability. The relevant but occasionally addressed success elements are flexibility and interdependency. The indifferent and occasionally addressed success element is financial leverage. In the control stage, the relevant and frequently addressed success elements are project milestones scanning, product monitoring, managerial interaction and resource deployment. The relevant but occasionally addressed success elements are learning, organisational communication, organisational adaptability, employee development and innovative technologies. The indifferent and occasionally addressed success elements are political scanning, economic scanning, market scanning, innovative routines and employee satisfaction. Success elements are mainly process elements, and belong predominantly to the internal business perspective.

There are elements to which managers pay significant attention, but these elements are not believed to address success. These elements can be relevant and frequently addressed, and relevant but occasionally addressed. In the evaluation stage, the relevant and frequently addressed elements are time, geological uncertainty, financial market uncertainty, environmental uncertainty, technological uncertainty, cash flows, financial summary measures and environmental impact. The relevant, but occasionally addressed elements are economic uncertainty and organisational impact. In the control stage, the relevant and frequently addressed elements are budgetary constraints, financial market scanning, environmental scanning, financial targets, timescale targets and environmental targets. The relevant but occasionally addressed elements are corporate alignment scanning, corporate alignment and technological development. This set of elements consists of both process elements and outputs, and belongs largely to the financial and external environment (green issues) perspectives.

Finally, there are the elements to which managers pay little attention, and these elements are not believed to address success. These are indifferent and occasionally addressed elements. In the evaluation stage, they are competition, political uncertainty, social uncertainty, political impact, market share and social impact. In the control stage, they are customer satisfaction and market position. This set of elements consists of both process elements and outputs, and belongs essentially to the external environment perspective.

As has been discussed in Chapter 4, some interesting, and sometimes surprising, insights into the elements involved in strategic project management are described in the following. First, flexibility and learning are success elements, but are only occasionally addressed. Second, managers are often indifferent to such elements as financial leverage, competition, innovative routines, employee satisfaction and customer satisfaction. Finally, managers pay little attention to market, political and social issues, especially in the evaluation stage. In summary, the elements critical to success, and those that managers focus on, are not a good match.

According to the findings of the present research, techniques are effective facilitators for managing strategic projects, especially in the evaluation stage, as managers apply a diverse range of techniques to address most elements involved in strategic project management. The above evidence disclaims Dyson and Foster (1980), Bontis *et al.* (1999) and Mooraj *et al.* (1999), who have referred to a restricted appropriateness and use of techniques to address the elements involved in strategic project management.

Nevertheless, techniques alone are not sufficient for that purpose, as certain elements are not quantifiable, and techniques often tend to focus on quantified aspects. Reports and peer reviews, for instance, complement techniques in managing strategic projects.

As found by this research, techniques are more frequently and formally used in the evaluation stage than in the control stage. Moreover, techniques are flexible instruments, as they are applied for both evaluating and controlling strategic projects. Evaluation and control seem to be, therefore, interrelated processes, as claimed by Simons (1995), although managers often perceive them as discrete and independent (Amram and Kulatilaka, 1999a,b).

In this research project, managers are invariably familiar with, and widely use, net income, ROI, payback period, IRR, and NPV, as claimed by Barwise *et al.* (1989), Stewart (1994) and Buckley and Tse (1996). Managers consider net income and ROI company standards, and IRR and NPV fundamental requirements, except for the payback period. The payback period is less applied than the previous measures, and it lacks managerial credibility. Managers criticised it for being a simplistic rule of thumb that usually ignores the time value of money, although suitable for less stable environments. Managers also suggest the use of other techniques that were not originally included in the questionnaire, namely CAPEX, ROCE, life cycle costs, development cost per barrel and reserve-to-production ratio (R/P).

Managers are also closely familiar with, and invariably use, sensitivity analysis, which is, according to a planning analyst, "*a simple to do, simple to understand tool*". Although managers are widely familiar with cost-benefit analysis, they only occasionally use it for specific projects (*e.g.* technological and environmental projects), or in parts of a project.

Managers are quite unfamiliar with, and rarely use, leveraged NPV and human resource accounting (HRA). Leveraged NPV is rarely used because managers invariably invest in attractive investments without seeking external funding. However, managers in small firms are usually more aware of leveraged NPV, as they search for external funding. Managers usually separate investment from financial decisions, and commonly use leveraged NPV for non-core business investments.

Managers are highly aware of, and regularly use some techniques that account for uncertainty, namely forecasting, risk analysis and risk-adjusted NPV. Forecasting is often used at a corporate level, and is considered a primary technique. It is the technique that incorporates uncertainty with the highest level of application among managers who are aware of it, even higher than the payback period. Risk analysis is considered a project-specific (*e.g.* exploration and environmental projects) but influential technique, often used in the early stages of evaluation, and occasionally in a qualitative way. Risk-adjusted NPV is considered a project specific (*e.g.* exploration projects) but fundamental measure.

Managers are highly familiar with, but only occasionally use, other techniques that incorporate uncertainty, namely scenario analysis, decision-tree analysis and simulation. Scenario analysis is often used at a corporate level at specific instants through a limited number of scenarios, sometimes for *ad hoc* planning. It is usually used for corporate planning and international business evaluation. It is considered a controversial technique: some managers like it, some are reluctant to accept it, and others dislike it. Managers are occasionally inclined to use sensitivity analysis instead.

Decision-tree analysis and simulation are both considered project-specific (*e.g.* exploration and infrastructure projects) techniques. Decision-tree analysis is considered to be a powerful technique that focuses on key variables, and simpler than continuous probabilistic techniques, such as risk analysis. It is usually associated with expected monetary value, and it is often used late when decisions are already made. Simulation is considered to be an intensive technique, which deals with complex problems associated with multiple technical variables, and cost-effective for large scale projects.

Managers are highly aware of, but rarely apply, contingency analysis. Contingency analysis is usually associated with contingent costs and is commonly replaced by sensitivity analysis.

Managers often apply some techniques informally. They are highly familiar with, but only occasionally use some techniques that deal with some degree of mathematical complexity, namely scheduling and financial performance monitoring. Scheduling, compared to other techniques that deal with some degree of mathematical complexity, is the most used technique among managers who are aware of it, particularly in big firms. It is used for both planning and control, and it is also considered an operational technique. Financial performance monitoring is still used at a corporate level to measure business performance. However, a few companies are now using it as a benchmark for project control. Managers are highly familiar with, but rarely use capital rationing. Capital rationing is informally used at a corporate level to measure investment efficiency and ranking via cost management.

Managers are also fully aware of, but rarely use optimisation. Optimisation can be used for both project evaluation and control. There are two meanings: first, re-engineering the technical side of a project in order to reduce costs. Second, to find the most effective use of capital that generates the optimal outcomes in a portfolio context. In the case of portfolio management, optimisation is considered a complex, time consuming technique informally or intuitively used at a corporate level, which accounts for different departmental interests.

Managers are fairly aware of, and rarely apply ABC and manpower rationing. ABC is generally replaced by homemade procedures. Manpower rationing is indirectly used through cost management (*e.g.* organisational charts) and is crucial for large scale projects.

Managers are rarely aware of, and seldom apply, complex techniques, namely utility function and game theory. While the main barrier for using utility function is the assessment of one's risk aversion level, the principles of game theory are just informally applied, for instance, for block bidding.

Finally, managers are also rarely aware of, and seldom apply, recently developed techniques, namely real options, EVA, Balanced Scorecard and Intellectual Capital, as claimed by Slater *et al.* (1998). These techniques are intended to create value from the outset of a project, and to drive a firm's superior performance and aspiration. Real options are considered extremely complex and difficult to quantify. A few companies use EVA for project post-completion assessment, and a few more are about to use it in the near future.

A few companies have already started to use the Balanced Scorecard to measure business unit performance. A few more companies are introducing it for setting goals and control measures for project management. The Balanced Scorecard seems to be a technique with a growing application among managers who are aware of it. Finally, Intellectual Capital is often identified by knowledge management.

Nevertheless, managers do not appear to use recently developed techniques to tackle most of the relevant but only occasionally addressed success elements, namely flexibility (*e.g.* Real Options), learning, organisational communication and organisational adaptability (*e.g.* Balanced Scorecard), and employee development and innovative technologies (*e.g.* Intellectual Capital). There is, therefore, the potential for the managerial application of these techniques to drive a firm to long-term success.

The current research proposes sets of techniques for assisting and systematising successful strategic project management. The evaluation and control sets of techniques are in line with Chapman and Howden (1997), who combined several techniques as a process of managing projects. These sets are simple, general and comprehensive instruments, which combine a variety of the most frequently used traditional techniques with recently developed techniques in order to tackle most of the elements involved in successful strategic project management. These sets of techniques are applicable for different categories of strategic projects, types and sizes of companies, and levels of decision-making. They are theoretically supported, are aligned with managerial needs for application, build a bridge among process elements and outputs involved in strategic project management, act as success facilitators in the evaluation stage, and formally address success in the control stage.

As the respondents of the assessment sheets have stated, the proposed sets of techniques are comprehensive, theoretically supported instruments that help systematise strategic project management, as well as effective facilitators for successful strategic project management. Managers are often keen on using the techniques. However, the application of the techniques is a function of the application itself, which depends on the simplicity and expediency of their use, and on corporate sanctions, in order to gain credit. The evaluation set of techniques is considered to be suitable, but it does not assess the risk profile of a project portfolio. Nevertheless, the control set includes too many techniques, where interventions play a key role, as well as overstating the use of performance monitoring techniques at the expense of techniques that enable the decisions to be made or redesign to be initiated, and overlooking the relationship between corporate and project performance, which often occurs during the portfolio review.

The proposed sets include recently developed techniques, which are often complex and not yet mature instruments. These techniques cannot be simply imposed, as, according to the assessment sheets, managers resist adopting new procedures and need to develop a practical understanding on these techniques. In the first instance recently developed techniques might be introduced as *'a way of thinking'*, as suggested by Schoemaker (1995) and Amram and Kulatilaka (1999b), in order to reduce managerial scepticism. Some authors suggest the combination of options thinking, resource-based thinking and strategic thinking as part of a new paradigm for proactively managing strategic projects, as discussed below.

According to Leslie and Michaels (1997) and Amram and Kulatilaka (1999b), options thinking proposes a firm's ability to scan both market and product information in order to leverage an option's value, *i.e.*, make an option value more than the price paid to get or generate it. It also advocates that pre-emptive investments discourages potential entrants by restricting their payoffs as a result of impacting the market structure (*ibid.*) and by strengthening the proprietary nature of options (Buckley, 1998).

As Foss (1997a), Buckley (1998) and Grant (1998) advocate, resource-based thinking claims that a firm must be adaptive and generative, and dynamically develop inimitable resources and competencies supported by managerial involvement, commitment and leadership. Inimitable resources and competencies represent a firm's *'crown jewels'* (Grant, *op. cit.*: 193), and, according to Foss (*op. cit.*) and Grant (*op. cit.*), they are responsible for identifying, acquiring, sustaining and renewing a firm's competitive position in order to allow a firm for the appropriation of superior rents.

According to Schoemaker (1992, 1995) and Bunn and Salo (1993), strategic thinking identifies core competencies to be developed or co-opted as a way of leading to more innovative options. These core competencies, which must be continuously in line with a firm's mission and goals, should be the most robust and synergistic competencies, *i.e.* those that permeate diverse possible futures and multiple strategic segments, in order to enable a firm to create value.

Finally, the most remarkable research finding of the current study is to alert managers that there appears to be a gap between the elements to which managers often pay considerable attention in managing strategic projects, namely financial issues, and the elements that are often believed to explain successful strategic project management, namely internal business issues. Managers seem to focus on the symptoms rather than the underlying causes. As a strategic planning manager observed, *"I used to work for a company where such a gap existed, ultimately leading to the demise of the company"*.

There are also some other interesting findings. First, a strategic project's financial success is also believed to be explained by non-financial elements. Second, process elements are believed to explain a strategic project's success rather than the outputs. The latter seems to be a controversial finding, as a project's success is most closely assessed via its closing (financial) results. However, outputs record success rather than explain it.

Western culture tends to overemphasise the financial perspective, and western managers are inclined to focus their attention on financial aspects. Nevertheless, the relevance of environmental (green) issues to strategic project management cannot be ignored. Furthermore, the internal business perspective is believed to explain successful strategic project management. In the first instance, this study suggests that the convergence of financial, environmental (green) and internal business issues might be a healthy route for the UK upstream oil and gas sector towards successful strategic project management. In the case of specific situations, namely overseas projects, external environment (*e.g.* social, political and economic) issues might also be taken into account.

This research seeks to be an embryo for further work to be developed in the project management field. It is not an end *per se*, but a means of transforming the managerial understanding on the multidisciplinary nature of strategic projects, the comprehensiveness of strategic project management, the gap between the elements managers often pay great attention to in managing strategic projects and those elements that are often believed to explain a strategic project's success, and the effective use of techniques as facilitators for successful strategic project management.

Nevertheless, it is important to mention that the proposed sets of techniques are not a guarantee of a project's success. As has been mentioned by some questionnaires and assessment sheets, reports and peer reviews, and particularly the human factor, such as skills and *'know-how'* to make use of the techniques, and organisational issues, namely managerial vision, judgement and experience, complement techniques in facilitating a firm's long-term prosperity. In summary, the combination of different forms of knowledge, such as individual, group, explicit and tacit knowledge, with the transferral of individual experience to group knowledge, the constraints to one's actions in making use of techniques and the actions to put these various forms of knowledge into practice appear to impact on successful strategic project management.

Finally, this research project recommends future research direction. The focus might be on (1) reviewing the proposed set of elements involved in strategic project management (for instance, to include issues associated with partners and contractors) and the range of techniques for managing strategic projects; (2) investigating the role of other forms of knowledge rather than individual, explicit knowledge (*e.g.* techniques) in supporting successful strategic project management; (3) exploring the role of techniques in the process of conceiving a strategic project; (4) extending the methodology to the upstream oil and gas sector in different countries or to other UK industries; and (5) attempting to link successful strategic project management to a firm's success.

The most interesting research in the future will be motivated by the conflict between, on the one hand, the usual managerial disregard for the applicability of recently developed techniques, which promise a project's success, and, on the other hand, the managerial claim on managing their strategic projects successfully without the use of these recently developed techniques. It is stimulating to test whether the proposed sets of techniques contribute to, and differentiate, successful strategic project management between firms that apply these proposed sets from those which do not apply them.

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TEXT CUT OFF IN ORIGINAL

- APPENDIX I -

Interview Schedule

Name:
Date:

1. What is strategy?
2. What is strategic opportunity?
3. What is a strategic project?
4. What are the Exploration and Production (E&P) Department's strategies, strategic opportunities and strategic projects?
5. What are the E&P Department's categories of strategic projects?
6. What is the evaluation of strategic projects?
7. How is, and should be in your opinion, the evaluation of strategic projects carried out?
8. What are the main elements involved in evaluating strategic projects?
9. What are the uncertainties involved in evaluating strategic projects?
10. Do you use any techniques for evaluating strategic projects?
11. Are the existing techniques for evaluating strategic projects effective? If not, what else is necessary for this purpose?
12. What is the control of strategic projects?
13. How is, and should be in your opinion, the control of strategic projects carried out?
14. Do you use any techniques for controlling strategic projects?
15. Are the existing techniques of controlling strategic projects effective? If not, what else is necessary for this purpose?
16. What are the main elements involved in controlling strategic projects?
17. What are the main actions in managing strategic projects?
18. How should strategic projects be managed effectively?

- APPENDIX II -

Questionnaire

Strategic Project Management in the UK Upstream Oil and Gas Sector

A Study by Warwick Business School and The Institute of Petroleum

Please note: Third parties will NOT be given access to individual company data. Data will be used for research purposes only.

If you have any queries about this survey, please contact Boris Asrilhant at Warwick Business School:

Phone: (0) 1203 524504
Fax: (0) 1203 524650
E-mail: survey99-wbs@wbs.warwick.ac.uk

Guidance for Completing the Questionnaire

This page provides some information to complete the questionnaire. Please take a few minutes to read them carefully.

THE AIMS OF THIS RESEARCH: This research aims to identify important elements (characteristics, factors and outputs) of strategic project management and the role of techniques in supporting the management process.

WHY IS THE MANAGEMENT OF STRATEGIC PROJECTS IMPORTANT? Strategic projects represent the core of corporate growth and change. They are essential if a firm wants to achieve and sustain long-term prosperity. Nevertheless there is a lack of systematic understanding of what constitutes effective strategic project management and what guides and supports such a decision-making process.

WHAT ARE STRATEGIC PROJECTS? Strategic projects are part of an extensive investment programme for long-term corporate upgrades and extensions responsible for ensuring strategic positioning. Strategic projects often involve high uncertainty, comprise intangible benefits and promise attractive long-term outcomes. In this piece of work strategic projects are taken to be those projects which enclose strategic features and cover a wide range of categories such as field exploration, giant field development, gas utilisation, company acquisition and joint venture, among others.

WHAT IS STRATEGIC PROJECT MANAGEMENT? The management of strategic projects comprises two main stages: evaluation and control. **Evaluation** involves the design, planning, and valuation of a project, which ends at its authorisation. **Control** comprises the management, review and redesign of the project through to its completion.

Please note:

1. This survey covers both evaluation and control of strategic projects. If you are not involved in both stages, please answer only the sections relevant to you.
2. If you have not been involved in any strategic project, please forward this questionnaire to someone who has been involved at a managerial level.

Section 1: Management of Your Last Strategic Project

1. Considering the **LAST COMPLETED STRATEGIC PROJECT you were involved in**, please tick as appropriate (✔) to what category(ies) your last strategic project belongs:

- ❑ Field exploration
- ❑ Long-term field testing (*e.g.* pilot system)
- ❑ Giant field development
- ❑ Marginal field development
- ❑ Infrastructure (*e.g.* a new processing plant or new pipeline)
- ❑ Gas utilisation
- ❑ Logistic (*e.g.* plant redesign to reduce production costs)
- ❑ High overhead asset decommissioning
- ❑ Asset disposal
- ❑ Technology (or methodology) research and development
- ❑ Corporate information system
- ❑ Employee capability programme
- ❑ Organisational restructuring
- ❑ Joint venture
- ❑ Partnership
- ❑ Strategic alliance
- ❑ Company acquisition
- ❑ Company merger
- ❑ Market entry
- ❑ Other (Please specify): ....

2. Please indicate the **investment climate during the management of your last strategic project:**

Industry's economic situation	Recessive	1	2	3	4	5	Expansive
Oil price	Low	1	2	3	4	5	High
Your firm's financial situation	Poor	1	2	3	4	5	Excellent
Your firm's market position	Weak	1	2	3	4	5	Strong
Strength of competition in the industry	Low	1	2	3	4	5	High
Your firm's attitude towards risk	Conservative	1	2	3	4	5	Innovative
Your firm's decision-making style	Directive	1	2	3	4	5	Consensus-driven

3. Please indicate to what extent do you agree that your **last strategic project** was:

	Strongly Disagree 1	2	3	4	Strongly Agree 5	Don't Know
Successfully completed (*i.e.* goals and results were successfully attained)	1	2	3	4	5	❑
Financially successful	1	2	3	4	5	❑
Successful for strategic (*i.e.* non-financial) reasons	1	2	3	4	5	❑

4. Please give the main reasons for (and barriers to, if applicable) successful completion:

____

____

____

Section 2: Techniques for Managing Strategic Projects

1. Considering the **techniques available for managing strategic projects**, please tick as appropriate **(✔):**

- whether you are **aware of each technique;**
- whether you think that **in general the technique is used;** and
- whether you believe that **the technique was used in your last strategic project.**

Please comment, where relevant, on the reasons (*e.g.* easily communicated, simple/complex, new, frequently/rarely used, tendency to be used in the future) **for using or not using each technique in managing strategic projects**.

	Are you aware of:	Is it generally used:	Was it used in your last strategic project:	Any comment about why using it or not:
1. Return on Investment (ROI)	❑	❑	❑	…………………………………………
2. Net Income	❑	❑	❑	…………………………………………
3. Payback Period	❑	❑	❑	…………………………………………
4. Internal Rate of Return	❑	❑	❑	…………………………………………
5. Net Present Value (NPV)	❑	❑	❑	…………………………………………
6. Leveraged NPV	❑	❑	❑	…………………………………………
7. Risk-Adjusted NPV	❑	❑	❑	…………………………………………
8. Sensitivity Analysis	❑	❑	❑	…………………………………………
9. Cost-Benefit Analysis	❑	❑	❑	…………………………………………
10. Forecasting	❑	❑	❑	…………………………………………
11. Scenario Analysis	❑	❑	❑	…………………………………………
12. Contingency Analysis	❑	❑	❑	…………………………………………
13. Decision-Tree Analysis	❑	❑	❑	…………………………………………
14. Simulation	❑	❑	❑	…………………………………………
15. Risk Analysis	❑	❑	❑	…………………………………………
16. Capital Rationing	❑	❑	❑	…………………………………………
17. Manpower Rationing	❑	❑	❑	…………………………………………
18. Scheduling (*e.g.* PERT-CPM)	❑	❑	❑	…………………………………………
19. Activity-Based Costing	❑	❑	❑	…………………………………………
20. Financial Performance Monitoring (*e.g.* ROI over time)	❑	❑	❑	…………………………………………
21. Optimisation	❑	❑	❑	…………………………………………
22. Real Options	❑	❑	❑	…………………………………………
23. Game Theory	❑	❑	❑	…………………………………………
24. Utility Function	❑	❑	❑	…………………………………………
25. Cognitive Mapping	❑	❑	❑	…………………………………………
26. Economic Value Added™	❑	❑	❑	…………………………………………
27. Balanced Scorecard™	❑	❑	❑	…………………………………………
28. Human Resource Accounting	❑	❑	❑	…………………………………………
29. Intellectual Capital™	❑	❑	❑	…………………………………………
30. Any other (Please specify:)				
…………………………………………	❑	❑	❑	…………………………………………

Section 3: Evaluation of Strategic Projects

- Considering the evaluation of strategic projects **IN GENERAL TERMS**, please indicate to what extent each element is relevant to SUCCESSFUL **EVALUATION** and is addressed in practice.
- Considering the evaluation of your **LAST STRATEGIC PROJECT**, please tick (✓) whether the element stated was applicable and, if it was, then specify which (if any) techniques (*e.g.* payback period, NPV, scenario analysis, etc) were used to address the element.

1. STRATEGIC PROJECT'S CHARACTERISTICS

	IN GENERAL TERMS Absolutely Irrelevant … Absolutely Relevant	IN GENERAL TERMS Never Addressed … Always Addressed	IN YOUR LAST STRATEGIC PROJECT
FEASIBILITY (Strategic project's difficulty of realisation and implementation)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………
TIMESCALE (Strategic project's time to maturity)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………
DURABILITY (Strategic project's economic life, *e.g.* platform production life span)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………
FLEXIBILITY (Strategic project's flexibility to adapt to changes in external circumstances)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………

2. FINANCIAL FACTORS

	IN GENERAL TERMS Absolutely Irrelevant … Absolutely Relevant	IN GENERAL TERMS Never Addressed … Always Addressed	IN YOUR LAST STRATEGIC PROJECT
TIME (Time value of money)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………
FINANCIAL CAPABILITY (Firm's financial situation)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………
FINANCIAL LEVERAGE (Firm's requirement to raise external funding, *e.g.* project finance, leasing)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………
FINANCIAL MARKET UNCERTAINTY (Uncertainty related to financial market variables, *e.g.* oil price, exchange rate)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………

3. EXTERNAL FACTORS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant ... Absolutely Relevant	Never Addressed ... Always Addressed	
COMPETITION (Firm's rivalry to competitors)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
ECONOMIC UNCERTAINTY (Uncertainty related to economic environment, *e.g.* growth, inflation)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
SOCIAL UNCERTAINTY (Uncertainty related to social environment, *e.g.* cultural issues, consumer attitudes)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
POLITICAL UNCERTAINTY (Uncertainty related to political environment, *e.g.* taxation, expropriation, government support)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
ENVIRONMENTAL UNCERTAINTY (Uncertainty related to environmental legislation, pressure groups)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
GEOLOGICAL UNCERTAINTY (Uncertainty related to geological issues, *e.g.* oil(gas) reserve)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
TECHNOLOGICAL UNCERTAINTY (Uncertainty related to changes in technology)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………

4. INTERNAL FACTORS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant ... Absolutely Relevant	Never Addressed ... Always Addressed	
CORPORATE ALIGNMENT (Strategic project's adherence to corporate mission and goals)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
COMPETENCY ALIGNMENT (Strategic project's fit with corporate strengths)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
INTERDEPENDENCY (Strategic project's interaction with other projects and activities)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………

5. OUTPUTS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant — Absolutely Relevant	Never Addressed — Always Addressed	
CASH FLOWS (Costs and benefits by time period)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
FINANCIAL SUMMARY MEASURES	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
ENVIRONMENTAL IMPACT (Strategic project's impact on environment)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
SOCIAL IMPACT (Strategic project's impact on society)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
POLITICAL IMPACT (Strategic project's impact on key stakeholders (*e.g.* government))	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
MARKET SHARE (Firm's market position due to the strategic project)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
ORGANISATIONAL IMPACT (Strategic project's impact on the organisation)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………

Section 4: Control of Strategic Projects

- Considering the control of strategic projects **IN GENERALTERMS**, please indicate to what extent each element is relevant to SUCCESSFUL **CONTROL** and is addressed in practice.
- Considering the control of your **LAST STRATEGIC PROJECT**, please tick **(✔)** whether the element stated was applicable and, if it was, then specify which (if any) techiques (*e.g.* Gantt Chart, PERT-CPM, financial performance monitoring, etc) were used to address the element.

1. FINANCIAL FACTORS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant … Absolutely Relevant	Never Addressed … Always Addressed	
FINANCIAL MARKET SCANNING (Monitoring of financial market information, *e.g.* oil price, exchange rate)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: ....
BUDGETARY CONSTRAINTS (Financial constraints affecting a strategic project's execution)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: ....

2. EXTERNAL FACTORS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant … Absolutely Relevant	Never Addressed … Always Addressed	
MARKET SCANNING (Monitoring of customer and competitor information, *e.g.* brand image, competitor activity)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: ....
ECONOMIC SCANNING (Monitoring of economic information, *e.g.* growth, inflation)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: ....
ENVIRONMENTAL SCANNING (Monitoring of environmental information, *e.g.* water emission, oil pollution)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: ....
POLITICAL SCANNING (Monitoring of political information, *e.g.* taxation, expropriation, government support)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: ....

3. INTERNAL FACTORS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant … Absolutely Relevant	Never Addressed … Always Addressed	
CORPORATE ALIGNMENT SCANNING (Monitoring of strategic project's adherence to corporate mission and goals)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
PROJECT MILESTONES SCANNING (Monitoring of progress against strategic project's milestones)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
PRODUCT MONITORING (Monitoring of product information, *e.g.* oil quality, appropriate gas supply)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
MANAGERIAL INTERACTION (Ability to promote involvement, commitment and leadership)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
RESOURCES DEPLOYMENT (Ability to apply current resources and competencies)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
LEARNING (Ability to learn from past experience, *e.g.* interim and post-appraisal)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
INNOVATIVE ROUTINES (Ability to change organisational routines)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………
INNOVATIVE TECHNOLOGIES (Ability to introduce new technologies)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………………

4. OUTPUTS

	IN GENERAL TERMS		IN YOUR LAST STRATEGIC PROJECT
	Absolutely Irrelevant … Absolutely Relevant	Never Addressed … Always Addressed	
FINANCIAL TARGETS (Degree to which financial targets (*e.g.* costs, incomes, financial summary results) are achieved)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
TIMESCALE TARGETS (Degree to which strategic project's deadlines are met)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
CUSTOMER SATISFACTION (Level of customer contentment achieved)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
ENVIRONMENTAL TARGETS (Degree to which environmental targets are achieved)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
MARKET POSITION (Level of market position achieved)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
CORPORATE ALIGNMENT (Degree to which corporate mission and goals are supported)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
EMPLOYEE SATISFACTION (Level of internal contentment and morale achieved)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
ORGANISATIONAL COMMUNICATION (Quality of internal communication around the strategic project)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
EMPLOYEE DEVELOPMENT (Degree of development of employee skills)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
TECHNOLOGICAL DEVELOPMENT (Degree of development and diffusion of technology)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………
ORGANISATIONAL ADAPTABILITY (Degree of organisational adaptability to changes in external circumstances)	1 2 3 4 5	1 2 3 4 5	Was this element applicable? ❑ Yes ❑ No If applicable, please list techniques (if any) used to address the element: …………………………………………………

Section 5: Strategic Project Management

1. Please indicate to what extent do you agree that, **IN GENERAL TERMS,** strategic projects you are involved in are:

	Strongly Disagree				Strongly Agree	Don't Know
Successfully completed (*i.e.* goals and results are successfully attained)	1	2	3	4	5	❑
Financially successful	1	2	3	4	5	❑
Successful for strategic (*i.e.* non-financial) reasons	1	2	3	4	5	❑

2. Considering strategic project management **IN GENERAL TERMS**, please indicate to what extent do you agree that:

	Strongly Disagree				Strongly Agree	Don't Know
The application of techniques is essential for successful strategic project management	1	2	3	4	5	❑
Simple techniques (*e.g.* NPV) represent an *'organisational ritual'* rather than instruments to assist managers to achieve successful strategic project management	1	2	3	4	5	❑
Managerial intuition complements techniques for successful strategic project management	1	2	3	4	5	❑
Luck boosts successful strategic project management	1	2	3	4	5	❑
Political decisions in the organisation inhibit successful strategic project management	1	2	3	4	5	❑

Please provide the following information about yourself and your organisation:

Respondent's Profile

Your Name (Optional): Dr/Mr/Ms.. Your Position: ....

Your Level of Management: ❑ Top ❑ Middle ❑ Lower ❑ Other (Please identify):...............................

No. of Years Working in the Field / in the Company / in your Position: ..../................../..................

Do you have any international managerial experience?.................. If yes, for how long?...............................

Firm's Profile

Firm's Name (Optional): ....Year of Establishment: ....

No. of Employees:.. Turnover in Dec/98 (£ M):..

Is your firm: Private or Public?............... Parent or Affiliate?................ Integrated?.........International?.........

This is the end of the questionnaire. Thank you for your co-operation!

In order to thank responding companies for their assistance with this study, a summary report of the research findings will be sent out. If you would like to receive a copy of the report, please attach your business card to this questionnaire.

Please put the completed questionnaire in the pre-paid envelope and send it to:

Boris Asrilhant, Doctoral Researcher, University of Warwick, Warwick Business School, Coventry, CV4 7BR

- APPENDIX III -

Covering Letter for Questionnaire

24 November 1999

Mr "X"
Position
Company "A"
Address

Dear Mr "X",

Ref.: Strategic Project Management in the UK Upstream Oil and Gas Sector

I, along with my supervisor, Prof. Robert G. Dyson, have established the above research project based in the Warwick Business School, with the collaboration of the Institute of Petroleum.

The survey aims to develop an understanding of the following key topics as applied to strategic project management in the UK Exploration and Production sector of the petroleum industry:

(1) Are techniques applied to manage strategic projects? If so, which ones are applied?

(2) What are the relevant elements involved in the strategic project management process, and how are they considered in practice?

(3) To what extent do techniques contribute to, and relevant elements affect, successful strategic project management?

I enclose a questionnaire for you to complete it. I would like to emphasise that there are no right or wrong answers: your answers represent your individual experience concerning the topic and thus your opinion is valid. Please return the questionnaire in the pre-paid envelope provided by 10 December 1999. If you have any concerns about the questionnaire please contact survey99-wbs@wbs.warwick.ac.uk. Your participation is extremely important and the success of our research project depends largely on your co-operation in completing our questionnaire.

All responses will be treated in strictest confidence and used for statistical purposes only. No individual business organisations will be identified as a result of the published statistical evidence complying with the Data Protect Act (1984). To thank participants for their assistance, I will be sending out a summary report on our research findings. If you would like to receive a copy of the report, please attach your business card to the questionnaire enclosed.

I would like to thank you for your co-operation, and look forward to sharing our results with you.

Yours sincerely,

Boris Asrilhant
Doctoral Researcher
Tel: (0) 1203 524504; Fax (0) 1203 524650
E-mail: survey99-wbs@wbs.warwick.ac.uk

- APPENDIX IV -

Assessment Sheet and Covering Letter

13 February 2001

Mr "X"
Position
Company
Address

Dear Mr "X",

Ref.: Strategic Project Management in the UK Upstream Oil and Gas Sector

In order to thank you for your co-operation with the above research project based in Warwick Business School, with the collaboration of the Institute of Petroleum, please find enclosed two documents:

(1) An executive summary of the research findings resulting from fifty-four questionnaires involving multidisciplinary managers holding different positions at fifteen companies of different sizes in the UK upstream oil and gas sector, and

(2) a proposal for evaluation and control sets of techniques for assisting and systematising successful strategic project management.

Please find enclosed a separate one-page assessment sheet regarding the second document ("Evaluation and Control Sets of Techniques"). We invite you to fill in the assessment sheet in approximately 10 minutes and return it in the stamped envelope provided by 28 February 2001. If you have any concerns about the assessment sheet, or would like to receive further details on the current research project, please contact survey99-wbs@wbs.warwick.ac.uk. Your collaboration is vital for validating the proposed sets and will be treated in the strictest confidence.

I would like to thank you again for your co-operation, and hope the research findings will contribute to your professional life.

Yours sincerely,

Boris Asrilhant
Doctoral Researcher
Tel: (0) 24 7657 3115; Fax (0) 24 7652 4650
E-mail: survey99-wbs@wbs.warwick.ac.uk

CONFIDENTIAL

ASSESSMENT SHEET

Please answer the following questions based on **the evaluation and control sets proposed at the end of the paper "Evaluation and Control Sets of Techniques"**:

	Strongly Disagree				Strongly Agree	Don't Know
1. The **presentation** of the proposed sets is adequate	1	2	3	4	5	❑
2. The **content** of the proposed sets is adequate	1	2	3	4	5	❑
3. I believe that the proposed sets are comprehensive instruments for managing strategic projects	1	2	3	4	5	❑
4. I believe that the proposed sets help systematise strategic project management	1	2	3	4	5	❑
5. I believe that the proposed sets will assist me in managing strategic projects	1	2	3	4	5	❑
6. I believe that the proposed sets are effective facilitators for successful strategic project management	1	2	3	4	5	❑
7. I intend to use the proposed sets as a benchmark for successful strategic project management	1	2	3	4	5	❑

	Very Bad	Bad	Average	Good	Very Good
8. Please give an **overall score** for the proposed sets	1	2	3	4	5

9. Please comment on the proposed sets, if necessary:

____

____

____

____

____

Respondent's Profile

Your Name (Optional): Dr/Mr/Ms.................................... Your Position: ....

THANK YOU AGAIN FOR YOUR CO-OPERATION!

Please put the completed assessment sheet in the stamped envelope and send it to:

Boris Asrilhant, Doctoral Researcher, University of Warwick, Warwick Business School, Coventry, CV4 7AL

- APPENDIX V -

Medians and Ranges for Skewed Items of Measurement

The following table presents the medians and ranges for the skewed items of measurement in the evaluation stage.

Item of Measurement	Criterion of Measurement	Median	Range
Feasibility	Level of Relevance	5	2
Timescale	Extent of Addressing	5	3
Time	Level of Relevance	5	2
Time	Extent of Addressing	5	3
Financial Market Uncertainty	Level of Relevance	5	3
Financial Market Uncertainty	Extent of Addressing	5	4
Geological Uncertainty	Level of Relevance	5	4
Geological Uncertainty	Extent of Addressing	5	2
Corporate Alignment	Level of Relevance	5	2
Cash Flows	Level of Relevance	5	4
Cash Flows	Extent of Addressing	5	4
Financial Summary Measures	Level of Relevance	5	4
Financial Summary Measures	Extent of Addressing	5	4
Environmental Impact	Extent of Addressing	4	4

The following table presents the medians and ranges for the skewed items of measurement in the control stage.

Item of Measurement	Criterion of Measurement	Median	Range
Budgetary Constraints	Level of Relevance	5	3
Budgetary Constraints	Extent of Addressing	5	3
Project Milestones Scanning	Level of Relevance	5	2
Learning	Level of Relevance	4.5	3
Financial Targets	Level of Relevance	5	3
Financial Targets	Extent of Addressing	5	2
Corporate Alignment	Level of Relevance	4	4

- APPENDIX VI -

Spearman's Rho

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE INVESTMENT CLIMATE DURING THE MANAGEMENT OF THE LAST STRATEGIC PROJECT

	Industry's Economic Situation	Oil price	Firm's Financial Situation	Firm's Market Position	Strength of Competition in the Industry	Firm's Attitude towards Risk	Firm's Decision-Making Style
Industry's Economic Situation	1.00	0.548* (0.00)	0.311* (0.025)	0.345* (0.012)	0.090 (0.524)	0.281* (0.043)	-0.106 (0.455)
Oil price		1.00	0.189 (0.172)	0.208 (0.131)	0.181 (0.190)	0.105 (0.449)	-0.090 (0.518)
Firm's Financial Situation			1.00	0.701* (0.00)	0.151 (0.274)	0.010 (0.941)	0.057 (0.684)
Firm's Market Position				1.00	0.151 (0.275)	0.205 (0.137)	0.295* (0.030)
Strength of Competition in the Industry					1.00	-0.019 (0.889)	0.051 (0.717)
Firm's Attitude towards Risk						1.00	0.123 (0.377)
Firm's Decision-Making Style							1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE DEGREE OF SUCCESS OF THE LAST STRATEGIC PROJECT MANAGEMENT

	Successful Completion	Financial Success	Success for Strategic Reasons
Successful Completion	1.00	0.478* (0.001)	0.387* (0.006)
Financial Success		1.00	0.330* (0.027)
Success for Strategic Reasons			1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE LEVEL OF RELEVANCE OF FINANCIAL EVALUATION ELEMENTS

	Time	Financial Market Uncertainty	Financial Capability	Financial Leverage
Time	1.00	-0.032 (0.819)	0.233 (0.093)	0.077 (0.589)
Financial Market Uncertainty		1.00	0.121 (0.385)	0.066 (0.642)
Financial Capability			1.00	0.514* (0.00)
Financial Leverage				1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE EXTENT OF ADDRESSING FINANCIAL EVALUATION ELEMENTS

	Time	Financial Market Uncertainty	Financial Capability	Financial Leverage
Time	1.00	0.230 (0.101)	0.280* (0.044)	0.136 (0.345)
Financial Market Uncertainty		1.00	0.206 (0.143)	-0.085 (0.564)
Financial Capability			1.00	0.441* (0.002)
Financial Leverage				1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE LEVEL OF RELEVANCE OF EXTERNAL EVALUATION ELEMENTS

	Geol. Uncertainty	Env. Uncertainty	Tech. Uncertainty	Economic Uncertainty	Political Uncertainty	Comp.	Social Uncertainty
Geological Uncertainty	1.00	0.081 (0.558)	0.209 (0.132)	-0.131 (0.345)	0.005 (0.969)	-0.136 (0.335)	-0.023 (0.871)
Env. Uncertainty		1.00	0.433* (0.001)	0.165 (0.234)	0.246 (0.073)	0.344* (0.012)	0.332* (0.015)
Tech. Uncertainty			1.00	0.118 (0.278)	0.182 (0.192)	0.155 (0.278)	0.179 (0.200)
Economic Uncertainty				1.00	0.323* (0.017)	0.176 (0.212)	0.485* (0.00)
Political Uncertainty					1.00	0.342* (0.013)	0.376* (0.006)
Comp.						1.00	0.313* (0.025)
Social Uncertainty							1.00

(*) Statistically significant correlation (p <.05).

Spearman's Rho (2-tailed Significance) for the Extent of Addressing External Evaluation Elements

	Geol. Uncertainty	Env. Uncertainty	Tech. Uncertainty	Economic Uncertainty	Political Uncertainty	Comp.	Social Uncertainty
Geological Uncertainty	1.00	-0.164 (0.235)	0.329* (0.016)	0.136 (0.328)	0.049 (0.725)	0.01 (0.993)	0.036 (0.803)
Env. Uncertainty		1.00	0.417* (0.002)	0.049 (0.725)	0.088 (0.529)	0.306* (0.028)	0.134 (0.348)
Tech. Uncertainty			1.00	0.454* (0.001)	0.035 (0.622)	0.098 (0.492)	0.256 (0.070)
Economic Uncertainty				1.00	0.273* (0.046)	0.194 (0.168)	0.425* (0.002)
Political Uncertainty					1.00	0.378* (0.006)	0.639* (0.00)
Comp.						1.00	0.245 (0.089)
Social Uncertainty							1.00

(*) Statistically significant correlation (p <.05).

Spearman's Rho (2-tailed Significance) for the Level of Relevance of Evaluation Outputs

	Cash Flows	Fin. Summ. Measures	Env. Impact	Org. Impact	Political Impact	Market Share	Social Impact
Cash Flows	1.00	0.448* (0.001)	0.071 (0.610)	0.206 (0.135)	0.032 (0.820)	-0.055 (0.702)	0.125 (0.373)
Fin. Summ. Measures		1.00	0.043 (0.772)	0.222 (0.129)	0.200 (0.172)	-0.137 (0.371)	0.080 (0.595)
Env. Impact			1.00	0.195 (0.158)	0.230 (0.098)	0.187 (0.190)	0.174 (0.214)
Org. Impact				1.00	0.174 (0.213)	0.216 (0.128)	0.120 (0.393)
Political Impact					1.00	0.444* (0.001)	0.543* (0.00)
Market Share						1.00	0.395* (0.004)
Social Impact							1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE EXTENT OF ADDRESSING EVALUATION OUTPUTS

	Cash Flows	Fin. Summ. Measures	Env. Impact	Org. Impact	Political Impact	Market Share	Social Impact
Cash Flows	1.00	0.431* (0.002)	0.219 (0.112)	0.243 (0.079)	0.050 (0.722)	0.010 (0.947)	0.075 (0.593)
Fin. Summ. Measures		1.00	0.207 (0.159)	0.413* (0.004)	0.204 (0.165)	0.015 (0.925)	0.181 (0.225)
Env. Impact			1.00	0.249 (0.073	0.353* (0.010)	0.222 (0.117)	0.340* (0.013)
Org. Impact				1.00	0.150 (0.287)	0.333* (0.018)	0.122 (0.388)
Political Impact					1.00	0.444* (0.001)	0.688* (0.00)
Market Share						1.00	0.491* (0.00)
Social Impact							1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE LEVEL OF RELEVANCE OF EXTERNAL CONTROL ELEMENTS

	Environmental Scanning	Political Scanning	Economic Scanning	Market Scanning
Environmental Scanning	1.00	0.319* (0.031)	-0.015 (0.923)	-0.020 (0.897)
Political Scanning		1.00	0.180 (0.242)	0.503* (0.001)
Economic Scanning			1.00	0.487* (0.001)
Market Scanning				1.00

(*) Statistically significant correlation (p <.05).

SPEARMAN'S RHO (2-TAILED SIGNIFICANCE) FOR THE EXTENT OF ADDRESSING EXTERNAL CONTROL ELEMENTS

	Environmental Scanning	Political Scanning	Economic Scanning	Market Scanning
Environmental Scanning	1.00	0.155 (0.303)	0.105 (0.491)	-0.184 (0.227)
Political Scanning		1.00	0.432* (0.003)	0.494* (0.001)
Economic Scanning			1.00	0.420* (0.004)
Market Scanning				1.00

(*) Statistically significant correlation (p <.05).

Spearman's Rho (2-tailed Significance) for the Level of Relevance of Internal Control Elements

	Proj. Milestones Scanning	Learning	Man. Interaction	Res. Depl.	Innovative Tech.	Corp. Alig. Scanning	Prod. Monit.	Innovative Routines
Proj. Milestones Scanning	1.00	0.453* (0.001)	0.455* (0.001)	0.587* (0.00)	0.259 (0.078)	-0.270 (0.066)	0.272 (0.067)	0.230 (0.119)
Learning		1.00	0.574* (0.00)	0.438* (0.002)	0.319* (0.027)	0.00 (0.999)	0.312* (0.035)	0.198 (0.182)
Man. Interaction			1.00	0.443* (0.001)	0.378* (0.008)	-0.220 (0.133)	0.145 (0.337)	0.440* (0.002)
Res. Depl.				1.00	0.239 (0.102)	-0.052 (0.730)	0.179 (0.233)	0.166 (0.265)
Innovative Tech.					1.00	-0.200 (0.178)	0.181 (0.229)	0.203 (0.172)
Corp. Alig. Scanning						1.00	0.052 (0.733)	-0.201 (0.180)
Prod. Monit.							1.00	0.125 (0.409)
Innovative Routines								1.00

(*) Statistically significant correlation (p <.05).

Spearman's Rho (2-tailed Significance) for the Extent of Addressing Internal Control Elements

	Proj. Milestones Scanning	Learning	Man. Interaction	Res. Depl.	Innovative Tech.	Corp. Alig. Scanning	Prod. Monit.	Innovative Routines
Proj. Milestones Scanning	1.00	0.426* (0.003)	0.230 (0.116)	0.478* (0.001)	0.386* (0.007)	-0.046 (0.758)	0.241 (0.107)	0.320* (0.028)
Learning		1.00	0.316* (0.029)	0.588* (0.00)	0.247 (0.091)	0.073 (0.624)	0.263 (0.078)	0.275 (0.061)
Man. Interaction			1.00	0.447* (0.001)	0.341* (0.018)	-0.164 (0.266)	0.140 (0.355)	0.518* (0.000)
Res. Depl.				1.00	0.268 (0.065)	0.186 (0.206)	0.253 (0.090)	0.531* (0.00)
Innovative Tech.					1.00	0.047 (0.755)	0.437* (0.002)	0.277 (0.060)
Corp. Alig. Scanning						1.00	0.106 (0.487)	-0.050 (0.740)
Prod. Monit.							1.00	0.149 (0.321)
Innovative Routines								1.00

(*) Statistically significant correlation (p <.05).

Spearman's Rho (2-tailed Significance) for the Level of Relevance of Control Outputs

	Fin. Targets	Tim. Targets	Env. Targets	Corp. Align.	Org. Com.	Org. Adapt.	Tech. Dev	Empl. Dev.	Empl. Satisf.	Cust. Satisf.	Mark. Posit.
Fin. Targets	1.00	0.442* (0.002)	0.343* (0.018)	0.369* (0.777)	0.042 (0.011)	0.062 (0.673)	0.114 (0.438)	-0.005 (0.973)	0.066 (0.658)	0.088 (0.564)	0.056 (0.722)
Tim. Targets		1.00	0.583* (0.00)	0.341* (0.020)	0.085 (0.569)	0.087 (0.554)	0.304* (0.036)	0.111 (0.459)	0.126 (0.398)	0.178 (0.243)	0.066 (0.676)
Env. Targets			1.00	0.318* (0.031)	0.309* (0.036)	0.219 (0.138)	0.313* (0.032)	0.209 (0.158)	0.320* (0.030)	0.333* (0.026)	0.076 (0.630)
Corp. Align.				1.00	0.070 (0.646)	0.068 (0.655)	-0.026 (0.861)	-0.041 (0.786)	0.170 (0.260)	0.154 (0.320)	0.205 (0.192)
Org. Com.					1.00	0.448* (0.002)	0.480* (0.001)	0.571* (0.00)	0.520* (0.00)	0.257 (0.092)	-0.173 (0.273)
Org. Adapt.						1.00	0.221 (0.132)	0.199 (0.180)	0.396* (0.006)	0.306* (0.041)	0.154 (0.326)
Tech. Dev							1.00	0.427* (0.003)	0.413* (0.004)	0.301* (0.044)	0.007 (0.962)
Empl. Dev.								1.00	0.466* (0.001)	0.238 (0.116)	-0.259 (0.094)
Empl. Satisf.									1.00	0.476* (0.001)	-0.078 (0.624)
Cust. Satisf.										1.00	0.457* (0.002)
Mark. Posit.											1.00

(*) Statistically significant correlation ($p < .05$).

Spearman's Rho (2-tailed Significance) for the Extent of Addressing Control Outputs

	Fin. Targets	Tim. Targets	Env. Targets	Corp. Align.	Org. Com.	Org. Adapt.	Tech. Dev	Empl. Dev.	Empl. Satisf.	Cust. Satisf.	Mark. Posit.
Fin. Targets	1.00	0.359* (0.012)	0.240 (0.104)	0.343* (0.020)	0.378* (0.009)	0.119 (0.420)	0.324 (0.026)	0.163 (0.274)	0.130 (0.390)	0.150 (0.492)	0.183 (0.240)
Tim. Targets		1.00	0.274 (0.062)	0.352* (0.016)	0.324* (0.026)	0.250 (0.086)	0.281 (0.055)	0.173 (0.244)	0.263 (0.077)	0.052 (0.737)	-0.082 (0.600)
Env. Targets			1.00	0.200 (0.183)	0.472* (0.001)	0.222 (0.133)	0.378* (0.010)	0.201 (0.175)	0.275 (0.030)	0.333* (0.064)	0.111 (0.477)
Corp. Align.				1.00	0.092 (0.542)	0.021 (0.887)	0.084 (0.578)	-0.151 (0.315)	0.150 (0.320)	0.136 (0.378)	0.339 (0.028)
Org. Com.					1.00	0.489* (0.00)	0.462* (0.001)	0.489* (0.00)	0.419* (0.004)	0.103 (0.507)	0.145 (0.358)
Org. Adapt.						1.00	0.386* (0.007)	0.392* (0.006)	0.340* (0.021)	0.212 (0.163)	0.253 (0.102)
Tech. Dev							1.00	0.382* (0.009)	0.322* (0.029)	0.401* (0.007)	0.243 (0.122)
Empl. Dev.								1.00	0.439* (0.002)	0.200 (0.189)	0.174 (0.264)
Empl. Satisf.									1.00	0.249 (0.103)	0.113 (0.478)
Cust. Satisf.										1.00	0.421* (0.005)
Mark. Posit.											1.00

(*) Statistically significant correlation ($p < .05$).

Spearman's Rho (2-tailed significance) for the Degree of Success of Strategic Project Management in General Terms

	Successful Completion	Financial Success	Success for Strategic Reasons
Successful Completion	1.00	0.482* (0.00)	0.428* (0.002)
Financial Success		1.00	0.282* (0.047)
Success for Strategic Reasons			1.00

(*) Statistically significant correlation ($p < .05$).

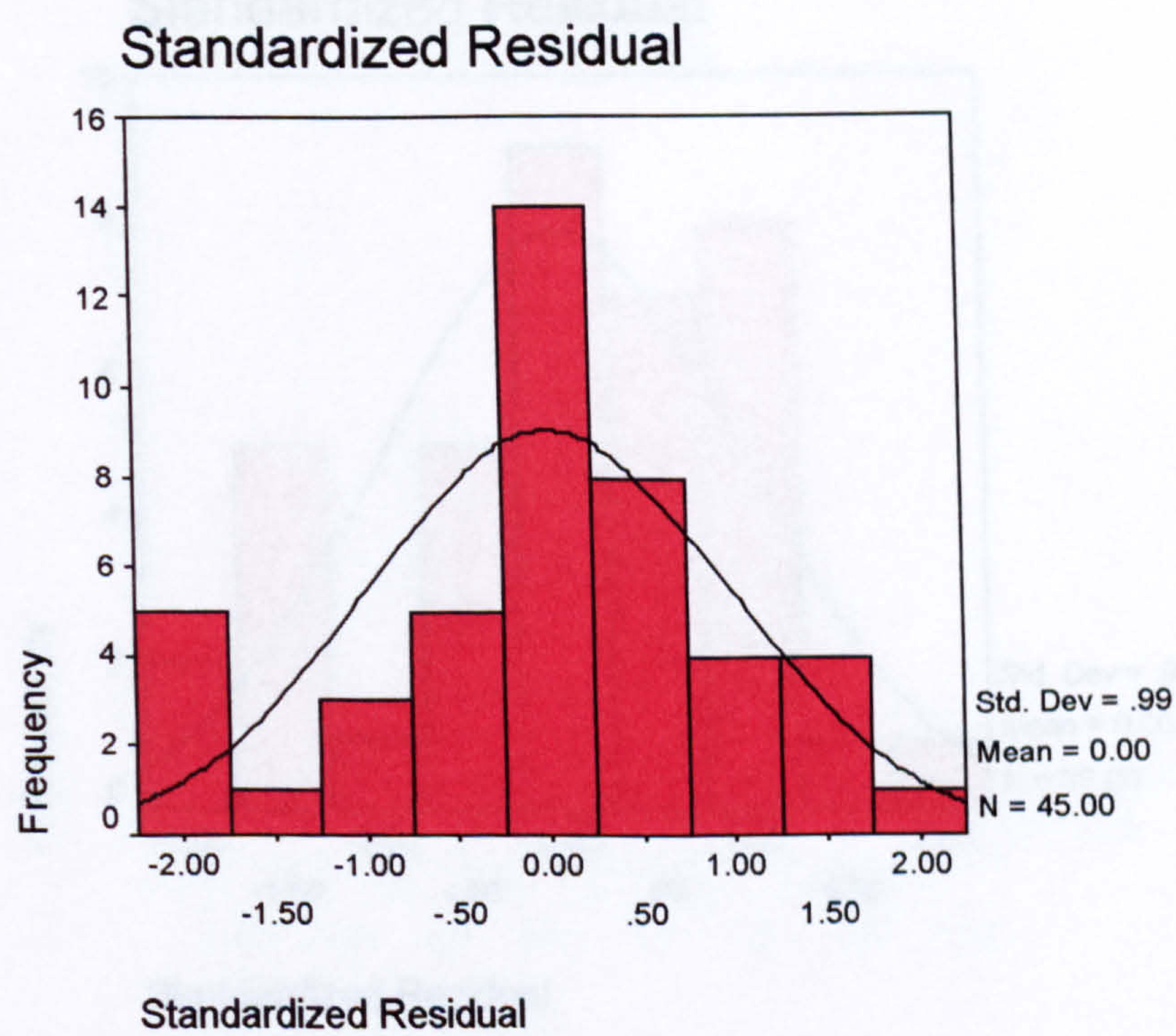
- APPENDIX VII -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 1A)

Statistics

Standardized Residual

N	Valid	45
	Missing	0
Mean		4.10E-16
Std. Deviation		.9885711
Skewness		-.380
Std. Error of Skewness		.354
Kurtosis		-.414
Std. Error of Kurtosis		.695



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.126	45	.069	.946	45	.05(

a. Lilliefors Significance Correction

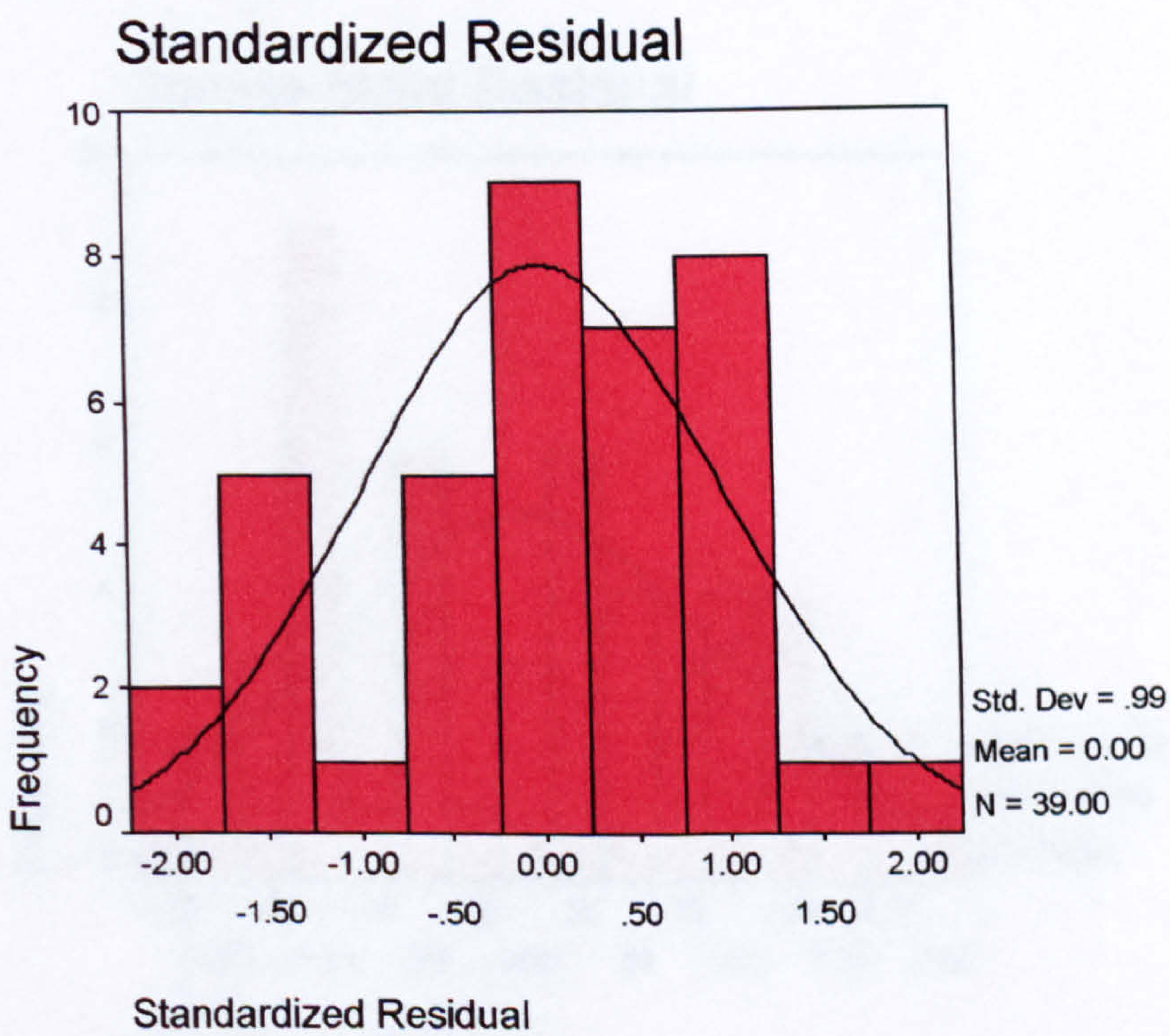
- APPENDIX VIII -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 1B)

Statistics

Standardized Residual

N	Valid	39
	Missing	0
Mean		2.45E-16
Std. Deviation		.9867544
Skewness		-.341
Std. Error of Skewness		.378
Kurtosis		-.662
Std. Error of Kurtosis		.741



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.099	39	.200*	.951	39	.15:

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

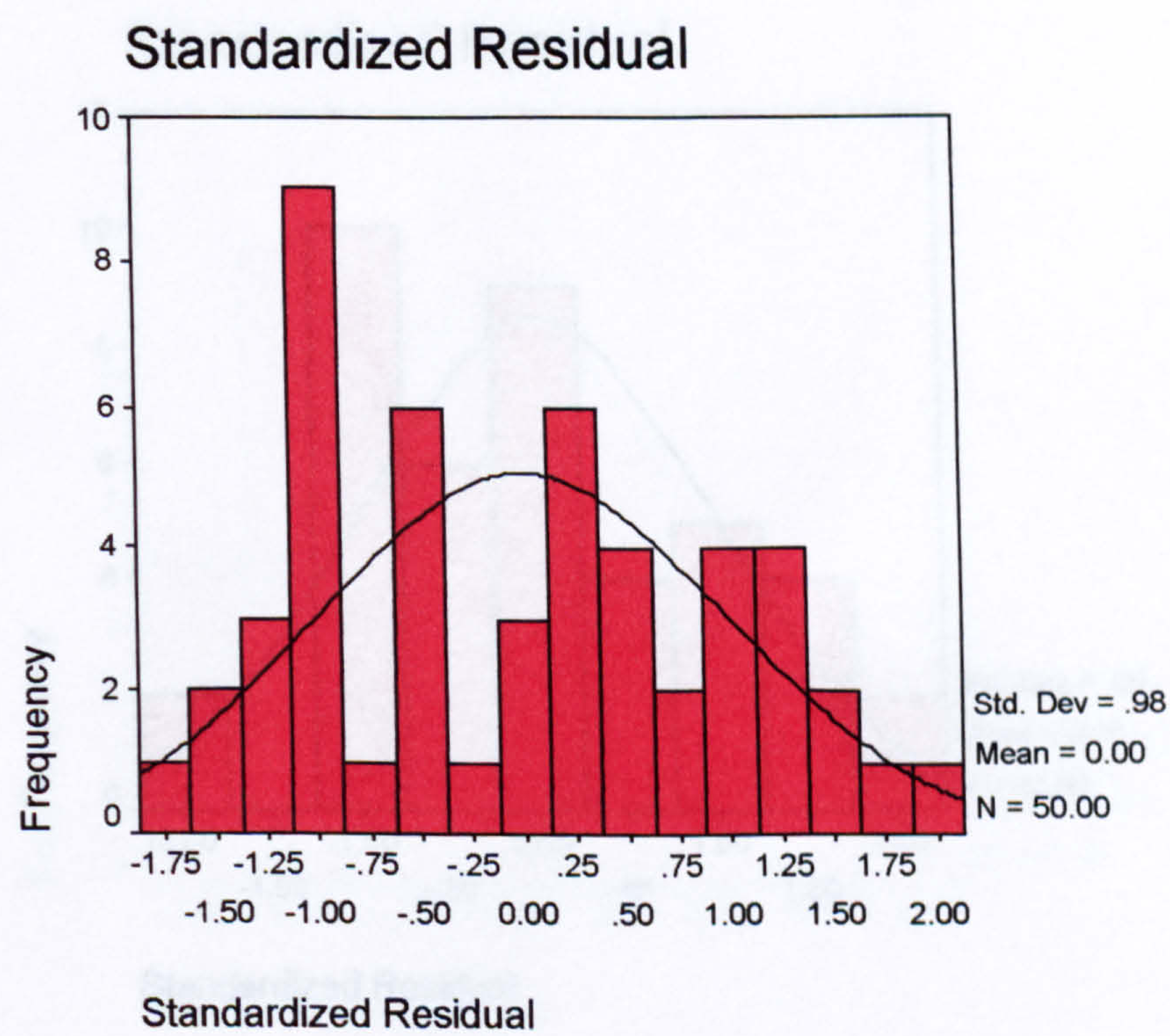
- APPENDIX IX -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 2A)

Statistics

Standardized Residual

N	Valid	50
	Missing	0
Mean		5.24E-16
Std. Deviation		.9793792
Skewness		.123
Std. Error of Skewness		.337
Kurtosis		-1.115
Std. Error of Kurtosis		.662



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.120	50	.069	.946	50	.04

a. Lilliefors Significance Correction

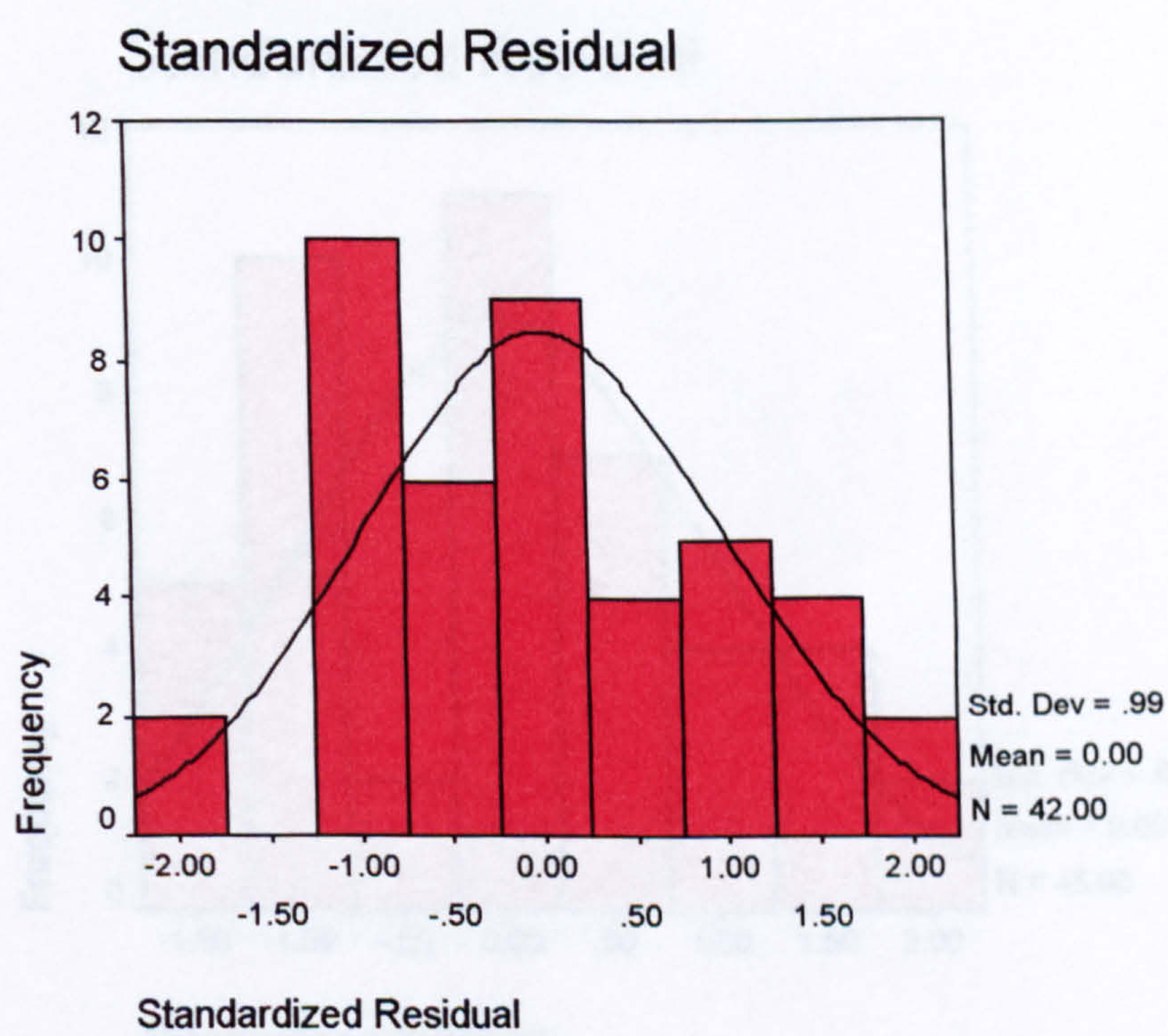
- APPENDIX X -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 2B)

Statistics

Standardized Residual

N	Valid	42
	Missing	0
Mean		-1.6E-16
Std. Deviation		.9877296
Skewness		.056
Std. Error of Skewness		.365
Kurtosis		-.774
Std. Error of Kurtosis		.717



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.080	42	.200*	.963	42	.33[illegible]

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

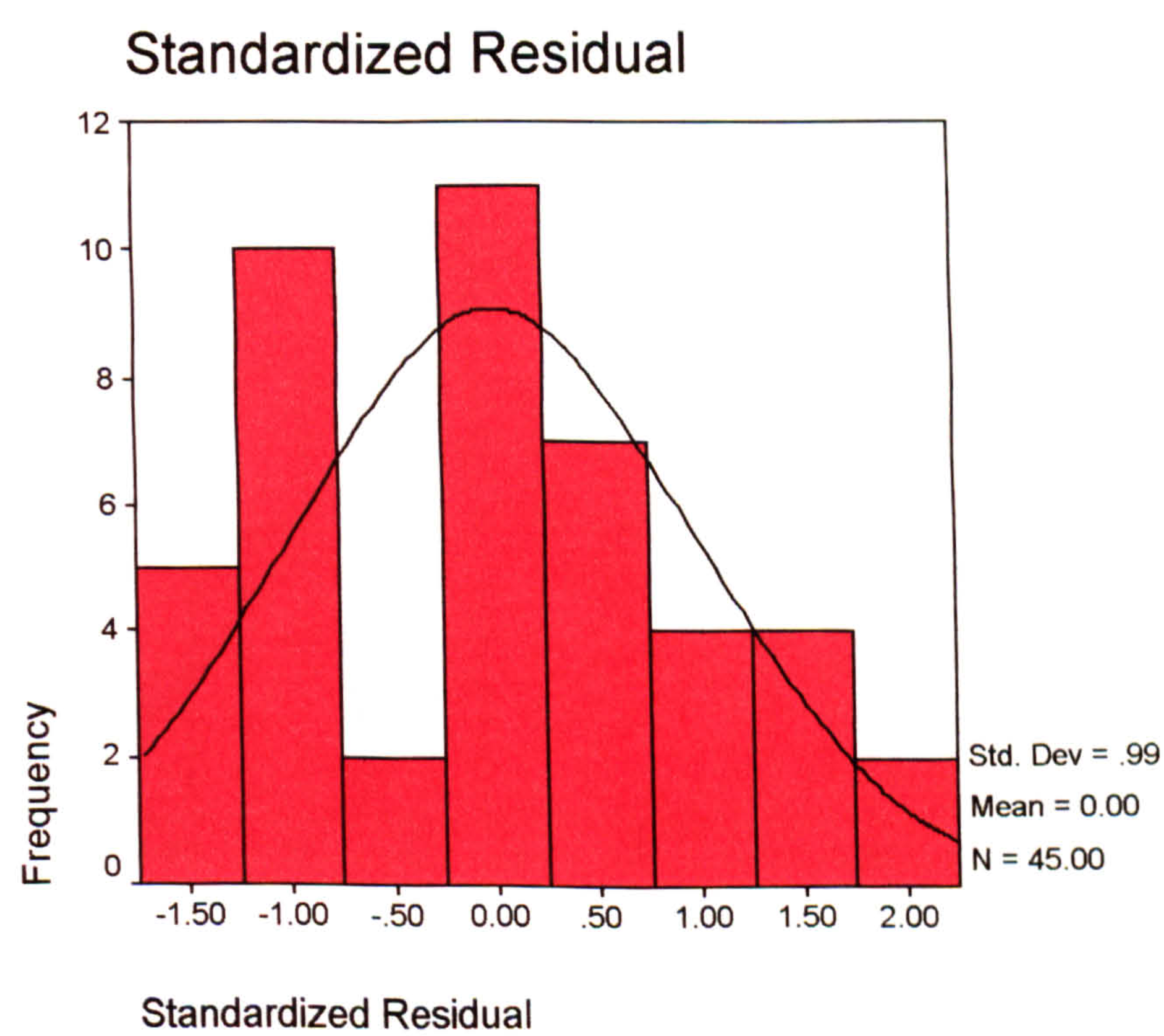
- APPENDIX XI -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 3A)

Statistics

Standardized Residual

N	Valid	45
	Missing	0
Mean		9.03E-16
Std. Deviation		.9885711
Skewness		.213
Std. Error of Skewness		.354
Kurtosis		-.861
Std. Error of Kurtosis		.695



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.136	45	.035	.955	45	.13[illegible]

a. Lilliefors Significance Correction

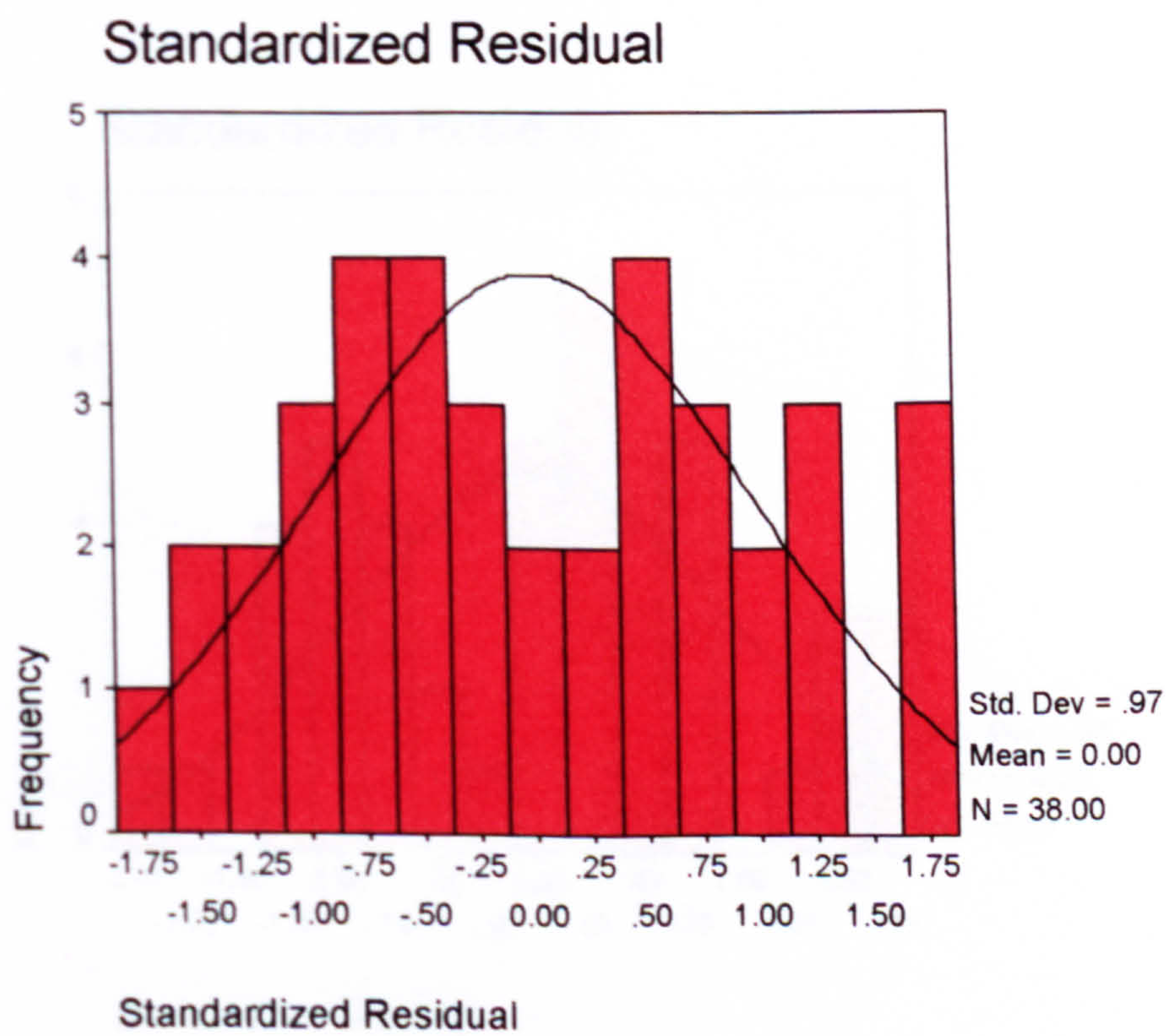
- APPENDIX XII -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 3B)

Statistics

Standardized Residual

N	Valid	38
	Missing	0
Mean		5.03E-16
Std. Deviation		.9725975
Skewness		.169
Std. Error of Skewness		.383
Kurtosis		-.969
Std. Error of Kurtosis		.750



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.096	38	.200*	.961	38	.34

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

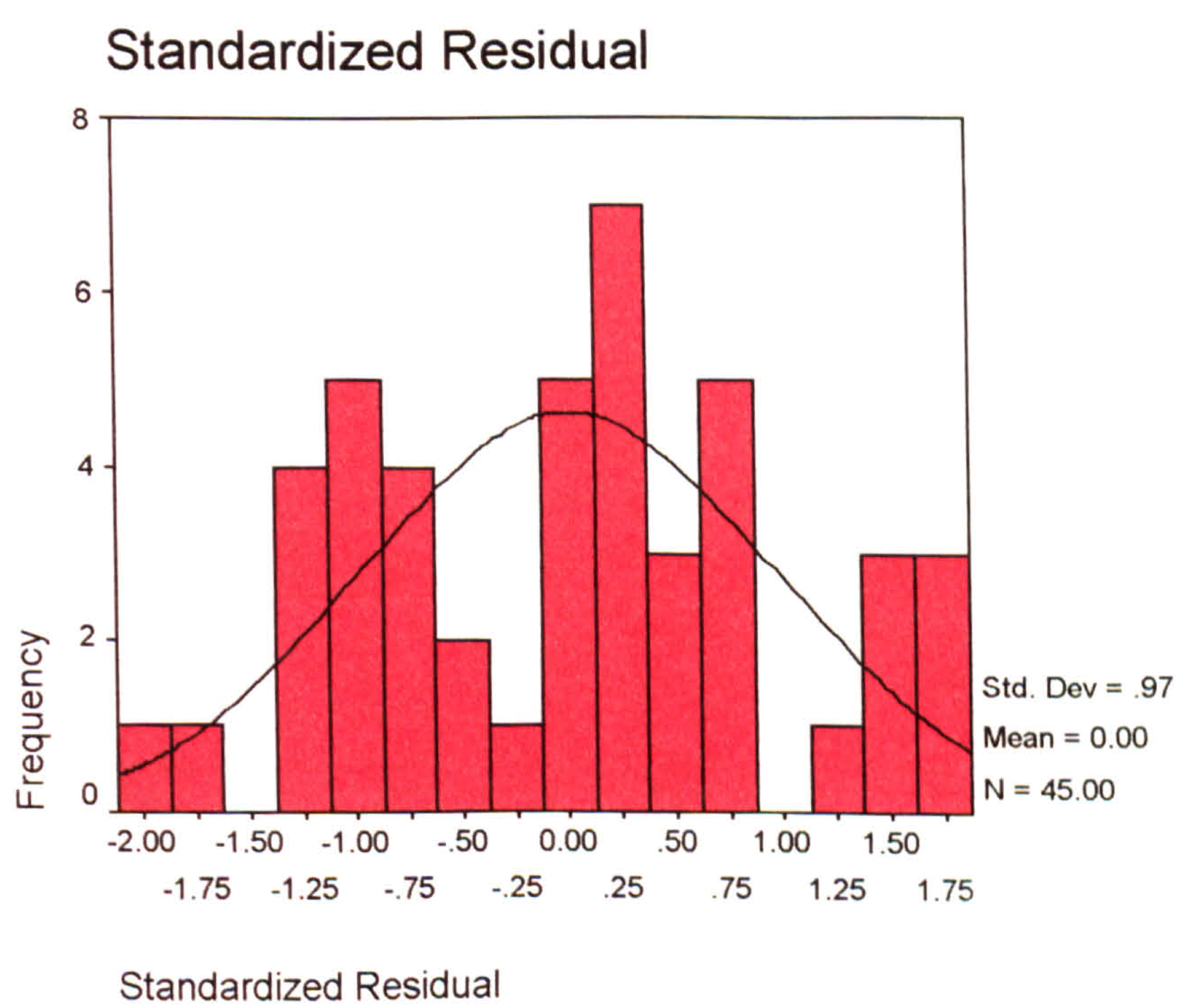
- APPENDIX XIII -

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 4A)

Statistics

Standardized Residual

N	Valid	45
	Missing	0
Mean		-2.2E-15
Std. Deviation		.9653073
Skewness		.056
Std. Error of Skewness		.354
Kurtosis		-.757
Std. Error of Kurtosis		.695



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residua	.090	45	.200*	.961	45	.26

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

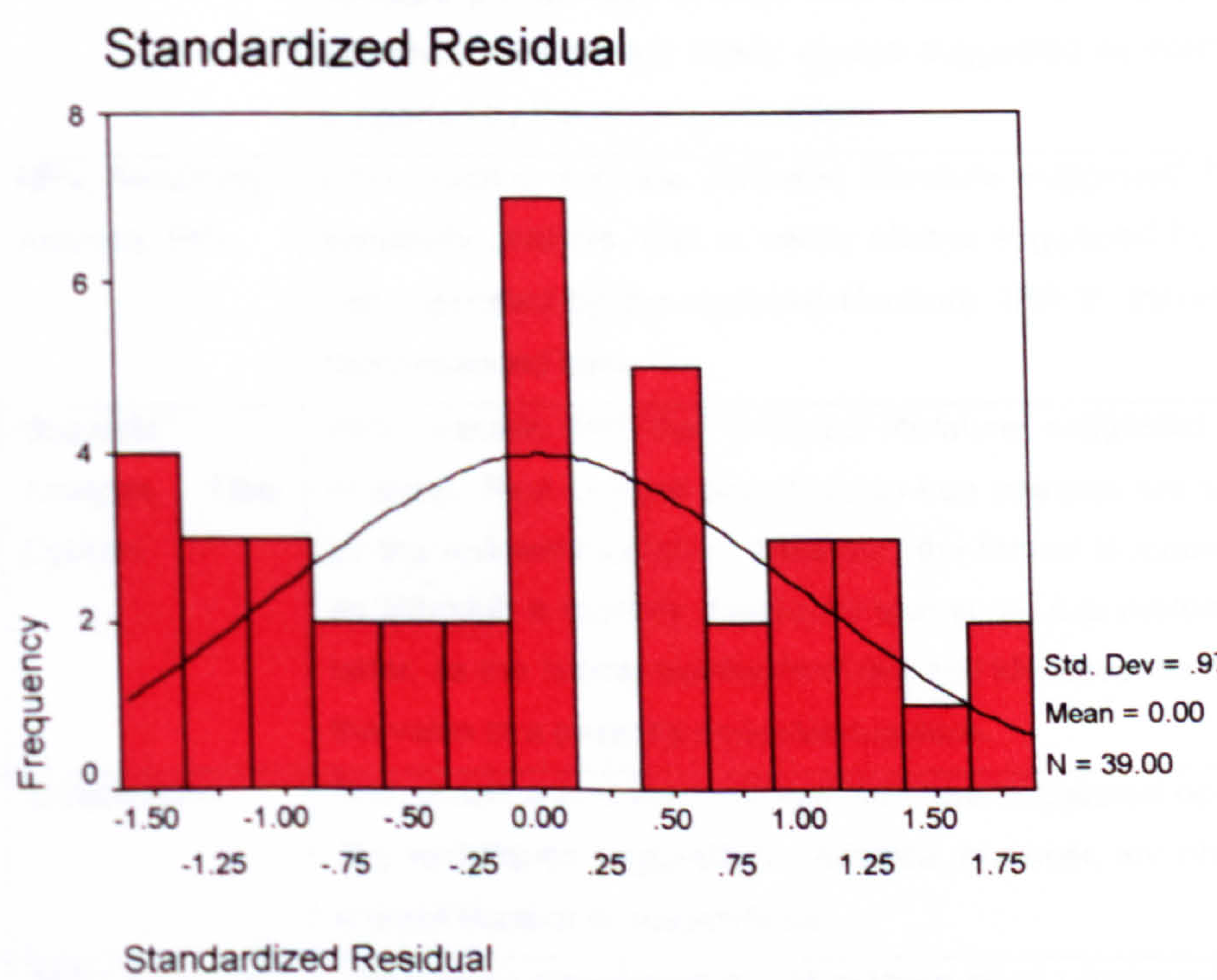
- APPENDIX XIV-

Statistics, Histogram and Lilliefors Test for the Standardised Residuals (Model 4B)

Statistics

Standardized Residual

N	Valid	39
	Missing	0
Mean		-4.5E-15
Std. Deviation		.9733285
Skewness		.057
Std. Error of Skewness		.378
Kurtosis		-1.064
Std. Error of Kurtosis		.741



Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual	.110	39	.200*	.949	39	.11

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

- APPENDIX XV –

CONNECTION BETWEEN TECHNIQUES AND ELEMENTS INVOLVED IN MANAGING STRATEGIC PROJECTS

TABLE 1 - RECOMMENDED TECHNIQUES FOR EVALUATION SUCCESS ELEMENTS

Evaluation Success Element	Recommended Techniques	Comments
Feasibility	Risk Analysis	Both practice and the reviewed literature suggested risk analysis.
Timescale	NPV, Scheduling, IRR, Sensitivity Analysis	Both practice and the reviewed literature suggested NPV and payback period. However, payback period is not recommended, as some respondents do not consider it a credible technique. Scheduling is borrowed from the current practice, as the reviewed literature preliminarily labelled it as a control technique. IRR and sensitivity analysis are nearly always suggested by practice, and supported by the reviewed literature.
Durability	NPV, Sensitivity Analysis, IRR	Both practice and the reviewed literature suggested NPV and sensitivity analysis. IRR is nearly always suggested by practice, and supported by the reviewed literature. IRR is, therefore, also recommended here.
Flexibility	Scenario Analysis, Real Options	Both practice and the reviewed literature suggested scenario analysis. Real Options and decision-tree analysis are suggested by the reviewed literature. However, the former is recommended, as although a recently developed technique, it is preferred to the latter, as the former tackles flexibility and identifies more explicitly the value of a project's embedded options.
Inter-dependency	Optimisation	Both practice and the reviewed literature suggested optimisation. The techniques suggested by practice, however, are proposed by a small number of respondents.
Corporate Alignment	NPV, Scenario Analysis, Balanced Scorecard	There is no superimposition of practice on the reviewed literature. Scenario analysis, although considered a controversial technique by the respondents, stems from the reviewed literature. Contingency analysis is not recommended by this study, as it can be a variant of scenario analysis. NPV is recommended by this study. It is considered a good current practice, despite not being addressed in the reviewed literature. The Balanced Scorecard is also recommended, despite being a recently developed technique. Although the Balanced Scorecard tackles corporate alignment, the reviewed literature preliminarily labelled it as a control technique.

TABLE 1 - RECOMMENDED TECHNIQUES FOR EVALUATION SUCCESS ELEMENTS (CONTD.)

Evaluation Success Element	Recommended Techniques	Comments
Competency Alignment	Scenario Analysis, Balanced Scorecard	Both practice and the reviewed literature suggested scenario analysis. The techniques suggested by practice, however, are proposed by a small number of respondents. The Balanced Scorecard is also recommended. Although it tackles competency alignment, the reviewed literature preliminarily labelled it as a control technique.
Financial Capability	Net Income, ROI	Both practice and the reviewed literature suggested net income. ROI is nearly always suggested by practice, and supported by the reviewed literature. ROI is, therefore, also recommended here.
Financial Leverage	ROI, Net Income	Both practice and the reviewed literature suggested ROI and net income. The techniques suggested by practice, however, are proposed by a small number of respondents.

TABLE 2 - TECHNIQUES FOR EVALUATION ELEMENTS TO WHICH MANAGERS PAY GREAT ATTENTION BUT ARE NOT BELIEVED TO EXPLAIN SUCCESS

Evaluation Element to Which Managers Pay Great Attention	Techniques Mainly Used in Practice	Techniques that Address the Element in the Reviewed Literature
Time	**NPV, IRR**	**IRR, NPV,** Leveraged NPV, Risk-Adjusted NPV, Sensitivity Analysis, Cost-Benefit Analysis, Decision-Tree Analysis, Risk Analysis, Human Resource Accounting, Real Options
Geological Uncertainty	**Simulation**, Sensitivity Analysis, **Risk Analysis**	Decision-Tree Analysis, **Simulation**, **Risk Analysis**, Real Options
Financial Market Uncertainty	Sensitivity Analysis, **Scenario Analysis**	Risk-Adjusted NPV, Forecasting, **Scenario Analysis**, Contingency Analysis, Decision-Tree Analysis, Real Options
Environmental Uncertainty	**Risk Analysis, Scenario Analysis, Contingency Analysis**	**Scenario Analysis, Contingency Analysis**, **Risk Analysis,** Simulation
Technological Uncertainty	Sensitivity Analysis, **Scenario Analysis**	Forecasting, **Scenario Analysis**, Contingency Analysis, Risk Analysis, Real Options
Economic Uncertainty	**NPV,** Net Income	Payback Period, IRR, **NPV,** Leveraged NPV, Risk-Adjusted NPV, Sensitivity Analysis, Cost-Benefit Analysis, Scenario Analysis, Contingency Analysis, Decision-Tree Analysis, Risk Analysis, Optimisation, Human Resource Accounting, Real Options

Table 2 - Techniques for Evaluation Elements to Which Managers Pay Great Attention but are not Believed to Explain Success (contd.)

Evaluation Element to Which Managers Pay Great Attention	Techniques Mainly Used in Practice	Techniques that Address the Element in the Reviewed Literature
Cash Flows	**NPV, IRR,** Net Income, ROI	Payback Period, **IRR, NPV,** Leveraged NPV, Risk-Adjusted NPV, Sensitivity Analysis, Cost-Benefit Analysis, Scenario Analysis, Contingency Analysis, Decision-Tree Analysis, Risk Analysis, Optimisation, Human Resource Accounting, Real Options
Financial Summary Measures	**Risk Analysis, Scenario Analysis**	Cost-Benefit Analysis, **Scenario Analysis**, Contingency Analysis, Simulation, **Risk Analysis**
Environmental Impact	Manpower Rationing, Net Income, IRR, Forecasting, Optimisation, Scenario Analysis, Capital Rationing	(*)
Organisational Impact	**Sensitivity Analysis,** Scenario Analysis	Forecasting, **Scenario Analysis**, Contingency Analysis, Risk Analysis, Real Options

(*) No technique suggested by the reviewed literature.

Table 3 - Recommended Techniques for Evaluation Elements to Which Managers Pay Great Attention, but are not Believed to Explain Success

Evaluation Element to Which Managers Pay Great Attention	Recommended Techniques	Comments
Time	NPV, IRR	Both practice and the reviewed literature suggested NPV and IRR.
Geological Uncertainty	Risk Analysis	Both practice and the reviewed literature suggested simulation and risk analysis. Some respondents considered risk analysis similar to simulation. Here, the former is considered financially oriented, and the latter technically oriented. Simulation is adequate for big scope projects. Sensitivity analysis should not be recommended to tackle any source of uncertainty.
Financial Market Uncertainty	Scenario Analysis, Forecasting, Real Options	Both practice and the reviewed literature suggested scenario analysis. Forecasting is nearly often suggested in practice, and is suggested by the reviewed literature. Real Options are also suggested by the reviewed literature and, despite being a recently developed technique, it is recommended.

TABLE 3 - RECOMMENDED TECHNIQUES FOR EVALUATION ELEMENTS TO WHICH MANAGERS PAY GREAT ATTENTION, BUT ARE NOT BELIEVED TO EXPLAIN SUCCESS (CONTD.)

Evaluation Element to Which Managers Pay Great Attention	Recommended Techniques	Comments
Environmental Uncertainty	Risk Analysis, Scenario Analysis	Both practice and the reviewed literature suggested risk analysis, scenario analysis and contingency analysis. Contingency analysis is not recommended, as it can be a variant of scenario analysis.
Technological Uncertainty	Risk Analysis, Scenario Analysis	Both practice and the reviewed literature suggested risk analysis and scenario analysis.
Economic Uncertainty	Scenario Analysis, Forecasting, Risk Analysis, Real Options	Both practice and the reviewed literature suggested scenario analysis. Forecasting and risk analysis are nearly often suggested in practice and by the reviewed literature. Real Options are also suggested by the reviewed literature and despite being a recently developed technique, it is recommended.
Cash Flows	NPV, Net Income, IRR	Both practice and the reviewed literature suggested NPV. IRR is nearly often suggested in practice, and by the reviewed literature. Net income is also recommended, although it is associated with profits rather than cash flows.
Financial Summary Measures	NPV, IRR, Net Income, ROI	Both practice and the reviewed literature suggested NPV and IRR. Net income and ROI are also recommended, although they are in fact accounting summary measures.
Environmental Impact	Risk Analysis, Scenario Analysis	Both practice and the reviewed literature suggested scenario analysis and risk analysis.
Organisational Impact	Balanced Scorecard	The reviewed literature did not suggest any technique to tackle organisational impact. The Balanced Scorecard, although preliminarily labelled as control technique, is theoretically appropriate for this purpose. Manpower rationing is proposed by a small number of respondents.

TABLE 4 - TECHNIQUES FOR EVALUATION ELEMENTS TO WHICH MANAGERS PAY LITTLE ATTENTION AND ARE NOT BELIEVED TO EXPLAIN SUCCESS

Evaluation Element to Which Managers Pay Little Attention	Mainly Used Techniques in Practice	Techniques that Address the Element in the Reviewed Literature
Political Uncertainty	Sensitivity Analysis, **Scenario Analysis**	Forecasting, **Scenario Analysis**, Contingency Analysis, Risk Analysis
Competition	**Scenario Analysis, Contingency Analysis**	**Scenario Analysis**, **Contingency Analysis**, Game Theory
Social Uncertainty	**Risk Analysis**, **Contingency Analysis**	Forecasting, Scenario Analysis, **Contingency Analysis, Risk Analysis**
Political Impact	Forecasting, Payback Period, IRR, NPV, Risk-Adjusted NPV, **Scenario Analysis**,	Cost-Benefit Analysis, **Scenario Analysis**, Contingency Analysis, Simulation, Risk Analysis
Market Share	Net Income, Forecasting	**Game Theory**
Social Impact	(*)	Cost-Benefit Analysis, Scenario Analysis, Contingency Analysis, Simulation, Risk Analysis

(*) No technique suggested by the respondents.

TABLE 5 - RECOMMENDED TECHNIQUES FOR EVALUATION ELEMENTS TO WHICH MANAGERS PAY LITTLE ATTENTION AND ARE NOT BELIEVED TO EXPLAIN SUCCESS

Evaluation Element to Which Managers Pay Little Attention	Recommended Techniques	Comments
Political Uncertainty	Scenario Analysis	Both practice and the reviewed literature suggested scenario analysis.
Competition	Scenario Analysis	Both practice and the reviewed literature suggested scenario analysis and contingency analysis. Contingency analysis is not recommended, as it can be a variant of scenario analysis. The techniques suggested by practice, however, are proposed by a small number of respondents.
Social Uncertainty	Scenario Analysis and Risk Analysis	Both practice and the reviewed literature suggested contingency analysis and risk analysis. Contingency analysis is not recommended, as it can be a variant of scenario analysis. Scenario analysis is recommended instead.
Political Impact	Scenario Analysis	Both practice and the reviewed literature suggested scenario analysis. The techniques suggested by practice, however, are proposed by a small number of respondents.

Table 5 - Recommended Techniques for Evaluation Elements to Which Managers Pay Little Attention and are not Believed to Explain Success (contd.)

Evaluation Element to Which Managers Pay Little Attention	Recommended Techniques	Comments
Market Share	Scenario Analysis	There is no superimposition of practice on the reviewed literature. In order to fit with the previous evaluation elements, scenario analysis is recommended.
Social Impact	Scenario Analysis and Risk Analysis	Respondents did not suggest any technique to address social impact. Scenario analysis is suggested by the reviewed literature and complied with the recommendation of scenario analysis for tackling political impact and scenario analysis and risk analysis for social uncertainty.

Table 6 - Recommended Techniques for Control Success Elements

Control Success Element	Recommended Techniques	Comments
Managerial Interaction	Balanced Scorecard, Scheduling	Both practice and the reviewed literature suggested the Balanced Scorecard. Scheduling is also recommended. It is considered a good current practice, despite not being addressed in the reviewed literature. Intellectual Capital is not recommended, as it is an extremely recent technique. The techniques suggested by practice, however, are proposed by a small number of respondents.
Resource Deployment	Scheduling	Both practice and the reviewed literature suggested scheduling. Scheduling, however, is proposed by a small number of respondents.
Learning	Scheduling, Financial Performance Monitoring, EVA, Balanced Scorecard	Respondents did not suggest any technique to address learning. However, the reviewed literature suggested a realm of techniques. This study recommends some of these techniques, namely scheduling, financial performance monitoring, EVA and the Balanced Scorecard.

TABLE 6 - RECOMMENDED TECHNIQUES FOR CONTROL SUCCESS ELEMENTS (CONTD.)

Control Success Element	Recommended Techniques	Comments
Innovative Routines	Balanced Scorecard, Risk Analysis	There is no superimposition of practice on the reviewed literature. The Balanced Scorecard is suggested by the reviewed literature, and is preferred to the Intellectual Capital, as the latter is an extremely recent technique. Risk analysis is also recommended. Although it tackles innovative routines, the reviewed literature preliminarily labelled it as an evaluation technique. The techniques suggested by practice, however, are proposed by only a small number of respondents.
Project Milestones Scanning	Scheduling	Both practice and the reviewed literature suggested scheduling. Forecasting is suggested by a small number of respondents comparing to scheduling, and is not recommended.
Product Monitoring	No recommendation	Neither the respondents, nor the reviewed literature suggested any technique to tackle product monitoring.
Innovative Technologies	Intellectual Capital, Sensitivity Analysis	There is no superimposition of practice on the reviewed literature. Intellectual Capital is suggested by the reviewed literature. However, it is recommended with reservation, as it is an extremely recent technique. Sensitivity analysis is also recommended. Although It tackles innovative technologies, the reviewed literature preliminarily labelled it as an evaluation technique. The techniques suggested by practice, however, are proposed by a small number of respondents.
Political Scanning	IRR, Sensitivity Analysis, Scenario Analysis, Forecasting	The reviewed literature did not suggest any technique for tackling political scanning. IRR, sensitivity analysis, scenario analysis and forecasting are preliminarily labelled as evaluation techniques, suggested by practice and considered appropriate techniques to tackle political scanning. The techniques suggested by practice, however, are proposed by a small number of respondents.
Economic Scanning	Sensitivity Analysis, Scenario Analysis, Forecasting	The reviewed literature did not suggest any technique for tackling economic scanning. Sensitivity analysis, scenario analysis and forecasting are suggested by practice and considered appropriate techniques to tackle economic scanning, as they are to tackle political scanning. The techniques suggested by practice, however, are proposed by a small number of respondents.

TABLE 6 - RECOMMENDED TECHNIQUES FOR CONTROL SUCCESS ELEMENTS (CONTD.)

Control Success Element	Recommended Techniques	Comments
Market Scanning	No recommendation	Neither the respondents, nor the reviewed literature suggested any technique to tackle market scanning.
Organisational Communication	Balanced Scorecard	There is no superimposition of practice on the reviewed literature. The Balanced Scorecard is suggested by the reviewed literature. The techniques suggested by practice, however, are proposed by a small number of respondents.
Organisational Adaptability	Balanced Scorecard	Respondents did not suggest any technique to address organisational adaptability. The Balanced Scorecard is suggested by the reviewed literature, and is preferred to the Intellectual Capital, as the latter is an extremely recent technique.
Employee Development	Intellectual Capital	Respondents did not suggest any technique to address employee development. Intellectual Capital is suggested by the reviewed literature, and recommended with some reservation.
Employee Satisfaction	No recommendation	The reviewed literature did not suggest any technique to tackle employee satisfaction. The techniques suggested by practice are proposed by a small number of respondents.

TABLE 7 - TECHNIQUES FOR CONTROL ELEMENTS TO WHICH MANAGERS PAY GREAT ATTENTION BUT ARE NOT BELIEVED TO EXPLAIN SUCCESS

Control Element to Which Managers Pay Great Attention	Techniques Mainly Used in Practice	Techniques that Address the Element in the Reviewed Literature
Budgetary Constraints	**Scheduling, Capital Rationing**	**Capital Rationing, Scheduling**
Financial Market Scanning	Forecasting, **Financial Performance Monitoring**, Sensitivity Analysis	**Financial Performance Monitoring**
Corporate Alignment Scanning	**Capital Rationing**, Scheduling, NPV, IRR, Balanced Scorecard, Optimisation	**Capital Rationing**, Manpower Rationing, Financial Performance Monitoring
Environmental Scanning	Risk Analysis, Scenario Analysis, Cost-Benefit Analysis, Sensitivity Analysis, Simulation	(*)
Financial Targets	Forecasting, **Financial Performance Monitoring**, NPV	**Financial Performance Monitoring,** EVA, Balanced Scorecard
Timescale Targets	Scheduling, **Forecasting**	Scheduling
Environmental Targets	Cost-Benefit Analysis, Sensitivity Analysis	Balanced Scorecard

Table 7 - Techniques for Control Elements to Which Managers Pay Great Attention but are not Believed to Explain Success (contd.)

Control Element to Which Managers Pay Great Attention	Techniques Mainly Used in Practice	Techniques that Address the Element in the Reviewed Literature
Corporate Alignment	IRR, ROI, NPV, Risk-Adjusted NPV, Scheduling, **Financial Performance Monitoring**	Capital Rationing, Manpower Rationing**, Financial Performance Monitoring,** Balanced Scorecard
Technological Development	Decision-Tree Analysis, Simulation	Intellectual Capital

(*) No technique suggested by the reviewed literature.

Table 8 - Recommended Techniques for Control Elements to Which Managers Pay Great Attention, but are not Believed to Explain Success

Control Element to Which Managers Pay Great Attention	Recommended Techniques	Comments
Budgetary Constraints	Capital Rationing, Scheduling	Both practice and the reviewed literature suggested capital rationing and scheduling.
Financial Market Scanning	Financial Performance Monitoring, Forecasting, Sensitivity Analysis, Real Options	Both practice and the reviewed literature suggested financial performance monitoring. Forecasting, sensitivity analysis and real options are also recommended. Although they tackle financial market scanning, the reviewed literature preliminarily labelled them as evaluation techniques.
Corporate Alignment Scanning	Capital Rationing, Financial Performance Monitoring	Both practice and the reviewed literature suggested capital rationing. The techniques suggested by practice, however, are proposed by a small number of respondents. Manpower rationing and financial performance monitoring are suggested by the reviewed literature. Manpower rationing is, however, adequate for big scope projects.

Table 8 - Recommended Techniques for Control Elements to Which Managers Pay Great Attention, but are not Believed to Explain Success (contd.)

Control Element to Which Managers Pay Great Attention	Recommended Techniques	Comments
Environmental Scanning	Risk Analysis, Scenario Analysis	The reviewed literature did not suggest any technique for tackling environmental scanning. Risk analysis and scenario analysis are recommended. They tackle environmental scanning / environmental uncertainty, but the reviewed literature preliminarily labelled them as evaluation techniques. The techniques suggested by practice, however, are proposed by a small number of respondents.
Financial Targets	Financial Performance Monitoring, Forecasting, EVA, Balanced Scorecard	Both practice and the reviewed literature suggested financial performance monitoring. Forecasting is also recommended. Although it tackles financial targets, the reviewed literature preliminarily labelled it as an evaluation technique. EVA and the Balanced Scorecard are suggested by the reviewed literature. Respondents, although in small number, also suggested the latter.
Timescale Targets	Scheduling	Both practice and the reviewed literature suggested scheduling. Forecasting is suggested by a small number of respondents comparing to scheduling, and therefore it is not recommended.
Environmental Targets	Balanced Scorecard, Sensitivity Analysis	There is no superimposition of practice on the reviewed literature. The Balanced Scorecard is suggested by the reviewed literature. Sensitivity analysis is nearly often applied in practice and also recommended. Cost-Benefit analysis is not recommended, as it is not widely used to tackle other elements. The techniques suggested by practice, however, are proposed by a small number of respondents.

TABLE 8 - RECOMMENDED TECHNIQUES FOR CONTROL ELEMENTS TO WHICH MANAGERS PAY GREAT ATTENTION, BUT ARE NOT BELIEVED TO EXPLAIN SUCCESS (CONTD.)

Control Element to Which Managers Pay Great Attention	Recommended Techniques	Comments
Corporate Alignment	Financial Performance Monitoring, Capital Rationing, Balanced Scorecard	Both practice and the reviewed literature suggested financial performance monitoring. Capital rationing, manpower rationing and Balanced Scorecard are suggested by the reviewed literature. Manpower rationing is, however, adequate for big scope projects. IRR is a current practice, is not recommended, but it does not necessarily drive to the maximisation of shareholders' wealth. The techniques suggested by practice, however, are proposed by a small number of respondents.
Technological Development	Intellectual Capital, Risk Analysis	There is no superimposition of practice on the reviewed literature. Intellectual Capital is suggested by the reviewed literature. However, it is recommended with reservation. Simulation (or risk analysis) is suggested by practice. Although it tackles technological development, the reviewed literature preliminarily labelled it as an evaluation technique. Decision-tree analysis is not recommended, as it is not widely used to tackle other elements. The techniques suggested by practice are proposed by a small number of respondents.

TABLE 9 - TECHNIQUES FOR CONTROL ELEMENTS TO WHICH MANAGERS PAY LITTLE ATTENTION AND ARE NOT BELIEVED TO EXPLAIN SUCCESS

Control Element to Which Managers Pay Little Attention	Mainly Used Techniques in Practice	Techniques that Address the Element in the Reviewed Literature
Customer Satisfaction	(*)	Balanced Scorecard
Market Position	(*)	Balanced Scorecard

(*) No technique suggested by the respondents.

Table 10 - Recommended Techniques for Control Elements to Which Managers Pay Little Attention and are not Believed to Explain Success

Control Element to Which Managers Pay Little Attention	Recommended Techniques	Comments
Customer Satisfaction	Balanced Scorecard	Respondents did not suggest any technique to tackle customer satisfaction. The Balanced Scorecard is suggested by the reviewed literature.
Market Position	Balanced Scorecard	Respondents did not suggest any technique to tackle customer satisfaction. The Balanced Scorecard is suggested by the reviewed literature.